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# TECHNOLOGY, INFORMATION AND POWER:

# MANAGERIAL TECHNICIANS IN CORPORATE AMERICA, 1917-2000

Thomas David Haigh

A DISSERTATION
in
History and Sociology of Science

Presented to the Faculties of the University of Pennsylvania in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

2003

Walter Licht
Supervisor of Dissertation

[signature]
Graduate Group Chairperson

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with a background and set of interests extraordinarily close to my own. During the next few years we traveled together to seminars and conferences, swapped sources and references, collaborated to teach a new course I had designed, and chatted continuously about computing and its history. This mutual flux of ideas benefited us enormously, especially after Nathan embarked on a dissertation topic that overlapped substantially with my own in terms of both sources and research questions. That my work disputes a number of his findings is a testimony to the enormously rewarding nature of that relationship, which has challenged both of us to raise the level of our scholarship.

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Award in Electrical History, granted by the IEEE History Center, provided a third year of fellowship support for the project, during which the first half of the dissertation assumed something very close to its final shape.

The history of computing community is close-knit and extremely friendly. In the absence of a formal annual conference or workshop, it nevertheless conspires to meet on a frequent basis under a variety of pretexts. I was fortunate to receive invitations, plane tickets and hotel rooms to participate in the UNIAC 50th Anniversary conference, the Pittsburgh conference on the History and Heritage of Scientific Information Systems and the preliminary workshop for the second conference, the Paderborn workshop on Software Issues in the History of Computing, the Amherst workshop on the Use of History to Improve the Teaching of Computer Science and the ADAPSO Reunion in Washington DC. I am particularly indebted to William Aspray in his role at the CRA, Burton Grad at the Software History Center, Mary-Ellen Bowden of the Chemical Heritage Foundation, and the team at the Babbage for going out of their way to include me in these events. Each of these events allowed me to build and renew contacts in the field, exposed me to the ideas and advice of the leaders in the field and gave me a pleasing sense that somebody might indeed care about this work – in which context I must thank Martin Campbell-Kelly, JoAnne Yates, Mike Mahoney, David Hounshell, Glen Asner, and Boyd Rayward.

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These words are written at Colby College, where I must thank my colleagues, in particular James R. Fleming and Henry A. Gemery, for their friendship and engagement. My students were entertaining and frequently stimulating, while the town of Waterville – and indeed the entire central Maine region – assisted my progress dramatically through its notable lack of distractions during the academic year.

To my parents, I owe thanks not only for gifts too numerous and profound to list here, but also the more mundane blessing of a very thorough proofing delivered by my mother. My wife Maria has been finishing her own dissertation at almost exactly the same time, yet despite this she has remained good natured and loving throughout our shared academic ordeals. She found time to read my work and contribute more than her share to our domestic harmony. Though our future remains uncertain, I know that I am in good hands.

Waterville, Maine. May 2002

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# ABSTRACT

## TECHNOLOGY, INFORMATION AND POWER:

## MANAGERIAL TECHNICIANS IN CORPORATE AMERICA, 1917-2000

Thomas David Haigh

Walter Licht

The dissertation charts the changing use made of technology in business administration during the twentieth century, from the office managers and bookkeeping machines of the 1920s to the chief information officers and personal computers of the 1990s. As computers spread, from the 1950s onward, corporate managers were more reliant than ever on administrative systems, but were forced to delegate their design and operation to a host of new specialist groups. Its primary focus is on the professional opportunities and organizational challenges arising from this influx of administrative technology. It examines the attempts of organized groups I refer to as "managerial technicians" to turn their expertise in the techniques and technologies of administrative systems into a claim to broad managerial authority. It pays particular attention to the emergence of the concept of information within corporate management, and to the use of appeals to "systems" expertise and to science to establish authority. The primary groups considered here are the office managers of the National Office Management Association, the "systems men" of the Systems and Procedures association, the punched card supervisors of the National Machine Accounting Association, data processing managers, operations research experts, management information systems specialists, and chief information officers. Each community united corporate staff with consultants, business school staff and technology suppliers. These were social movements within

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corporate society, as each community sought to raise its position on the organizational chart and establish itself as truly managerial rather than merely technical. This framing exposes many startling continuities, despite enormous changes in technology. Several chapters focus on attempts to create a professional identity for corporate computing staff, including the certification efforts of the Data Processing Management Association and the efforts of some within the Association for Computing Machinery to shape a broad identity I call "pan-computer professionalism." Other topics include: the original of entry of computers into corporate administration; the relationship between programming, systems analysis, and software engineering; office automation; office automation and personal computing in the 1980s; corporate computing in the 1990s; and changing labor practices in programming, data processing, and punched card work.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| ACM | Association for Computing Machinery |
| ACPA | Association of Computer Programmers and Analysts |
| AFIPS | American Federation of Information Processing Societies |
| AIEE | American Institute of Electrical Engineers |
| AITP | Association of Information Technology Professionals (formerly DPMA) |
| AMA | American Management Association |
| ASM | Association for Systems Management (formerly SPA) |
| BPR | Business Process Reengineering |
| CDP | Certificate in Data Processing |
| CFO | Chief Financial Officer |
| CIO | Chief Information Officer |
| COBOL | COmmon Business Oriented Language |
| CRM | Customer Requirements Management |
| DPMA | Data Processing Management Association (formerly NMAA) |
| EDP | Electronic Data Processing |
| ERP | Enterprise Resources Planning |
| FORTRAN | FORmular TRANslator |
| GE | General Electric |
| IBM | International Business Machines |
| ICCP | Institute for the Certification of Computer Professionals |
| IDP | Integrated Data Processing |

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| IEEE | Institute of Electrical and Electronic Engineers |
| IRE | Institute of Radio Engineers |
| IS | Information Systems |
| IT | Information Technology |
| MAA | Machine Accountants Association |
| MIS | Management Information System |
| NMAA | National Machine Accountants Association (formerly MAA, later DPMA) |
| NOMA | National Office Management Association |
| OR | Operations Research |
| ORSA | Operations Research Society of America |
| RBP | Registered Business Programmer's examination |
| RCA | Radio Corporation of America |
| SCDP | Society for Certified Data Processors |
| SDC | System Development Corporation |
| SHARE | (Though always capitalized, SHARE did not stand for anything) |
| SIAM | Society for Industrial and Applied Mathematics |
| SIGBDP | Special Interest Group in Business Data Processing (part of ACM, later SIGBIT) |
| SIGBIT | Special Interest Group in Business Information Technology (later SIGMIS) |
| SIM | Society for Information Management (later SMIS) |
| SMIS | Society for Management Information Systems (later SIM) |
| SPA | Systems and Procedures Association (later ASM) |

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# 1. INTRODUCTION

A crucial aspect of the evolution of the American corporation has gone largely unnoticed by historians: the separation of expertise in administrative methods and technologies from senior management and their eventual delegation to a new class of specialists whose role was at once technical and managerial. I call them, therefore, managerial technicians, because their domain of technical expertise encompassed skills and activities that were formerly part of the realm of management itself. Unlike earlier generations of system-obsessed general managers, these men and women did not enjoy direct authority over the operations of the business. Their claim to power was based instead on a mixture of expertise, professionalism, and science. This attempt to separate technical expertise in administrative techniques and systems from mainstream management originated with the scientific office management movement of the 1910s and 1920s. However, it only won widespread acceptance during the 1950s and 1960s, as corporations turned to clerical systems and procedures experts (or "systems men" as they called themselves), operations researchers, and the advocates of management information systems.

Their mission was indeed a bold one, for true acceptance of their beliefs would demand a redefinition of what was and what was not truly managerial, and a fundamental upheaval of existing systems of corporate status. For this reason, progress was initially slow. Cutting edge administrative technologies of the nineteenth century, such as adding machines and carbon paper, did not demand an enormous amount of arcane knowledge, and so provided a poor basis for technical expertise. The managerial technicians made significant strides only after allying themselves with the new technology of the electronic computer and with the widespread use of punched card machines for corporate administration. On its arrival, during the 1950s, in the accounting departments of large corporations the computer was expensive, complex and unfamiliar. Over the following decades, computing activity moved beyond the data center into a

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ubiquitous network of software applications, servers and personal computers. Computing now accounts for more than half of the capital investment made by US firms, costing business worldwide an estimated trillion dollars per year.[1] Technological advance has been both rapid and consistent. However, a stable model for the integration of information processing technology, and expertise, into the social order of business has never been established. Spectacular growth has coexisted bizarrely with constant disappointment.

The computer did not develop from laboratory curiosity to the central tool of business administration by itself. New spaces, both physical and cultural, were constructed around it as businesses found themselves employing new classes of worker to bridge the gulf between the worlds of binary logic and corporate management. From the 1940s onward, the increasing use of punched card machines, computers and other complex technologies has shifted control over the execution of ever-broader aspects of a firm's more important administrative processes into the hands of technical specialists. The new occupations included programmers, systems analysts, data processing supervisors, and computer operators. Yet the position of these expanding legions of technicians within the broader society of corporate management has never been altogether a comfortable one. The culture and priorities of the computer department and its inhabitants have often been at odds with those of the surrounding business. Administrative computer staff have formed their own communities and occupational identities, spanning firms and industries to unite corporate supervisors, computer suppliers, and consultants.

No single conceptual category or professional identity spans the time period considered here. My dissertation is therefore structured around an ongoing activity: the design, construction and control of large-scale systems for routine corporate administration. These systems are as

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[1] Like all such estimates, these numbers are vague. They are taken from Michael Albrecht and James W. Cortada, "Optimizing Investments in Information Technology", National Productivity Review 17, no. 3 (Summer 1998):53-60, page 54.

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important today as they were a century ago, and so they provide a clearly demarcated cross-section through the decades. These systems include payroll, inventory management, order processing, customer billing and so on. They are the administrative backbones of every corporation and are, to some extent, unique for each business. From these routine transactions come managerial reports. They have often been very closely associated with the production of accounting data, and with attempts to impose formal planning systems.

Four particularly important groups of questions must be asked about these crucial corporate systems:

**Who developed such systems?** What was their professional and educational background? How were they recruited? What did they call themselves? What models of professional identity were proposed, and how was each promoted?

**What did they do?** What different kinds of job were created? How were prestige and control divided between them? What did the practice of system development mean for the occupational cultures and subcultures which developed?

**How did they think about their work?** How did consultants, technology salespeople, and analysts promote and legitimate their work to corporate executives? What did they see as the proper place of administrative technology within the corporation, and what did they present as the main barriers to such a position? How did system developers interact with other occupational subgroups within the corporation?

**What did they make them with?** How did the technologies around which custom information systems are built develop? How have technologies co-evolved with professional identities, development practices, and changing corporate expectations?

My concern is, above all, with the experiences, motivations and beliefs of the different groups of men and women who worked with these technologies and who pushed to make a space for the technician in the ranks of management. These people built themselves new corporate

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departments, new professional societies, and new job titles. Their identities, collective and individual, took shape in a very literal process of negotiation and debate – in journals, at conferences, at professional meetings and with their corporate colleagues. They believed passionately in the rightness of their various causes, striving mightily to rise up the organizational chart, spread the organizational forms they held dear, and redeem the shining promise of the computer from whatever troubles had befallen it. While changes in technology played an important part in the evolution of many of these identities, technology was never the only factor at work.

Questions of identity have been neglected in historical discussion of corporate administration, but corporations are ultimately nothing more than assemblages of people, managers included. The creation, maintenance, and development of corporate structures depends on constant interaction between people, interaction that is itself heavily structured by social norms and personal identities. The current organization chart of any company represents nothing more than a momentary truce in a host of never-ending battles. To make sense of stories such as this one, historians of work must be prepared to pry apart the interests of different groups within the managerial and professional classes with the same vigor they have probed the complex identities of other workers. Just like the American working class, the corporate managerial class was assembled painstakingly and through a long historical process in which participants privileged certain aspects of their identities and submerged others.

## Continuity Amid Revolution

We are often told that the constantly changing nature of computer technology pushes business toward a state of unprecedented flexibility, so that the corporation and everyone in it must be prepared to reinvent itself annually or risk extinction. Yet careful historical analysis reveals that the story of corporate administrative technologies is characterized by a remarkable

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continuity in its organizational, professional, managerial and cultural dimensions. Even within the realm of the technical, the increase in the capabilities of computer hardware (which cannot but compel astonishment at its sustained pace over five decades) has been accompanied by a much slower rate of change in the application programs. And application programs are, after all, the things people buy computers in order to use.

Many of the most fundamental problems in contemporary use of administrative technologies may be traced back well before the invention of the computer. The office management reformers of the 1910s and 1920s were the first group to claim recognition as a distinct and managerially important profession on the basis of expertise in the design and execution of effective administrative systems. While the level of success, prestige and organizational responsibility they enjoyed was far lower than that of the computer staff of later generations, this has much more to do with the changing managerial and technological environment within which they worked that with any fundamental change in the ideas they advocated.

Ironically enough, the claim of an impending and revolutionary disruption of traditional business methods has itself been a constant. This claim is older than the computer itself. It has been intimately associated with another claim: that the computer, and the administrative technologies which preceded it, were just tools. They served as means, rather than ends in themselves, and did not, in and of themselves, offer anything of substance to corporate administration. Only when harnessed towards particular organizational ends, only when embedded in a larger system, only when overseen by experts who understood both technology and business, could expenditure on administrative technology be a sensible investment. A good system was more important than any individual piece of technology could ever be.

This was the central message of generations of experts, consultants and technicians of various stripes throughout the twentieth-century. These men and women have attempted to

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legitimate themselves as experts in the techniques and technologies of business administration – to bridge the gulf between the managerial and the technological. The central elements of this strategy have remained remarkably consistent from 1917, when William Henry Leffingwell published Scientific Office Management, through to the e-business gurus of the late-1990s.[2]

They begin with the observation that business is as reliant on its administrative systems as it is on its production systems. Administrative systems grow ever more elaborate, expensive and employ an ever-growing and perpetually unprecedented number of people. Yet administrative productivity lags industrial productivity. Management has traditionally paid far more attention to improvement in industrial processes than to the improvement, rationalization and automation of administrative processes. This, they say, must change.

They follow this with the promise technology holds the key to the improvement of administrative effectiveness – but only if it is used properly. Simply buying new machines will add expense and complexity to an already inadequate system. Technicians (used here in a pejorative sense) and salesmen lack a true managerial perspective. What is needed, they insist, is the harnessing of systems and technology to the true needs of management. To make it clear that they are not merely pushing technologies, they add that a pre-fabricated system could never do the job. Each company must perform its own top-to-bottom re-evaluation of each and every department, form, report, procedure and file.

The only solution, they continue, is therefore the consolidation of authority over administrative systems in the hands of a new breed of managerial professional. Existing, general-purpose executives have neither the time nor the expertise to deal with these challenges. A new, top-level department must, they conclude, be chartered to coordinate and/or centralize all

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[2] William H Leffingwell, Scientific Office Management (Chicago: A. W. Shaw, 1917).

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administrative activity. This department must sit at the very top of the organizational chart – with its head at the same level as the executives responsible for production, finance and marketing. Implicit in this message, which seemed as fresh during the 1990s as it did in the 1920s, is the idea that no serious attempt to do this has ever been made before. (Few of the people making these claims appear to have had any idea of the lack of novelty in their pronouncements).

These claims have been the basis of a number of managerial movements, each one closely tied to the establishment of a new corporate department and the construction of an accompanying profession. Each one has involved at least one new professional society, and each has been closely tied to the propagation of a new corporate function or department. Each movement has thus formed an identity that has given a shared purpose and shared identity to thousands of corporate employees across a range of industrial sectors. Consultants, academics and companies producing administrative technologies have played a part in each movement, particularly those promoting operations research and management information systems. This external involvement created diverse communities whose members often moved between work as consultants, business school faculty and corporate managers.

There have, of course, been many changes. The succession of groups that have occupied this terrain, while for the most part closely related, have differed in numerous respects. Changing technologies, new managerial ideas, shifts in the American economy and professional rivalries have spurred substantial changes in the name of the department responsible for administrative technology, its relationship to other administrative functions, the professional associations its leaders belong to, its relationship to operational and executive management and its organizational mandate. The chart below summarizes the different groups considered here.

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| Most Influential In | Movement & Corporate Function | Key Techniques | Key Technologies | Association | Distinguishing feature |
|---|---|---|---|---|---|
| 1920-1950 | (Scientific) Office Managers.<br><br>Office Management Department (occasionally Department of Office) | Form design; time-motion study; bonus systems; flow-charting; procedures manuals; specialization of work; formalization of testing and hiring procedures; use of machinery to centralize tasks. | Forms; Filing systems; Addressing machines; calculating machines; accounting machines; dictating machines. | National Office Management Association (NOMA)<br><br>Office Executives group of American Management Association | Centralization of control of all clerical activity; blend of managerial system design with improved supervision and then-novel personnel management techniques. |
| 1950-1970 | Systems Men<br><br>Systems and Procedures Department (aka Methods Department, Clerical Methods department, Procedures Department, Administrative Services Department, etc.) | Flow-charting; procedures manuals; forms control; reports control; departmental reorganization; | Emphasis on all-round mastery of different techniques and development of internal-consultant role. Specialties include forms and reports, as well as punched cards, integrated data processing (paper tape) and, increasingly, computer technology. | Systems and Procedures Association (SPA) | Strong claims made to status as corporate staff experts. Focus on design of systems – not supervision of their execution. Attempt to unite different specialists into a single "generalist" profession. |

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| **Most Influential In** | **Movement & Corporate Function** | **Key Techniques** | **Key Technologies** | **Association** | **Distinguishing feature** |
|---|---|---|---|---|---|
| 1950-present | Operations Research<br><br>Operations Research Department | Linear programming; game theory; queuing theory; simulation; forecasting. | Computers for modeling and simulation. | Operations Research Society of America (ORSA). Management Science Association (MSA). Society for Industrial and Applied Mathematics (SIAM). | "Scientific method" is unique selling point. Try to avoid association with particular techniques. Initially staffed with natural scientists. |
| 1949-1960 | Machine Accountant<br><br>Tabulating Department (many other names common) | Use and supervision of punched card machines; design of new punched card routines. | Electro-mechanical punched card machines. | National Machine Accounting Association (NMAA). | Association represented supervisors and would-be supervisors with managerial aspirations. |
| 1955-1975 | Electronic Data Processing (EDP)/ Data Processing (DP)<br><br>Electronic Data Processing Department | Systems Analysis (especially flowcharts), Programming, Coding, Machine operation, Management and supervision of computer department. | Computers, punched card machines, ancillary equipment. Operated in "batch mode" for routine administrative tasks. | Data Processing Management Association (DPMA). (Before 1962 was the NMAA). | Combines administrative computing and punched card machines into a single corporate department and professional identity. |

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| Most Influential In | Movement & Corporate Function | Key Techniques | Key Technologies | Association | Distinguishing feature |
|---|---|---|---|---|---|
| 1960-1985 | Management Information Systems (aka Total Systems)<br><br>Vice President – Management Information Systems | Design and integration of a single huge information system, tying together all reports and all operations. Provides all managers with all information needed to do job, on a timely basis. | Computers (in particular real-time, on-line systems able to store and process large volumes of data interactively). | American Management Association. Powerful elements of SPA and DPMA. From 1969, the Society for Management Information Systems (SMIS). | More managerially-oriented than EDP. Early influence of systems men. Challenge to power of corporate financial staff. Considerable academic involvement in 1970s. Tied to strategic planning. |
| 1982-2000 | Chief Information Officer<br><br>Information Systems or Information Technology | Procedures and standards for decentralized computing, Coordination of information across departmental boundaries, Communication and collaboration with senior management, Strategic Alignment of IT with organizational goals. | Mainframe computers, Server computers, Personal computers, Networks, Databases, Software, Terminals. | Society for Information Management (SIM).<br><br>Various for-profit magazines, seminar series and meetings – most notably those sponsored by CIO Magazine. | Attempt to restore focus on business content of information, rather than details of computer technology. Anticipated during 1970s with concept of "data as strategic resource". |

**Table 1: Summary of the managerial movements considered in this dissertation, their associations, key techniques, technologies and distinguishing features.**

Most of this dissertation concerns the quarter-century from 1950 to 1975. While this saw several generations of computer technology, and the development of a number of new corporate functions, it represented no more than a part of one person's working lifetime. Indeed, many of the then-youthful pioneers of corporate computing remain alive today. It is therefore no surprise to find that many individuals made the transition between two or more of the managerial

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movements described here. A number of prominent participants in the systems and procedures movement of the 1950s had previously been active in office management circles, while many individuals who began their career in machine accounting moved into systems and procedures, data processing and management information systems. Likewise, the chief information officers and senior computing staff of the 1990s had often begun their careers in the data processing departments of the 1960s.

The actual practice of system development, and the experience of programmers and analysts, has changed much less quickly than rhetorical shifts might lead one to suppose. This is in large part because most effort has been devoted to fixing and extending existing systems rather than designing new ones. The frantic pace of hardware development has sat uneasily with the more measured pace of change in business organization and methods. However, I argue that it was precisely the slow nature of change in the realities of computer use that required these frequent shifts in the names and buzzwords involved in such managerial movements. This is akin to the response of a political party or product backed by a large promotional budget but cursed with persistent failure to make progress toward its goals. In both cases, the response is a series of re-launches and re-branding exercises, in which new identities are used to salvage desirable qualities while jettisoning the baggage of failure. Underlying and unresolved tensions coupled with the constant promise of new technologies and new approaches to drive shifts in rhetoric.

### Narrative Summary

The first section of the dissertation, "Experts and Machines in Corporate Administration, 1917-1958" examines the first groups of would-be managerial technicians during the period before their alliance with computer technology. Chapter two discusses the only group to have received an appreciable amount of historical attention: the scientific office management movement. Its relationship with technology was more complex, and more ambivalent, than

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previously supposed. These office management reformers argued that office machines would improve efficiency only when installed as part of a fundamental, centralized and technocratic approach to office work. In practice, however, they generally failed to win the managerial recognition they sought. Their claim to unique expertise in systematization was instead usurped by the promises of office equipment to provide a quick, easy fix.

By the 1950s, several new groups of managerial technicians were striving to assert control over the creation of administrative systems. Chapter three focuses on the self-proclaimed "systems men" of the Systems and Procedures Association. While the systems men took many of their ideas and techniques from office management movement, they eschewed the direct supervision of clerical work. Instead, they aspired to senior staff management positions heading "systems" departments in the divisional or corporate offices of large firms. They attempted to turn a mass of individual specialties, such as forms design, file systematization and manual writing into the core of a new profession. The systems men are contrasted here with the better known, if little understood, attempts of scientifically trained operations research specialists to infiltrate corporate management during the same decade. Their story illuminates the opportunities created by the widespread adoption of the multidivisional corporate form during the 1950s, and shows that relations between line and staff management remained the subject of heated debate.

The immediate post-WWII years saw a huge increase in the use of punched card machines for administrative tasks such as bookkeeping, billing and payroll. Chapter four is the first detailed historical account of the institutional context, practices and occupational identities associated with administrative punched card work. By the 1950s, punched card operators and supervisors, by most traditional standards skilled craft workers and foremen, were trying to use their technical expertise to win professional status and managerial recognition. Inspired by corporate accountants, to whom most punched card supervisors were ultimately responsible, they tried to establish themselves as "machine accountants." Together, the machine accountants,

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systems men, and operations researchers show three distinct approaches to the construction of managerial expertise on technical foundations. Their assumptions and idea about what was, and was not, managerial were very different.

Section two, "Creating Data Processing, 1954-1958" documents the arrival of the electronic computer in the American corporation. Chapter five begins with an exploration of the bold claims made for electronics in general managerial literature, and then examines challenges and opportunities the computer posed for the each of the groups of managerial technicians previously introduced. Because the computer was so unfamiliar, contemporaries spent a great deal of time trying to explain why a computer might be useful, how to evaluate its potential within a particular business and what the benefits and perils of computer use might be. I build on this literature to document the process by which computers were sold and bought, focusing particularly on the role of feasibility study groups.

The construction of a new corporate institution, the data processing department, around the computer is the subject of chapter six. Data processing combined punched card work with elements of systems and procedures work, while introducing the new task of programming. This chapter looks at the ways in which early computers were actually used, reconstructing the tasks to which they were applied, the jobs created around them and the organizational and physical location of the new department. While the managerial literature promoted the computer as a revolutionary electronic technology, in practice data processing represented a gradual evolution of earlier punched card work. Within data processing, pay and prestige ascended from key punch work (data entry), to machine operation, to programming, to systems analysis, to supervision, to management. In the historiography of computing, this demonstrates that historians must approach the history of computer programming in the context of particular social settings (such as the data processing department, the laboratory, and the software tools team), rather than trying to generalize about the craft and identities of programmers in general.

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Section three, "From Data To Information: 1959-1975" charts the gradual evolution of data processing theory and practice over the period. Chapter six begins with an examination of the applications to which computers were put over this period, and the relative pay of the different data processing jobs (operator, programmer, and so on). The applications changed only slowly from administrative to operational jobs, while pay and prestige within data processing changed very little. Yet the new technologies of second- and third- "generation" computers had been expected to bring rapid change to the practices and applications of corporate computing. These included including real-time operation, random access storage (the disk drive), operating systems, and high level programming languages. But while these new machines were supposed to provide the technical basis for on-line, managerial applications and for the consolidation of many smaller computers into a single large system, in fact the transition to the new machines was quite wrenching even without major shifts in the kind of work performed. By looking closely at the actual reception, limitations and potential of these technologies in the context of corporate data processing, I explain this apparent contradiction.

The "totally integrated management information system," by far the most discussed corporate computing concept of the 1960s, is the subject of chapter seven. Firms tried to build enormous computer systems, into which they would place information on every aspect of their operations, and from which would flow exactly the information (including models and simulations) required by each manager. The idea was eagerly promoted by computer manufacturers, consultants, systems men, ambitious data processing managers, and operations research specialists. It promised to blur the lines between the technical and the managerial, and thus finally provide a firm platform on which the authority of the managerial technician could rest. In the process, they constructed the modern concept of the "information system" and first identified the computer as "information technology." While impossible to construct, these grand systems profoundly shaped managerial expectations of computer technology, supported the

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expansion of computing operations, and set goals that have been pursued to this day. The concept was also entangled with the Cold War systems ideology of cybernetics and "total systems" thinking, and so the chapter includes an examination of the ties between this idea and the prominent military application of computer technology to produce semi-automated command and control systems.

The practices and institutions of corporate computing changed more slowly, as shown in chapter nine. By the early 1970s, data processing managers faced more criticism than ever for their failure to keep to budgets and deadlines, or to provide a reasonable quality of service. Yet they retained their faith that they deserved, and would receive, institutional elevation close to the top of the organizational chart. This chapter focuses on the ideas advanced to deal with the operational problems of data processing, including schemes to charge users for services provided and to outsource data processing operations. It also presents the early history of packaged software, another apparently revolutionary technology, from the viewpoint of data processing practice. It concludes with a history of the strangely persistent prediction that the death of the corporate application programmer was imminent, as programming chores were handed over to some new kind of technological fix. While this idea was current from the 1950s to the 1990s, the number of application programmers rose unabated.

Section four, "Professionalism in Administrative Computing, 1959-1975" spans three further chapters. This section looks beyond the focus on technological practices and corporate institutions of the previous section, and focuses instead on the role of professional associations in the creation of occupational identities among corporate computing staff. Chapter ten examines the creation of data processing as a professional identity, through the efforts of the National Machine Accounting Association (NMAA) to remake itself for the computer era. After renaming itself the Data Processing Management Association (DPMA) it embarked on an ambitious program of professionalization and education, including the creation of a certification program for data

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processing managers. Using the association's remarkably detailed archival holdings, I show that these efforts foundered on the its internal contradictions: the association was unable to define a coherent body of data processing knowledge, or to retain the support of its existing punched-card oriented members while attracting the support of the better educated new staff drawn into corporate computing.

Chapter eleven looks at a parallel story, the attempts of a small but influential group of computer industry figures to shape a far broader professional identity, as "computer people," in which data processing would be united with scientific and technical computing work, computer science and even computer industry sales work. I dub this the "pan-computing professionalism" movement. Most of its key supporters had scientific backgrounds and had worked at one time for the RAND Corporation or Southern Californian aerospace firms. During the 1960s they enjoyed some success in setting up new institutions, including the American Federation of Information Processing Societies (AFIPS) and a popular special interest group within the academically inclined Association for Computing Machinery (ACM). Their story, and an account of their interactions with the often suspicious DPMA, illuminate both the alternate identities offered to data processing staff and the reasons for the general lack of contact between data processing and scientific/technical/academic computing.

Chapter twelve extends the story told in the two previous chapters into the 1970s and beyond. Changes during the early 1970s saw the forces of pan-computing professionalism gain the presidency of the ACM, and the installation of new and more open minded leadership at the DPMA. The two sides moved toward collaboration in several areas, including a joint certification scheme and collaboration within AFIPS. Yet many tensions remained, and in the end they failed (both separately and together) to construct a real professional identity for the corporate computing field. The section concludes with a brief survey of more recent developments in corporate computing professionalism.

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The final section, "Beyond Data Processing" gives a summary of the most important developments during the period 1975-2000, placing these more recent events in the context of the remainder of the dissertation. Chapter thirteen documents several important changes in the technologies and identities of corporate computing during the post-1975 period. A new professional identity, software engineering, developed as an alternative way of combining technical and managerial expertise in the development of corporate computing. Around the same time, the new importance of "data base management system" software accompanied an ideological shift (based on an evolution of earlier MIS thinking) toward a conception of the corporate computer department as a "data resource function." Another important development was the collapse of the traditional monopoly over computing resources held by the data processing department, as networks, minicomputers and microcomputers proliferated. Important trends in this direction included development of office automation during the 1970s and of the idea of "end-user computing" associated with the personal computers of the 1980s.

Chapter fourteen explores the rise of the concept of the Chief Information Officer (CIO), the title accorded to most senior corporate computing managers today. Though presented during the mid-1980s as a radical new idea, most of the claims made for the CIO had been seen before for managers of data processing and MIS. Proponents hoped that the CIO would be responsible for all corporate information, rather than just for the management of computer systems. The CIO concept was built on the idea, first presented during the 1970s, that information was a corporate resource comparable to money, in need of a senior corporate level officer to husband it. The chapter also investigates general shifts in the corporate computing workforce, and in the position and role of the corporate computer department during the 1980s and 1990s. It concludes with a brief discussion of the increasingly important role of consulting firms in combining managerial and technical expertise, and of the impact of the recent Internet bubble on the management of corporate computing.

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A concluding chapter restates some of the most important findings of the dissertation and explores their historiographic implications. I pay particular attention to the historical and historiographic implications of this story for our understanding of the social history of information. I also discuss some of the avenues for future work revealed by this dissertation.

## Computers and the Corporation

Almost nothing has been written by professional historians on the use of computers and punched cards in business administration (the primary subject of chapters four, five, six, seven, nine and thirteen). Of the occupations and associations I deal with, only the office managers (chapter two) had previously received any real historical scrutiny. The systems men (chapters three and eight), the tabulating machine supervisors (chapter four), the data processing managers (chapters ten and twelve), the enthusiasts for management information systems (chapter eight), the boosters of pan-computer professionalism (chapter eleven) and the chief information officers (chapter fourteen) had not been granted so much as a single article in an historical journal. The creation of their identities, the flowering of their associations and the evolution of their niches within the corporation remain terra incognita to the historical profession. More broadly, no more than a handful of papers have ever been published on the historical use of computers for administrative purposes within the American corporation. Just as startlingly, despite some attention to the development of programming theory and software engineering (discussed in chapter thirteen), no historian has ever really tried to document administrative programming or systems analysis work as it took place within the corporation.

Given this, there is little point in launching a prolonged defense of the originality of this dissertation topic, of the kind demanded of scholars in more populated specialties where a substantial mass of existing work on the topic under discussion must be shown to be incomplete, deluded, or irrelevant. Whatever flaws my work possesses, the absence of a novel subject is not

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one of them. Though the overall literature on the history of computing is now quite voluminous, it has had little to say about the people who ordered and used computers, or of the purposes for which they were used. Because corporate administration has been the most important use of computers from the 1950s onward, this is surprising. As James Cortada suggested recently "a quick look at how computers were used suggests that the history of the digital computer is every bit as much a business story as it is a tale of technological evolution." Cortada calls for a concerted shift of emphasis within historical studies of computing to explore representative patterns of use. As he observed, what little analysis exists has been skewed towards a handful of unrepresentative one-off systems such at the military SAGE air-defense network and the commercial SABRE air-reservation system.[3]

This omission is best explained by consideration of the process by which historical study of computing has developed. Early studies were written by pioneers with close personal involvement, and often addressed themselves to details of hardware design, in particular the assertion of claims to the attainment of various "firsts". In recent decades, attention within the history of computing has been shifting gradually from a close focus on the building of famous or seminal computers to a broader concern with software, commercially important systems and computer science as an intellectual discipline. Meanwhile, other recent work of potential relevance has been framed as exploration of programming or of software, neglecting the corporate context within which most computer use takes place.[4]

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[3] Cortada addressed the historical challenges posed by corporate computing in his collection James W. Cortada, Information Technology as Business History: Issues in the History and Management of Computers (Westport, CT: Greenwood Press, 1996).

[4] For notable examples of participant history, see Herman H Goldstein, The Computer from Pascal to von Neumann (Princeton, NJ: Princeton University Press, 1972) and Charles J Bashe et al., IBM's Early Computers (Cambridge, MA: MIT Press, 1986). For a fine synthesis of the recent history of computing literature see Martin Campbell-Kelly and William Aspray, Computer: A History of the Information Machine (New York, NY: Basic Books, 1996). Recent secondary work on the history of programming includes a popular history of programming languages, Steve Lohr, Go To: The Story of the Math Majors, Bridge Players, Engineers, Chess Wizards, Maverick Scientists and Iconoclasts--The Programmers Who

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The existing literature does provide some solid work on which to build, including histories of the development of computer technologies themselves and the firms that produced them. Work by historians such as Martin Campbell-Kelly, JoAnne Yates, and James Cortada has repeatedly shown that the computer industry was, more than anything else, a continuation of the pre-1945 office equipment industry – and in particular of the punched card machine industry. Their careful exploration of computer technology and the dynamics of the computer hardware industry leave little doubt that IBM's eventual dominance of the computer industry owes as much to the events of the 1930s as to those 1960s. One of the most important features of this emerging master narrative is the attention it pays to the producers of mechanical tabulating machines and other office equipment as the primary precursor of the modern computer industry – correcting an earlier emphasis on specialized machinery for scientific calculation. The continuities in the use of computer technology explored here complemented, and supported, these better understood continuities in the production and sale of computer technology.[5]

One relatively well-studied topic is the relationship of administrative technology to the work of clerical workers. Interest in this topic was kindled among labor historians during the 1970s as part of a more general interest in the deskilling effects of automation. Authors such as Margery W. Davies and Sharon Strom have been particularly concerned with the use of machinery and managerial ideologies to justify gendered divisions. This literature provides an

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Created the Software Revolution (New York: Basic Books, 2001), a study of software engineering Stuart S Shapiro, "Computer Software as Technology: an Examination of Technological Development"Carnegie-Mellon, 1990) and two dissertations on the so-called software crisis: Maria Eloina Pelaez Valdez, "A Gift From Pandora's Box: The Software Crisis" (Ph.D., University of Edinburgh, 1988) and Nathan Ensmenger, "From Black Art to Industrial Discipline: The Software Crisis and the Management of Programmers" (Ph.D., University of Pennsylvania, 2001).

[5] On continuity between computers and the earlier technologies and suppliers of punched card machines see Martin Campbell-Kelly, ICL: A Technical and Business History (New York: Oxford University Press, 1989), JoAnne Yates, "The Structuring of Early Computer Use in Life Insurance", Journal of Design History 12, no. 1 (1999):5-24, and James Cortada, Before the Computer: IBM, Burroughs and Remington Rand and the Industry they Created, 1865-1956 (Princeton, NJ: Princeton University Press, 1993).

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historiographic context for the office management chapter that is largely missing for the rest of the dissertation.[6] The "labor process" debates of two decades ago are directly relevant, concerned as they were with the impact of automation on work, the imposition of systems, and the relationship of computers to skilled work. For my purposes, however, their usefulness is limited because few of these authors tried to separate different groups, ideas or interests within the professional and managerial ranks of the corporation.[7] Two authors, Philip Kraft and Joan Greenbaum, extended this to an examination of the work of programmers, analysts, technical managers and operators – producing important snapshots of the social organization of data processing in the late 1970s.[8]

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[6] On office management and technology in the early twentieth century, see Margery W. Davies, Woman's Place is at the Typewriter: Office Work and Office Workers, 1870-1930 (Philadelphia, PA: Temple University Press, 1982), Sharon Strom, Beyond the Typewriter: Gender, Class and the Origins of Modern American Office Work, 1900-1930 (Urbana, IL: University of Illinois Press, 1992). The only historical investigation of computing in this vein, however, remains unpublished. In her dissertation, Margaret Hedstrom examined the general relationship of office work and office technology from 1900 to 1970. Her work deserves a wider audience, and contained what was until now the most thorough discussion of early clerical automation, the feasibility studies through which companies ordered early computers and the processes by which work was converted to computer operation. Unlike the current study, however, its primary focus was on skill and gender in office work – as a result, Hedstrom paid relatively little attention corporate institutions, to managerial professionalism or to the broader history of management. Margaret Lucille Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970" (Ph.D., University of Wisconsin-Madison, 1988). I am indebted to her colleague Paul Edwards for drawing Hedstrom's work to my attention.

[7] The seminal work here is, of course, Harry Braverman, Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century (New York: Monthly Review Press, 1974). Braverman and many of those he influenced address administrative computing directly. An important later work, looking at the origins of digitally controlled machine tools, is David F. Noble, Forces of Production: A Social History of Industrial Automation (New York, NY: Alfred A. Knopf, 1984). Other important studies of technology and work include Harley Shaiken, Work Transformed: Automation and Labor in the Computer Age (Lexington, MA: Lexington Books, 1986), Barbara Garson, The Electronic Sweatshop : How Computers are Transforming the Office of the Future into the Factory of the Past (New York, NY: Simon and Schuster, 1988), and Shoshana Zuboff, In The Age of the Smart Machine: The Future of Work and Power (New York, NY: Basic Books, 1988).

[8] Kraft's major work on this subject is Philip Kraft, Programmers and Managers: The Routinization of Computer Programming in the United States (New York: Springer-Verlag, 1977), though his most frequently cited contribution is Philip Kraft, "The Industrialization of Computer Programming: From Programming to 'Software Production'", in Case Studies on the Labor Process, ed. Andrew Zimbalist (New York: Monthly Review Press, 1979). Joan Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work (Philadelphia: Temple University Press, 1979) is particularly valuable for its first hand accounts of data processing work, and its treatment of the otherwise neglected role of computer operators.

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The only full-length monograph treatments of the historical development of information management techniques by American corporations have been concerned with the late nineteenth and early twentieth centuries. Most notable of these is JoAnne Yates' Control Through Communication, which combines an historical overview of administrative techniques and technologies such as memoranda, filing cabinets and copying machines with a number of detailed case studies of individual firms.[9] Despite America's uniquely deep commitment to the installation of computer hardware for corporate administration, the only book length, entirely historical monograph published on corporate use of computers and punched card machines is Dutch. Its author, Dirk de Wit, provides detailed long-term case studies of the use of information technology in the insurance industry and the national Giro bank system. De Wit's case studies make an important parallel to the American story, and are full of revealing detail.[10] The most insightful

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[9] JoAnne Yates, Control Through Communication: The Rise of System in American Management (Baltimore, MD: Johns Hopkins University Press, 1989). For a historical examination of changes in accounting information practices at DuPont, see Margaret Levenstein, Accounting For Growth: Information Systems and the Creation of the Large Corporation (Stanford: Stanford University Press, 1998). Three recent collections discuss the historical role of information, conceptualized primarily in the ahistorical sense used by economists and accountants, within corporate management. Peter Temin, Inside the Business Enterprise: Historical Perspectives on the Use of Information (Chicago, IL: University of Chicago Press, 1991). Lisa Bud-Frierman, ed., Information Acumen: The Understanding and Use of Knowledge in Modern Business (New York: Routledge, 1994). Naomi R. Lamoreaux and Daniel M.G. Raff, eds., Coordination and Information: Historical Perspectives on the Organization of Enterprise (Chicago: University of Chicago Press, 1995). Campbell-Kelly has addressed large scale Victorian administrative systems in a series of important case studies, including as Martin Campbell-Kelly, "Large-scale Data Processing in the Prudential, 1850-1930", Accounting Business and Financial History 2, no. 2 (? 1992):117-36 and Martin Campbell-Kelly, "The Railway Clearing House and Victorian Data Processing", in Information Acumen: The Understanding and Use of Knowledge in Modern Business, ed. Lisa Bud-Frierman (London: Routledge, 1994).

[10] Dirk de Wit, The Shaping of Automation : A Historical Analysis of the Interaction between Technology and Organization, 1950-1985 (Hilversum: Verloren, 1994). See also Dirk de Wit, "Caught Between Historical Experience and High Hopes: Automation at the Dutch Postal Cheque and Clearing Service, 1950-1965", IEEE Annals of the History of Computing 17, no. 2 (Summer 1995):9-21. A more general treatment of Dutch office technologies is given in Onno de Wit et al., "Innovation Junctions: Office Technologies in the Netherlands, 1880-1980", Technology and Culture 43, no. 1 (January 2002):50-72. While no full length treatment has been made, there are several important historical articles on the use of punched cards and computers by American corporations. Joanne Yates has published an overview of early computer use in life insurance firms, two case studies of punched cards and computers in the Prudential life insurance company, and another on use of packaged software by the life insurance industry. JoAnne Yates, "Co-evolution of Information-processing Technology and Use: Interaction Between the Life

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monograph on the evolution of corporate use of computer technology is actually by a non-historian, Andrew L. Friedman. The historical portions of his Computer Systems Development do an excellent job of relating professional, technological and organizational factors in the development of corporate information technology. Other authors, including Paul Strassmann and Kit Grindley, have also brought genuine historical insight to bear on the issues of information technology in the 1990s.[11]

Although computing is not yet central to it, the broader field of the history of technology has developed several broad themes and questions which must inform any study of the use of computers, among them consideration of the cultural and commercial factors embedded in technological artifacts and the reciprocal relationships between social and technological systems.[12] Like many areas of academic history, the history of technology is only now beginning to get to grips with the complexities of the post-World War II era. Early computer users took the

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Insurance and Tabulating Industries", Business History Review 67, no. 1 (Spring 1993):1-51, JoAnne Yates, "Application Software for Insurance in the 1960s and Early 1970s", Business and Economic History 24, no. 1 (Fall 1995):123-34, JoAnne Yates, "Early Interactions Between the Life Insurance and Computer Industries: The Prudential's Edmund C. Berkeley", IEEE Annals of the History of Computing 19, no. 3 (July-September 1997), Yates, "The Structuring of Early Computer Use in Life Insurance". Cortada's most recent work, such as James W. Cortada, "Using Textual Demographics to Understand Computer Use: 1950-1990", IEEE Annals of the History of Computing 23, no. 1 (January-March 2001):34-56, he has begun to address the applications to which computers were applied from the 1950s onward. Arthur Norberg has written on the use of punched card machines for calculation Arthur L Norberg, "High-Technology Calculation in the Early 20th Century: Punched Card Machinery in Business and Government", Technology and Culture 31, no. 4 (October 1990):753-79. Richard Nolan, one the most prominent corporate computing experts of the 1970s, contributed a chapter Richard L Nolan, "Information Technology Management Since 1960", in A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present, ed. Alfred D. Chandler and James W. Cortada (New York: Oxford University Press, 2000) on the historical use of information technology to a recent collection. Nolan's colleagues at the Harvard business school have included historical case studies of celebrated early systems at American Airlines and Bank of America in a book on the strategic use of information technology. James L. McKenney, Duncan C. Copeland, and Richard O. Mason, Waves of Change : Business Evolution through Information Technology (Boston: Harvard Business School Press, 1995).

11 Andrew L Friedman and Dominic S Cornford, Computer Systems Development: History, Organization and Implementation (New York: Wiley, 1989). Paul A. Strassmann, The Politics of Information Management (New Canann: The Information Economics Press, 1995). Kit Grindley, Managing IT At Board Level: The Hidden Agenda Exposed (London: Pitman Publishing, 1995).

12 Wiebe Bijker, Thomas Hughes, and Trevor Pinch, The Social Construction of Technological Systems (Cambridge, MA: MIT Press, 1987).

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lead in discovering uses for their machines, writing the most basic programming tools needed to use them, and shaping the features built into future models. Existing theoretical frameworks do not fully accommodate complex, heterogeneous and hierarchical systems of the kind produced by corporate administrative systems. Because of their crucial role in corporate administration, such systems are invariably configured to the specific needs of the firm. Hardware, software and expertise from inside and outside the company are brought together - collapsing distinctions between the producers and consumers of technology. System designers may be customers as far as IBM and other vendors are concerned, but they are the producers of the technology as used within the corporation. This reinforces the importance of corporate computer staff, their culture and their departments to the history of computer.[13]

## Technicians and Management

In 1956, an article called "So, You Want to Be a Manager?" appeared in the magazine of the National Machine Accountants Association. Its author, Robert A. Wilkinson, had a message of hope and opportunity to bring to his audience of punched card machine supervisors. "Who are you?" he asked. "You are a group of technical supervisors and technicians; well-versed in all aspects of business machines, business machines systems, electronics, punch card accounting, and computing methods. But, also, you are tomorrow's business leaders."

> For many years I have been interested in the problem of developing management leaders in a business system which has been built on the premise of technical expertness. A system in which we cultivate technicians, develop technicians, and promote technicians into management positions -- positions of leadership which involve things way beyond the limits of the technical. It was

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[13] In his most recent work, however, Thomas Hughes presents system integrators and managers as the key technological innovators in post-1945 America. Thomas Parke Hughes, Rescuing Prometheus (New York: Pantheon Books, 1998). See also the collection, Agatha C. Hughes and Thomas Parke Hughes, Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After (Cambridge, Mass.: MIT Press, 2000). For an example of work addressing the challenges computer architecture poses to innovation, see Carliss Y. Baldwin and Kim B. Clark, "Managing in an Age of Modularity", Harvard Business Review 75, no. 5 (Sept-Oct 1997):84-94.

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> most encouraging to me to learn that the NMAA is dedicated to increasing their professional and managerial stature, and in developing technicians for management.[14]

Though seldom expressed as clearly or directly, this was essentially the premise of all the groups discussed here, from the office managers of the 1910s to the chief information officers of the 1990s. Each sought, in one way or another, to shoulder the mantle of the managerial technician by asserting some form of technical authority over the administrative processes formerly overseen by non-specialist managers. Their biggest problem was the persistently low status of both technical work and routine administration in the eyes of senior corporate managers. Managerial status was something they pursued collectively, through concerted attempts to upgrade the accepted status and organizational position of the departments in which they worked. As part of these efforts, they actively promoted new concepts of management more compatible with their own aspirations, in which the boundaries between technical and managerial expertise had been redefined.

The concept of the managerial technician is clearly an interesting, and problematic one. It may strike the reader as being an oxymoron. In this the reader may very well be right. I will not attempt a defense of the correctness or the desirability of combining managerial and technical claims to authority. What is not debatable, however, is that many people have been trying for a long time to make such a claim to technical authority over many aspects of administrative management. Framing the subject this way exposes these historical continuities.

It must also be pointed out that the lines between technical and managerial authority have not always been clear, and have not always remained steady over time. Only during the late-nineteenth century did management really begin to emerge as a professional identity distinct from that of engineers. Yet the original source of the engineer's authority was technical prowess (and

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[14] Robert A. Wilkinson, "So, You Want to Be a Manager", Journal of Machine Accounting 7, no. 5 (May 1956):27-33.

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the ability to apply it within cost and organizational constraints). Frederick Taylor emerged from a well established community of systematic management reformers and consulting "management engineers," most of whom were trained as engineers and thought accordingly. As Edwin Layton has shown, well into the twentieth century some engineers pursued an independent professional identity and believed themselves, by virtue of their understanding of the demands of rational efficiency, to have a social obligation that transcended the loyalty of an employee to his employer. Thorsten Veblen and the leaders of the technocracy movement both believed that engineers, rather than managers, bankers or politicians, should be trusted to reorganize society. Eventually, however, the "revolt of the engineers" was quashed by corporate interests from within the engineering societies, in favor of a clearer demarcation between technical and managerial spheres in which the authority of engineers was sharply limited and broader authority could come only from career progression to a managerial rank.[15]

To many people during the last half century, the pendulum that empowered managers at the expense of engineers during the Victorian era has seemed ready to swing back to the technical side, handing some of the administrative authority gained by general managers back to specialists and experts. In some areas, this prediction has undoubtedly come true. Examining the ways in which these various groups of managerial technicians saw the corporate world, and attempted to shape their own places within it, has challenged me to reconsider the extent to which the approaches developed by historians to study the emergence of modern management and engineering during the late-nineteenth and early twentieth-century can guide our understanding

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[15] See Edwin T Layton, Jr., The Revolt of the Engineers: Social Responsibility and the American Engineering Profession (Cleveland: Press of Case Western Reserve University, 1971), David F. Noble, America By Design: Science, Technology and the Rise of Corporate Capitalism (New York: Knopf, 1977) and Robert Zussman, Mechanics of the Middle Class: Work and Politics Among American Engineers (Berkeley: University of California Press, 1985).

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the post-1945 era, a time in which the work of specialists and technicians has become ever more important to the functioning of corporate management.

As well as pursuing managerial status through professional improvement, the managerial technicians set themselves the equally tricky task of gaining executive status without sacrificing their technical authority. This was, in principle, possible, but only if they could succeeding in persuading others of their claims to hold technical authority over key areas of management (especially systematization). It is therefore worth considering briefly the role of the technician within the American corporation, and its relationship to professional and managerial status.

Nobody has done more to revitalize the study of corporate technical workers than Steven R. Barley, through a series of ethnographic studies and intellectually provocative articles. Barley believes that technicians have come to occupy an increasingly important part in corporate work, yet they do not fit the traditional roles accorded to managers, professionals, or craft workers. Barley has even gone so far as to suggest that the increasing importance of technical work in automated environments has propelled a shift away from rigid vertical hierarchies and towards a more horizontal, team-oriented form of work organization.[16]

Barley attempted an "ideal type" definition of the technicians. In most modern usage a technician is someone qualified to apply a particular body of knowledge (usually scientific, technical, or medical) in a practical way. Most technicians, particularly in Barley's own studies, work closely with professionals such as doctors and scientists, but in subservient roles. Technicians are often tied closely to particular complex, electronic technologies. Technicians

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[16] Stephen R. Barley, "Technicians in the Workplace: Ethnographic Evidence for Bringing Work into Organizational Studies", Administrative Science Quarterly 41, no. 3 (1996):404-41. See also Stephen R Barley and Julian E Orr, "Introduction: The Neglected Workforce", in Between Craft and Science: Technical Work in US Settings, ed. Stephen R Barley and Julian E Orr (Ithaca: Cornell University Press, 1998). As well as a rare interest in the realities of work, Barley shows what is (for an organizational theorist) a very welcome interest in history. See Stephen R. Barley, "What can we learn from the history of technology?" Journal of Engineering and Technology Management 15, no. 4 (September-December 1998):237-55.

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often perform a buffer role (lab technicians) between professionals and the material world, or what Barley called a broker role (computer support technicians) between internal users and an outside technical community. Like professionals, technicians perform esoteric and highly skilled work impenetrable to outsiders, yet technicians often operate equipment (like craft workers) and rely to a much greater extent upon on-the-job training. Distinctions are often drawn between technicians and "technical professionals" such as engineers. The latter have higher social standing, more formal and demanding education requirements, and lead more directly into managerial roles.[17]

The idea of computer technicians as "brokers," explored further by Stacia E. Zabusky, is a particularly important one. Zabusky suggested that computer support technicians have to serve, "as linguistic interpreters of a kind… translating technological realities into terms users can understand and, at the same time, to translate users' needs into terms that make sense in the technical world." She offered the provocative thought that while computer technicians are "formally employed by organizations, structurally speaking they appear instead to be positioned between the organization and the technical community." Zabusky discovered that computer technicians did not identify strongly with the culture or formal organization of the university for which they worked and concluded that, "they did not regard their careers, in other words, as linked to the organization, but instead as linked to an occupation." Administrators did not trust computer staff, but ran the risk of further alienating them by imposing traditional forms of

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[17] Barley, "Technicians in the Workplace: Ethnographic Evidence for Bringing Work into Organizational Studies". The differences between technicians and technical professionals are explored in Jeffrey Keefe and Denise Potosky, "Technical Dissonance: Conflicting Portraits of Technicians", in Between Craft and Science: Technical Work in US Settings, ed. Stephen R Barley and Julian E Orr (Ithaca: Cornell University Press, 1998)

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managerial control. Even here, where the role of the technicians was clearly demarcated as one of technical support rather than management, their role was problematic.[18]

This also illustrates the enormous importance of occupational subcultures to the understanding of organizational culture, and even of organizational structures. The leaders of many of the associations studied here were in the paradoxical position of encouraging their members to develop stronger professional identities in order to fit better within the managerial structures of their own corporations. Though organizational culture has been a fashionable topic in recent years, much work on the subject has implied that organizations (or at least successful organizations) can infuse a single strong culture and set of values throughout all employees. As Harrison M. Trice showed in his summary of the topic, many occupational groups have retained their own subcultures, ideologies, rituals and values within large organizations. The culture of top management is merely one organizational subculture among many, albeit a very strong and structurally privileged one. Occupational subcultures remain particularly strong in professional and technical fields, and encourage identification with peers outside one's own organization. Trice characterized identification with organizational hierarchies as a "grid" dimension of identity, and identification with occupational peers as a "group" dimension of identity. He suggests that engineers and accountants have weak group identities, having largely assimilated into the corporate grid system, while "corporate physicians" have managed to balance the two identities. Clearly the latter is what systems men, data processing managers, and many other

[18] Stacia E Zabusky, "Computers, Clients and Expertise: Negotiating Technical Identities in a Nontechnical World", in Between Craft and Science: Technical Work in US Settings, ed. Stephen R Barley and Julian E Orr (Ithaca: Cornell University Press, 1998). The first two quotations are from page 131, the final one is from page 139.

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groups of managerial technicians were trying to do – yet the lack of obvious models for success in this endeavor underlines the difficulties they faced. [19]

Comparison of the managerial technicians to Barley's characterization of typical technician posts is very revealing. On-the-job learning remained crucial for all the managerial technicians, and from the 1950s onward their authority has been closely tied to mastery of complex electronic technologies. Yet they have lacked, for the most part, a clearly demarcated area of expertise. Barley's work suggests the tantalizing possibility that this may have been due to their lack of a well defined relationship with an established profession. Most had close ties to particular technologies (office machines for the office managers, tabulating machines for the machine accountants, etc), but (for the ambitious vanguard at least) this was merely a stepping stone to managerial status. The clearest technician/professional relationship was that of punched card staff (or, as they called themselves, machine accountants) to accountants, yet even here the most ambitious technicians soon wished to supplant their masters. The computer brought with it many fast-growing and secure technical specialties. But the farther data processing managers and chief information officers tried to move from these technical niches, the more precarious was their authority and the less clear their actual area of expertise. Operations researchers and systems and procedures experts, the most managerially-oriented groups, suffered particularly from this problem because of their lack of a strong technological base to fall back on.

In contrast, Barley found that most technicians accepted the existing distribution of labor and wished no more than to be granted respect within their area of technical expertise. Barley's work on the meaning of professionalism to technicians (conducted with Bonalyn J. Nelsen) is also very provocative. Based on ethnographic examination of several technical occupations, they concluded that while technicians perceive professionalism as important, they do not conceptualize

[19] Harrison Miller Trice, Occupational Subcultures In the Workplace (Ithaca, N.Y.: ILR Press, 1993).

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it in the same way that the classic professions (and most sociologists) did. To technicians, professionalism means things like dressing neatly, being granted trust within one's domain of experience, acting confidently but with suitable deference to superiors, taking pride in one's work, and constantly upgrading one's technical skills. Most technicians, they observed, had little interest in the codes of ethics or in credentialing campaigns advanced by professional organizations in their fields. This has certainly been the trend in corporate computing, where formal exercises in credentialing and ethics failed to gain much momentum, yet many workers expressed a desire to be thought of as professionals.[20]

This points, of course, to the central problem of the managerial technician. If one's claimed area of technical expertise is part of management itself, one cannot expect to enjoy an uncontested occupational mandate or a clear and mutually understood working relationship with managers and other professionals. Yet technologies, from the file drawer to the Internet, have seemed to hold out enormous potential for the remaking of management and the restructuring of organizations. Belief in the need for a profession, and some new set of corporate institutions, able to the bridge these managerial and technical spheres has only gained in power over the course of the twentieth century.

My objective in the remainder of this chapter is to explore some of the main insights that can be borrowed from existing historical work on related topics and applied to the job at hand. Looking beyond the mainstream of existing management and technology history has led me to

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[20] Bonalyn J Nelsen and Stephen R Barley, Towards an Emic Understanding of Professionalism Among Technical Workers, EQW Working Papers WP 29 (Washington, DC: Office of Educational Research and Development, 1994). This is, of course, a politically charged issue. Some labor theorists would suggest that technicians are structurally exploited by professionals, perpetuating inequalities of wealth and educational opportunity through mechanisms of credentialing. Sean Creighton and Randy Hodson, "Whose Side are they On? Technical Workers and Management Ideology", in Between Craft and Science: Technical Work in US Settings, ed. Stephen R Barley and Julian E Orr (Ithaca: Cornell University Press, 1998) suggests that the attitudes of technicians have more in common with craft workers than with professionals. On the oppressive nature of credentials, see Magali Sarfatti Larson, "The Production of Expertise and the Constitution of Expert Power", in The Authority of Experts: Studies in History and Theory, ed. Thomas L Haskell (Boomington: Indiana University Press, 1984).

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rely heavily on three particular areas, none of them obscure: the intensive study of cultural identity that has occupied recent cultural history, the related concepts of class formation and collective social mobility that have long been debated by social and labor historians, and the idea of corporate departments as cultural institutions developed by organizational sociologists of the "new institutionalism" persuasion.

These elements all proved vital in developing an understanding of what the people I write about were doing, and believed themselves to be doing. I discovered a complexity, indeed a richness, to occupational culture and identity within the managerial and technical ranks of the corporation that has not yet really been documented by historians of business or technology. The managerial technicians were profoundly concerned with issues of status, identity, and collective mobility – issues central to recent labor history. Yet they were not, by any stretch of the imagination, members of the working class. Likewise, they were deeply concerned with organizational charts, managerial controls and many of the other icons of Chandlerian business history. This interest, however, came as part of social movements within corporate society – rather than through the careful top-down process of organizational engineering described by Chandler in Strategy and Structure. (One could not really class my study of these movements as history from the bottom-up, but it is at least history from the middle-out).[21] Finally, their concepts of identity and mobility were invariably tied to calls for organizational innovations. Their public pronouncements focused on the chartering, redefinition, elevation and expansion of corporate entities such as the data processing department or the office manager. The process by which such institutional features spread through the population of organizations is the central concern of recent institutionalist theorists of organization. Yet the messy reality of these historical processes

[21] The concept of pushes for computerization as social movements within corporate society has been developed by Robert Kling in a number of articles, including Rob Kling and S Iacono, "The Mobilization of Support for Computerization: The Role of Computerization Movements", Social Problems 35, no. 3 (June 1988):226-343.

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made the role of collective action by self-interested occupational groups seem far more important, or at least immediate, than one might suppose from the theoretical language that has marked most work in this area.

I make no claim to have achieved any kind of profound synthesis between these different approaches – historians are fortunate in that we are permitted to draw upon different theoretical concepts as needed to better understand elements of a particular story, rather than having to support grand universal claims with painfully constrained experimental results in the manner of sociologists or economists. I do, however, believe that many of the issues I deal with here have occupied an increasingly important role in American history over the past half century, and that future historians will have to attempt some similar mixing of perspectives to do justice to them. Just because mid-twentieth century managerial, technical and professional work in the administrative computing field was almost entirely white, middle class and masculine it does not follow that all the groups of people involved shared a homogenous and united consciousness. Neither does it follow that their identities are unworthy of historical study, or that their actions may be explained without reference to those identities. It is not only rebels and artisans who may suffer, in the evocative words of E. P. Thompson, from the enormous condescension of posterity.

## Sources of Managerial Legitimacy: Systems, Science, and Information

Managerial technicians have relied on appeals to technical expertise in three particularly important areas in order to justify their claims to managerial legitimacy. The first of these, systems, was one of the most vital concepts in the emergence of management as a distinct occupational group. It was claimed by almost all the groups considered here, particularly by the so-called systems men of the 1950s and 1960s and the office managers of the 1910s and 1920s. The second, science, held enormous authority in American society for much of the twentieth century, most particularly during the Progressive Era and the early Cold War period. It is not

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surprising, therefore, that claims to scientific expertise were made most prominently be the office managers of the 1910s and the operations research pioneers of the 1950s. The third, information, was relatively slow to develop. Twinned with system, in the concept of a "management information system" it shot to prominence during the 1960s as systems men and data processing managers grew increasingly close together. By the 1980s, computers were commonly referred to as information technology, and the chief information officer was the accepted term for the senior computer manager. Information emerged as the key factor in claims to managerial status on the basis of technical expertise, and in the process was effectively redefined in corporate usage as the content and output of computerized systems.

For most of the century, however, system was the most important of these ideas. Alfred Chandler's most influential work, The Visible Hand, presents the emergence of the role of manager, and its separation from that of owner, as part of a wider transformation of the American economy. Improvements in the technologies of production and distribution, together with considerable population growth, saw the emergence of a vast national market. By the 1880s a new breed of corporations had emerged, whose scale and complexity dwarfed that of the traditional partnership. Even where executive authority rested in the hands of an owning family, the sheer scale of operations demanded the introduction of salaried intermediaries between owner and foreman. During this transformation, managerial hierarchies selectively replaced market mechanisms as a means for the efficient coordination of industrial production. Through this process, he claims, the "careers of salaried managers became increasingly technical and professional." As Chandler has shown, ideas such as delegation of authority, line and staff separation, decentralization and accountability were not immediately obvious. Instead, they were slowly perfected by the railroads, the first businesses really to need them. Business historians

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have seen increasing reliance on professional managers, culminating in the separation of executive authority from ownership, as the key transition toward the modern corporation.[22]

The shift to salaried management was accompanied by a crucial shift in the basis of executive authority. Family firms and partnerships were run by their owners, whose power was turned to legitimate authority through general acceptance of the rights of businessmen to direct their own firms. Business owners also enjoyed a privileged class position in society as a whole. Managerial capitalism saw a shift of power to salaried managers, most of whom did not own significant portions of the assets they managed. These new managers could not legitimate their power through appeals to the rights of ownership, nor did they necessarily enjoy the middle class authority of the traditionally successful businessman. Instead, managers commanded obedience because of their position on the organization chart and their command of the new concepts of delegation and systematization. The creation of new kinds of expertise and professional competence was a central part of the development of American society in the early twentieth century. According to Reinhard Bendix, the push to professionalize management and to provide textbooks, theories and tools for the new cohorts of salaried managers represented an attempt to provide a new source of legitimacy, based on the idea that managers held an important and unique kind of expertise in a new science of management.[23]

This process of professional legitimization involved demarcation of an exclusive new body of generalized expertise and techniques. Managers embraced administrative systematization, with its close associations to efficiency and modernity. Although we now take

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[22] Alfred D. Chandler, The Visible Hand: The Managerial Revolution in American Business (Cambridge, MA: Harvard University Press, 1977), 81-121. Recent attention has turned to the enduring prevalence of smallness, specialization and diversity, a case made most thoroughly in Philip Scranton, Endless Novelty: Specialty Production and American Industrialization, 1865-1925 (Princeton, NJ: Princeton University Press, 1997).

[23] For discussion of the transition from entrepreneurial to bureaucratic authority as the source of legitimate power within business see Reinhard Bendix, Work and Authority in Industry: Ideologies of Management in the Course of Industrialization (Berkley, CA: University of California Press, 1974).

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for granted vertical filing cabinets, indexing systems, forms, memos, summary reports, and graphs, all of these technologies emerged in their present day forms between 1850 and 1900. By charting the emergence of formal communication as the primary method of managerial control, JoAnne Yates has told a story, sometimes implicit, of the emerging identity of the professional manager.[24] By the early twentieth century, systematization had become synonymous with modern management practice – an association celebrated with the publication, in 1901, of System: A monthly magazine devoted to the improvement of business method. System quickly became a leading popular magazine of American business (a distinction it has retained to this day through its descendent Business Week).

The business press adopted the system expert as an icon in its discussion of modern management. Early volumes of System featured stories about the Business Doctor, a consultant recounting his experience saving sleepy and old-fashioned businessmen from the insidious perils of cluttered desks, poor filing systems and ad-hoc procedures. After one or two striking demonstrations of the power of system the business owner (often the son of its founder) was won over by the expert's results and instituted a thoroughgoing reform of his business. The business methods of the previous generation were swept away and with them the old school works manager (jack of all trades, master of none), in favor of a system of delegation, systems and experts. In these stories the consultant systematizer was the epitome of professional management: highly skilled, self employed, autonomous, respected and above self-interest. For decades, the authority of the professional manager remained inseparable from his mastery of the instruments of bureaucratic administration: forms, reports, accounts, organizational structure and formal

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[24] Yates, Control Through Communication: The Rise of System in American Management, xvi. The ideological aspects of this process, largely implicit in her book, were given more direct expression in JoAnne Yates, "Evolving Information Use in Firms: Ideology and Information Techniques and Technologies", in Information Acumen : The Understanding and Use of Knowledge in Modern Business, ed. Lisa Bud-Frierman (New York: Routledge, 1994).

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procedures. Well into the 1920s, by which point the magazine claimed a readership of over seven hundred thousand, articles continued to celebrate the implementation of new and better systems and to include sample forms and charts to illustrate their operation.

This shift to legitimacy on the basis of delegated power and managerial expertise held its own contradictions. The office managers of the 1920s (chapter two) and the systems men of the 1950s (chapter three), for example, both attempted to use key managerial concepts such as systematization and the provision of functional authority to staff experts to build a case that they held their kinds of compelling technical expertise over many of the things held dear by general managers. Rather than produce a rational, bureaucratic world (of the kind admired by Herbert Simon and depicted in ideal form by Weber) these ideas served to provide the groups discussed here with the intellectual tools needed to attempt their own redefinition of managerial authority. These efforts were to reach their peak with the push, during the 1960s, for the redefinition of management as a kind of cybernetic exercise in technical controls and model building (chapter eight) where staff experts had largely replaced traditional managers and automated management information systems handled day to day decision making.[25]

The second important source of managerial legitimacy, science, was by far the least successful. The role of Frederick W. Taylor in promoting his idea of scientific management has been much studied by historians, and served as the direct inspiration for much work on "scientific" office management during the 1910s and 1920s (chapter two). Yet while claims to scientific status have been very important to those shaping the development of management as an academic discipline within universities, they have never meant very much within the culture of practicing managers. Ideas of science returned to the fore following World War II and its

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[25] James March and Herbert Simon, Organizations (New York, NY: Wiley, 1958). A good summary of Weber's concept of bureaucracy, and its later critics and champions, is given in Peter M. Blau and Marshall W. Meyer, Bureaucracy in Modern Society (3rd Edition) (New York, NY: Random House, 1987).

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successful use of science to produce breakthroughs in military technology and in the new field of operations research (chapter three). It was seized on enthusiastically by the elite "systems" groups of the military-industrial-academic complex such as the RAND Corporation, and by academic groups promoting the new "management science." While the language, and to a lesser extent the ideas, of these groups were influential during the late 1950s and 1960s in shaping the management information systems concept, its adherents within corporate America relied for their authority on systems and information, rather than science.[26]

Information proved the most important area of technical expertise for the legitimation of expert authority. Though first attempted within a corporate context by the scientifically and technologically innovative librarians of the "information science" movement of the 1950s and 1960s (a topic discussed briefly in chapter eight), claims to corporate information expertise were rapidly and irreversibly bound up with computer technology. During the 1960s, almost all managerially-oriented discussion of the desired place of the computer within management presented it as the enabling technology for the construction of an all-encompassing management information system. This would inform each and every corporate manager of everything (internal and external, projection and reality) that they needed to know to do their jobs. (This is the main subject of chapter eight). By the 1980s, the computer itself was increasingly known as "information technology" in managerial discussions, trade magazine had names like Infosystems and InfoWorld, and a push was underway to greatly upgrade the managerial authority of the computer department manager and issue him or her with the new title of Chief Information Officer (chapter fourteen). In the process, the term information lost much of its traditional association with the process of informing, and came instead to describe anything stored in

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[26] On Taylor, see Frederick Winslow Taylor, The Principles of Scientific Management (New York: Harper & Brothers, 1911), Daniel Nelson, Frederick W. Taylor and the Rise of Scientific Management (Madison: University of Wisconsin Press, 1980) and Robert Kanigel, The One Best Way : Frederick Winslow Taylor and the Enigma of Efficiency (New York: Viking, 1997).

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electronic form using "information technologies." It also gained a new meaning as the description of any mass of stored facts.

## Institutions, Occupations, and Identities

Each group of managerial technicians associated itself with the creation or upgrading of a particular corporate department or position. The office management movement wanted to create a strong office manager responsible for a powerful office department, the systems and procedures movement wanted to create a powerful systems group operating at the corporate staff management level, and so on. For each group, the need to win recognition and acceptance of the right kind of corporate department was its number one preoccupation. Members of each group showed each other model organization charts, itemized each characteristic of the perfect organizational mandate, and discussed ad-nauseum the problems that were holding them back. While they frequently advocated individual improvement, for example by taking evening courses or improving communication skills, their interest was really in collective mobility even when this was expressed through individual self-improvement. This mobility was to be obtained not just through individual promotion along existing career ladders, but through the general redefinition of what an organization chart was supposed to look like.

Their attempts to shape the corporation are hard to reconcile with the dominant theme in organizational analysis, which is one of impersonal rationality. Mainstream economists have had little interest in the internal functioning of the firm. Where scholars, such as Oliver Williamson, have sought to explain the development and nature of corporate control they have tended to look for rational explanations grounded in efficient coordination, improved information flow or the reduction of uncertainty.[27] Likewise, Alfred Chandler presented organizational innovation as a

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[27] Oliver E. Williamson, The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting (New York, NY: Free Press, 1987).

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process of rational experimentation within individual firms. Definition of corporate strategy, as he famously argued, precedes choice of corporate structure (or should do). By implication, the optimal organization form is dependent on the specific circumstances in which a firm finds itself operating.[28]

In contrast, much recent work in organizational sociology has adopted the so-called "New Institutionalist" perspective. This approach has its origins in attempts to explain the non-market based forces shaping organizational evolution in the public sector. The success of such organizations seemed based more on their adherence to certain socially imposed "myths and ceremonies" than any rational measure of their effectiveness. But while early work posited a separate class of "institutionalized organizations," scholars such as Walter W. Powell argued that the institutional perspective could be applied to organizations of all kinds. Efficient and inefficient features may be adopted through the same processes (in as far as there is any rational standard to separate them in the first place). Similarly, the focus of inquiry broadened from the reasons that particular organizational forms persist to the related question of why certain forms spread in the first place.[29]

The institutionalist approach is of particular interest here because it implies a social and cultural role in deciding why certain organizational features endure while others vanish, and why some spread while others do not. In other words, it shifts the focus from the invention of new organizational forms to the boarder topic of successful innovation within an organizational sector as a whole. In a famous paper, Paul J. DiMaggio and Walter W. Powell explored the topic of "institutional isomorphism", exploring the processes by which most of the organizations within a

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[28] Alfred D. Chandler, Jr., Strategy and Structure: Chapters in the History of the American Industrial Enterprise (Cambridge, MA: MIT Press, 1962).

[29] John W Meyer and Brian Rowan, "Institutionalized Organizations: Formal Structure as Myth and Ceremony", American Journal of Sociology (1977):340-63. Walter W Powell, "Expanding the Scope of Institutional Analysis", in The New Institutionalism in Organizational Analysis, ed. Walter W. Powell and Paul J. DiMaggio (Chicago: University of Chicago Press, 1991).

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particular sector (hospitals, banks, etc.) came to closely resemble each other. Two of the factors they identified are particularly important here. "Coercive isomorphism" takes place when organizations are pressured by other organizations, and by cultural expectations, to adopt a particular form. "Normative isomorphism" takes place as a result of professionalism, and of the socialization and selection mechanisms that put people of similar backgrounds and outlooks into corresponding positions in different organizations. The implication that professionalism is an important force in shaping organizational form is a stimulating one indeed. These processes may help to explain the rapid and general shifts experienced (at least on a cosmetic level) across a large population of corporations. For example, once a certain point was reached, for a firm to continue to have a personnel department rather than a human resources department would be seen as a sign of backwardness. Likewise, few firms today have a "data processing" department.[30]

To take Chandler's famous example of the multidivisional form, the key question is not what specific factors prompted DuPont family members to invent it, but what general factors explain its widespread adoption across various industries following World War II. After the new form was widely established as the preferred shape of forward looking firms, the choice to adopt it may have been motivated by a desire to seem modern (or at least not to seem backward) rather than any detailed analysis of its appropriateness. Likewise, the decision within a specific firm to create a management information system (chapter eight) or invest in an expensive Enterprise Resources Planning system (chapter fourteen) may have be motivated more by a general

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[30] Paul J. DiMaggio and Walter W. Powell, "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields", American Sociological Review 48, no. 2 (April 1983):147-60. For a survey of the use made of these concepts, and the claim that coercive and normative mechanisms have been largely neglected in later work, see Mark S Mizruchi and Lisa C Fein, "The Social Construction of Organizational Knowledge: A Study of the Uses of Coercive, Mimetic, and Normative Isomorphism", Administrative Science Quarterly 44(December 1999):653-83.

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perception that this is what peer firms were doing than by any distinctive causal factor within the specific organization. Focusing on change in a single firm might obscure this broader pattern.[31]

The recent work of Eric Abrahmson and Gregory Fairchild on managerial fads, and the role of consultants and business school professors in disseminating them, is particularly salient. As they observed, earlier institutional theory had focused primarily on the retention of organizational innovations. A broader focus on "variation, selection, retention and rejection" of changes would help to apply the same methodology to the study of fads (such as the craze for quality circles around a decade ago) as to the study of successful innovations. Their focus on the role of "knowledge entrepreneurs" on the propagation of managerial fads illustrates ways in which institutional change may be linked with the agendas of particular social groups. The importance of business school professors and consultants in propagating new ideas is apparent in much of this dissertation (particularly chapters eight, thirteen and fourteen).[32]

Despite its provocative nature and conceptual relevance, it is surprising that the new institutionalism has not been referenced a great deal by historians. One reason for this may be the rather abstract terminology adopted in its key theoretical works. The concept of institution itself is a rather confusing and conceptually overloaded one, making it hard to tell exactly what is happening. The terminology of "organizational fields" and "isomorphism" can seem, to the historian, rather vague, and apparently passive. Discussion of norms and coercion implies that

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[31] Chandler himself addressed these broader questions in Chandler, Visible Hand and, from an international perspective, Alfred D. Chandler, Scale and Scope: The Dynamics of Industrial Capitalism (Cambridge, MA: Belknap Press of Harvard University, 1992). Yet his answers remained noticeably different from those provided by sociologist Neil Fligstein in Neil Fligstein, The Transformation of Corporate Control (Cambridge, MA: Harvard University Press, 1990) and Neil Fligstein, "The Structural Transformation of American Industry: An Institutional Account of the Causes of Diversification in the Largest Firms, 1919-1979", in The New Institutionalism in Organizational Analysis, ed. Walter W. Powell and Paul J. DiMaggio (Chicago: University of Chicago Press, 1991).

[32] Eric Abrahmson and Gregory Fairchild, "Management Fashion: Lifecycles, Triggers, and Collective Learning Processes", Administrative Science Quarterly 44, no. 4 (December 1999):708-40.

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some kind of cultural standards are being applied to judge the legitimacy of organizational forms. The historian may reasonably ask: whose culture, whose norms? Any attempt to apply these theories therefore rests on the careful demarcation of social groups and interests involved, a task which is the stock in trade of social history.[33]

The method I adopt here is one of looking very broadly at changes in generally held ideas of how technology and expertise in information processing should be assimilated into the organization chart, and to what purpose they should be applied. The institutionalist call to examine changes in the organizational sector as a whole, suggests that this perspective is at least as valuable as the better established business history method of detailed reconstruction of change within a few organizations. (Having said that, the study of corporate computer use would be enormously strengthened if a few detailed case studies were available – the approaches are complimentary.)

The institutionalist perspective proved particularly relevant to this study because of the rapid rate of change in organizational forms, and the amount of work that everyone involved put into discussing and promoting organizational change. To take an important example, between 1954 and 1958, several thousand American firms ordered their first computer (chapters five and six). Before this the very term "electronic data processing department" had not been coined, and while some of these firms had groups devoted to technical calculation, and many had administrative punched card groups, none had any experience in applying an electronic computer to business. Nobody knew what was possible, let alone what might prove most efficient. In just a few years, each had to grapple with fundamental questions such as how a computer department

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[33] Institution may be the most confusing concept in social science. For a great job of sorting out the different meanings, see W. Richard Scott, Institutions and Organizations (Thousand Oaks, CA ; London: Sage, 1995). When applied in a qualitative case study, the new institutionalism can seem rather like social history. For an example, see Paul J DiMaggio, "Constructing an Organization Field as a Professional Project: US Art Museums, 1920-1940", in The New Institutionalism in Organizational Analysis, ed. Walter W. Powell and Paul J. DiMaggio (Chicago: University of Chicago Press, 1991).

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should be structured, what its role was, who should work in it, and where it should fit on the organization chart. These decisions were made within individual firms, admittedly. But in the absence of strong local traditions, managers answered them through a self-conscious process of looking around outside their own firms. Consulting firms offered advice, conferences were organized, hundreds of articles published in managerial and technical journals from the Harvard Business Review to The Journal of Machine Accounting, study groups organized, and best-practices documented. Existing corporate occupations, such as office managers, systems and procedures specialists, and punched card machine supervisors, offered their own distinctive solutions.

Within a few short years, a powerful consensus on the structure, location, staffing and mandate of the data processing department were defined. To a large extent, this was a collective decision with corporate America as a whole, rather than the aggregate outcome of thousands of independent decisions. For this reason the institutionalist perspective, with its focus on collective change among a population of organizations, rather than a single organization fits well with this topic. In this case, by looking at the surviving conference proceedings, journals, books, reports and studies we can recapture a significant proportion of the information and opinions with which a senior manager with an interest in the topics would have been familiar.

The question of whose culture and norms count in institutionalizing organizational forms is a provocative one. Many of the episodes in this book discuss the attempts of different groups to legitimate their expertise over a particular area of management – a process explored in sociological work on professionalization and expertise. Yet they have tried to do so primarily by proposing and promoting new corporate institutions – the formation and dissemination of which is the topic of the new institutionalism. At any particular point, their idea of the correct institutional arrangement has differed from that held by outsiders, most importantly from that held by senior managers with the power to fulfill these dreams. Yet, given time and favorable

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circumstances, ideas which first entered corporate discourse deep within the subcultures of particular occupational groups (for example, the idea that the computer department should be headed by a corporate vice president) have gradually won acceptance among top managers and been reflected on real organizational charts. My work here may therefore be seen as an attempt to blend these two approaches, in practice if not in theory, by exploring the role of organized occupational subgroups in the evolution of corporate form.[34]

## Managers and Professionals

Each of the groups of managerial technicians discussed in this dissertation, from the office managers onward, was represented by at least one "professional" association. The leaders of these associations devoted an enormous amount of time and energy to programs designed to boost the standing of their members, and win them an improved place within the managerial hierarchy. Yet the rhetoric and methods adopted in these programs were usually centered on professionalism. Every association had an ethical code. Most sponsored textbooks and organized seminars and courses. The National Machine Accounting Association (representing punched card supervisors, later the DPMA) embarked on an elaborate and expensive certification programs during the 1960s (chapters ten and twelve). The conference programs and journals of these associations reveal that professionalism was discussed almost as much as managerial standing, and that the two were often linked.

Yet, while the managerial technicians enjoyed a certain amount of success in winning improved managerial standing, no formal program of professionalization ever seems to have achieved very much. Why then did they believe managerial and professional claims to corporate

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[34] It must also be admitted that historians working outside the study of corporations, management and computing have achieved some notable successes in documenting the interrelation between professional identity and organizational forms. Charles E. Rosenberg, The Care of Strangers: The Rise of America's Hospital System (New York, NY: Basic Books, 1987) is a model work in this respect.

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authority to be so closely related? And, in the larger picture, are the two kinds of role compatible or mutually exclusive?

The role of managers within the broader middle class is beginning to come into historical focus. Social history gives us a reasonable idea of the emergence of the American urban middle class during the nineteenth century and its shifting composition, though this is a topic that has often been neglected in comparison with studies of the working class or the ruling elites. This story, as synthesized in a comprehensive review by Melanie Archer and Judith R. Blau, terminates in the development of an increasingly important corporate and managerial component to the middle class. It is clear that managers of all kind played an increasingly important part in the reshaping of the American middle class, and were in at least some ways distinct from the earlier established professional, industrial and commercial segments of the middle class. Unfortunately we still know relatively little about the details of this process.[35]

In addition, the cultural authority of management appears to have spread beyond its original roots within the hierarchies of specific corporations. During the 1970s, the idea of management as a technocratic "New Class", spanning corporate and governmental cultures gained considerable attention, during a politically charged debate over the existence of a newly dominant class of technocratic, academically certified experts. The idea has obvious resonance with the idea that the groups I examine are trying to assert technical authority over managerial functions, and with my concern about the relationship of managerial and professional authority. This new class idea was often combined with discussion of the putative transition to a "post-industrial" society in which command of expert knowledge replaced command of industrial resources as the basis of elite power. During the same era, a related line of inquiry explored the relationship of professionals and the ideology of professionalism to bureaucratic organization and

[35] Melanie Archer and Judith R. Blau, "Class Formation in Nineteenth-century America: The Case of the Middle Class", Annual Review of Sociology 19(1993):17(25).

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Marxist conceptions of class. But despite the enormous amount of recent attention given to "knowledge workers" and the so-called information society, American social science has largely failed to produce a coherent and empirically grounded explanation of late twentieth century middle class formation and its relationship to corporate structures and professional power.[36]

Some provocative work has come from Britain, concerning the relationship of managerial and professional classes. This discussion has centered on the idea of a "service class," defined as the, "widely influential hypothesis that professional, managerial and administrative employees constitute a class because they share a distinctive employment status, whose principal feature is the 'trust' that employers necessarily have to place in these employees whose delegated or specialized tasks give them considerable autonomy."[37] John H. Goldthorpe has argued that, "in some kinds of modern production unit the division between professional and managerial functions is becoming increasingly blurred – with consequent difficulties for maintaining the validity of the classificatory distinction." He cited data on intermarriage, individual transitions between the two groups, and their generally similar social positions in favor of this argument.[38]

The service class concept is particularly interesting for the purposes of this dissertation, because it groups together managers and professionals (such as accountants) employed by

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[36] Daniel Bell, The Coming of Post-Industrial Society: A Venture in Social Forecasting (New York: Basic Books, 1973). Alvin Ward Gouldner, The Future of Intellectuals and the Rise of the New Class (New York: Seabury Press, 1979). Hansfried Kellner and Frank W Heuberger, eds., Hidden Technocrats: The New Class and New Capitalism (New Brunswick, NJ: Transaction Publishers, 1992). On the information society see Frank Webster, Theories of the Information Society (New York: Routledge, 1995). On the idea of the knowledge worker see James W. Cortada, ed., Rise of the Knowledge Worker (New York: Butterworth--Heinemann, 1998).

[37] David Lockwood, "Marking Out the Middle Classes", in Social Change and the Middle Classes, ed. Tim Butler and Mike Savage (London: UCL Press, 1995), 1. This concept has the merit that it is grounded in a particular kind of employment relationship, and can plausibly distinguish this class both from closely supervised, routine workers (be they clerical or manual) and from self employed professionals and entrepreneurs. For this reason, "the saleriat" has sometimes been used as an alternative phrase.

[38] John H. Goldthorpe, "The Service Class Revisited", in Social Change and the Middle Classes, ed. Tim Butler and Mike Savage (London: UCL Press, 1995), 320.

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corporations. In contrast, most discussion of professionalism has stressed the autonomy and expertise of traditional professions such as doctors and lawyers. These groups hold a mass of academically grounded knowledge and skills relating to vitally important topics. Society has essentially made a deal with them – granting monopoly to state-certified practitioners, while trusting professional societies to set standards for the training and credentialing of new recruits. In return for espousing an ideology of public service, professionals are granted considerable autonomy over the conduct of their work, and can be judged only by fellow professionals. As a result the profession is said to be self-regulating. The authority of its members comes from education, adherence to a strong ethical code and the guarantee of quality provided by a certificate.[39]

Mike Savage and others have presented the contrary argument: that managers and professionals form two distinct segments of the middle class, and owe their power to command of different kinds of assets. According to Savage, the authority of managers accrues primarily from their position within a particular organization, and so is hard to transfer elsewhere. Professionals, in contrast, rely on the cultural capital of education and credentials. The formal authority of a manager, he reminds us, comes entirely from his or her position in a corporate hierarchy. This authority belongs to the company, and is not necessarily backed by more generally recognized credentials such as a professional degree. Each company is free to set its own standards for managers, and recruit as it sees fit. While the professional has mastered a carefully demarcated corpus of specialist knowledge, excessive specialization is frowned upon in a manager. Managers are usually promoted through the ranks, during which time the skills they require and the work they do may change fundamentally. Managers have no code of ethics, because they are expected

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[39] For an influential and comparatively recent discussion of professionalism and its relationship to expertise see Andrew Delano Abbott, The System of Professions: An Essay on the Division of Expert Labor (Chicago: University of Chicago Press, 1988).

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to serve the interests of their firm and its shareholders (as interpreted by the managers above them) rather than the more general interests of society. Savage therefore expected the security of the managerial middle class to erode along with the security of bureaucratic careers, while the professional middle class consolidated its power. [40]

Both sets of insights are helpful to my project. Goldthorpe reminds us that the lines between professional and managerial are becoming increasingly indistinct within the white-collar world of the corporation. Savage shows us that managerial and professional authority are based on fundamentally different kinds of social capital. Historical investigations have found the reality of professionalism to be messier than Savage implies, even in law and medicine.[41] These positions seem contradictory only if we expect a social order to be stable, rational and coherent. Instead, I suggest, corporate occupations have often seen professionalism and managerialism as two sides of the same coin, in an escape from clerical, blue-collar or technical status. Professional and managerial claims to power are indeed fundamentally incompatible in theory, but they have been widely combined in practice.

## Axes of Identity

One of the most striking things about the different groups of managerial technicians documented here is the difficulty they experienced in settling on a single kind of identity and

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[40] Mike Savage et al., Property, Bureaucracy and Culture: Middle-Class Formation in Contemporary Britain. (London: Routledge, 1992). Both camps mustered a mass of empirical data on housing, consumption patterns, social and spatial mobility, political behavior and employment relationships that has been conspicuously lacking from American discussion of the post-industrial society.

[41] The claim to serve society is particularly tenuous. While many groups claim professional status, no generally applicable empirical test exists to determine the professional status of an occupation. The most marginalized professions, such as social workers or long term adjunct instructors, have sometimes been presented as self-deluded proletarians in thrall to an ideology of professionalism that prevents them pursuing their true interests. For a seminal critique of professionalism as an empirical category, see Everett Hughes, Men and their Work (New York, NY: Free Press, 1951). For a study of professionalism demarcation in medicine, and its relationship to changing organizational forms, see Rosenberg, The Care of Strangers: The Rise of America's Hospital System. For the case of social workers, see Daniel J. Walkowitz, Working with Class: Social Workers and the Politics of Middle-Class Identity (Chapel Hill: University of North Carolina Press, 1999).

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persuading others to accept it. While they aspired to managerial status, ideas of how to achieve it, or even what it was, were dependent on one's perspective. They varied from person to person, from group to group, and over the course of time. For some, managerial status was compatible with, or could be achieved through, technical expertise. For the more lowly aspirants, such as the punched card staff of the 1950s (chapter four), a junior supervisory post or an accounting position appeared managerial. For others (chapter five), only a corporate-level executive position was managerial. Most of these groups considered themselves to be central to new approaches to management, yet were seen by executives as technicians or supervisors rather than true managers. In addition, many of these groups pursued managerial status within the firm by seeking to achieve professional status outside it. To the data processing supervisors of the 1960s (chapter ten), certification, education, and professional demarcation appeared the royal road to managerial status.

This makes the question of managerial status seem as subjective, as dependent on commitment to particular ideals, hopes and institutions, as we now understand working class identity to have been. We have seen that the numbers and importance of corporate managers increased enormously during the twentieth century. Corporate society became a social world of its own, with its own unique identities and sources of authority. To understand this demands that we apply something of the sensibility and methods of social and labor history to the ranks of management itself. This does not, however, imply an exclusive focus on the analytical categories of class, race and gender around which most social history is structured. This is not, I should emphasize, because these categories are any less important within the late twentieth-century corporation than they have been at any other time in history. I discovered, however, that these established axes of identity were necessary but not sufficient when probing within the black box of managerial and technical culture.

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For Chandler, interestingly, formalization and improvement within the new ranks of middle managers preceded that of executives. Only during the period 1900-1920 did schools, professional associations, and publications foster a new and distinct managerial identity within top management itself. This story is an implicitly class based one, as in his later work Chandler shifted from the discussion of individual firms and specific innovators to examine the emergence of a managerial class.[42] Olivier Zunz's Making America Corporate takes some of these themes and uses them as the basis for a social history of corporate management. His work is particularly important here, because it suggests ways in which a new and distinct social order arose within the increasingly complex structures of corporate life. Zunz depicts the emergence of the modern corporation as the assimilation of a diverse range of individuals into new roles within an the social world of the corporation. This process, he suggests, served to blur class differences, creating a large white-collar middle class, and ultimately a corporate society "more homogenous" than the earlier social order. For Zunz, this new class of middle managers established itself as a crucial part of a broader process of "middle-class formation and re-formation."[43]

Zunz also points toward the role of middle managers in shaping corporate institutions, with his provocative suggestion that, "the diverse group of individuals who staffed the early corporation... did not so much react to it as they did design it." He does not, however, seem to have really pursued this insight. Despite the diversity of their origins, once the various social groups he charts were assimilated into the corporate world they rarely seemed to pursue divergent interests or to shape overall corporate forms in directions other than favored by top management.

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[42] Chandler, Visible Hand. On the seminal role of middle management, see pages 413-4. On the later development of professionalism among more senior managers, see pages 464-468.

[43] Olivier Zunz, Making America Corporate: 1870-1920 (Chicago, IL: University of Chicago Press, 1990). On the heterogeneity of corporate society see p. 203. For his reference to middle class formation see p. 8.

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This is in part because his account ends in 1920, at which point the "more homogenous" social order is in place.

For all the attention the subject has received, these existing historical accounts of the rise of the corporate manager implicitly assume a general agreement of what is and what is not managerial, at least within a particular company and at a particular point in time. My own story picks up where Zunz left off, and examines a complementary process. Whereas Zunz saw a breaking down and assimilation of existing identities among the white collar workers of the corporation, my work focuses on the re-emergence of heterogeneity within the new social world of the corporation. These new distinctions, such as those between line and staff management, between managers and professionals, and between supervisors and technicians, were no longer simply reducible to the class distinctions inherited from wider society.

My contention is that those of us studying the evolution of the institutions and identities of the American manager have much to learn from the huge body of work exploring the evolution of the institution and identities of the American worker. The tools and sensibilities that have been used to paint such a rich portrait of the subjective and contested nature of working class formation and the multifaceted nature of identity can be usefully applied to the analysis of managers. Even as business historians have turned to examine the process of managerial class formation, they have tended (like the orthodox Marxists of old) to examine the structural emergence of a class rather than to probe the changing identities of those involved. In particular, they have treated the broad category of management itself as objective and unproblematic.

Since the 1960s, historians have been keen to bring dignity and historical "agency" to the marginalized groups left out of earlier stories – slaves, prostitutes, immigrant workers, the mentally ill, and so on. Much celebrated work in recent labor history has placed workers' actions within rich depictions of their complex mosaics of identity, stressing cultures, community lives and social consciousness. When social historians look at any group of people in any historical

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period, they tend to find that their story is much more complex than was previously thought, that their identity was somehow problematic or unstable, that their communities were riven with status differentials and rivalries, and that they exercised more control over their own lives and cultures than had been imagined.

In particular, the establishment of shared identities has been shown to be key to group social mobility. Unfortunately, labor historians share a general antipathy toward managers and are more likely to use the managerial class as a foil against which workers struggle to exert autonomy than as an object of study in its own right. Business historians, on the other hand, are well disposed towards managers and capitalism but have little time for the issues of class and identity that have preoccupied recent generations of social and labor historians. As a result, crucial questions about the identity of managers and the differences between different managerial groups have tended to fall into the chasm separating business and labor historians, never to be heard from again.

There are at least three high salient insights which can be drawn from recent social and labor history. The first broad insight is the subjective and problematic nature of class identity. The problem, particularly for scholars of American labor history, has been the frustrating failure of the American working class to recognize itself as such. During the nineteenth century, workers held onto a republican and artisanal view of themselves and their work long after losing most of their power and autonomy. They generally failed to support socialist politics (except for a brief flurry in the 1910s) and even the glorious triumphs of the 1930s merely set the stage for the slow but seemingly inevitable decay of organized labor. Continuing erosion of working class identity forced historians to recognize that even the seemingly empirical presence of a (working) class does not guarantee the emergence of class consciousness among that class. As Sean Wilentz has observed, it is only through, "rejecting more familiar definition of class consciousness as the only one, recognizing the possible coexistence of several tendencies and outlooks, sometimes in a

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single movement or in the minds of individual participants, that I think we can better understand the social and ideological tensions at work..."[44]

For this reason, E.P. Thompson's categorization as class formation as a "happening" and a "process of self-making" has proved widely influential. Recent work has shown class identification is highly subjective and endlessly nuanced. Even within a single workplace (such as a steelworks), a worker might identify primarily as the practitioner of a particular specialized skill (such as making moulds), a member of a craft union (covering, for example, all carpenters), part of a corporate family, a member of an industrial union, a parishioner of a specific church, a member of a trades union movement, a socialist or a member of an international movement. Class identities are layered on top of each other, and more general categories are often experienced through more specific ones. Broader class identities and beliefs form through the integration and piling up of particular identities (such as an experienced lathe operator in a GE factory) into overarching, emergent identities such as "working class" or "socialist" – an identity experienced through, not instead of, a worker's immediate world of friends, colleagues, supervisors and a particular plant. Business historians have not, as yet, been forced in a similar way to acknowledge the disunity of the managerial ranks of the corporation. These broad, top-level identities are inevitably subjective and incomplete, because they result from the alliance along one particular axis of people whose identities and interests diverge sharply in other ways.

The second, and closely related, insight is the fragmentation of identity along different axes. Social and cultural historians have embraced a multi-faceted concept of personal identity, in which class, race and gender interact with each other and with factors such as nationality and ethnic community. To live and to work is to constantly choose between these different identities, combining them in perhaps contradictory ways or privileging different aspects at different times,

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[44] Sean Wilentz, Chants Democratic: New York City and the Rise of the American Working Class, 1788-1850 (Oxford: Oxford University Press, 1984), 17.

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perhaps emphasizing an identity as a German immigrant in one's community, a male in one's household and a skilled manual worker in one's workplace. Social movements, political parties and community institutions each tug one's loyalty in one direction or another.

Managers and technicians grapple with similarly complex identities, though within the social world of the corporation the most important axes of identity will often differ from those applicable within broader society. One crucial axis is the distinction between managerial, technical and professional identities already mooted. Another is between divisional line management and corporate staff management. Within the ranks of corporate staff management, one might look to separations between the identities of accountants, personnel managers and production managers that mirror the structural realities of their different departmental allegiances and the historical process by which their cultures formed. Just as a worker might identity as both an employee of a firm and a member of a craft union, so too a financial manager was liable to be a CPA, a member of a professional organization with its own codes and interests and a part of a management cohort within the firm. His or her sense of membership in a corporate class of management was as complex, and as tied up with these more specific identities, as was a craftsman's possible feeling of pride in the achievements of the working class movement.

The third transferable insight is the juxtaposition of collective and individual mobility. A worker might seek individual mobility through obeying orders, working hard and hoping for eventual promotion to foreman. Unions, on the other hand, are designed to provide collective mobility for their membership as a whole – winning better pay, more autonomy, benefits and the like through collective solidarity. Workers would maintain the same skills and perform the same kinds of task, but the level of recognition awarded their jobs would be increased. It is clear that corporate occupations such as the punch card supervisors, the systems men and the office managers sought to achieve a similar kind of collective mobility. Their leaders did not seek to help their membership quit their jobs for better established, higher status occupations – rather

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they wanted to redefine corporate society to improve the standing of their trades. Their identity as part of a broader managerial class was as important, and as problematic, for this purpose as the identity of trade union members as part of a broader working class.

It is clear that the feelings held by many managerial and technical workers about their place with the organizations they work for have been deeply molded by their experiences as members of occupational and social organizations, be they national associations such as the Systems and Procedures Association, Data Processing Association or the American Management Association, the local chapters of such groups, or community based organizations such as a chamber of commerce or the Rotarians. David Lockwood, a veteran scholar of white-collar identity, suggests that the identity of middle class groups formed

> cooperatively, through various national associations, professional bodies and trade unions; through appointments or elections to the membership of innumerable representative and consultative bodies at local, regional and national levels; through informal social networks and cliques (including those of Rotarians and Freemasons). For a long time they have also used to the full their own personal resources, moral as well as material, in seizing opportunities afforded by both private and public educational and medical services.... This is the 'stuff' of which class formation is made up. From this perspective, then, the middle classes have probably always been much better formed than all but the most skilled sections of the working class...[45]

Much recent work of the cultures and social organizations of American workers has shown that class consciousness was rarely a simple product of mass social movements, and in general was not tied to radical unionism. This has highlighted the importance of other, more subtle avenues of class formation – mechanisms more likely to be paralleled among managerial groups. In particular the role of associations of all kinds (ethnic, religious, community, fraternal) has come into relief. The chapter organizations of the associations considered here appear to have played an important part in the formation of managerial and occupational identities. These identities were also shaped through the cultures of particular corporations (some paternalist, most

[45] Lockwood, "Marking Out the Middle Classes", 3.

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feudal), through geographical segregation and through the structures of different industries (some dominated by huge corporations, some the realm of small producers). This is not to say that working and managerial classes were necessarily any closer together than previously thought, merely that the kinds of process through which the classes formed and maintained their identities were often comparable. To this extent, therefore, we may think of the creation and evolution of an overarching managerial identity within corporate society as something akin to the better documented process of the formation of a working class identity with American society as a whole. By documenting occupational identities, and axes of identity, hitherto unknown to historians, this dissertation contributes to the historical understanding of the more general development of twentieth-century managerial and professional identities.

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# SECTION I: EXPERTS AND MACHINES IN CORPORATE ADMINISTRATION, 1917-1958

## 2. ENGINEERING THE PROGRESSIVE OFFICE, 1917-1940

This chapter examines the origins, beliefs and achievements of the office management reformers of the 1910s and 20s: the first group to seek recognition as a distinct profession on the basis of technical skill in efficient administration. Their success was limited, but the office managers raised fundamental questions about the nature of managerial authority and the limits of technology, efficiency and "system" as a tool for organizational transformation. These questions were to resonate through the rest of the century, and their legacy is explored in the remainder of this dissertation.

American business managers of the Progressive Era poured over forms and reports, marveled at files, and purchased typewriters, bookkeeping machines and dictating machines in vast numbers. This much is well known, yet historians have paid no attention to the process by which expertise in these administrative technologies and techniques was gradually lost its status as the hallmark of the professional manager and was delegated to a new class of managerial technicians. As corporations grew larger and more complex, senior executives turned their attention away from filing systems, and accountants asserted increasing control over financial reporting. The oversight of routine administration was left in the rather marginal and increasingly unappreciated hands of the "head clerk". An apparent gulf had opened between the concerns and

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skills of mainstream executives and the increasing complexity of clerical operations needed to support business.[46]

During the 1910s and 1920s, a self-interested coalition of consultants, clerical managers and academics, promoted a new kind of executive, the office manager, to bridge this divide. He would be a respected and autonomous professional, winning real authority as an expert in as experts in the application of Taylorism and other forms of what some called "management engineering". This clerical executive would oversee the hiring, payment and supervision of clerks, while combining technical mastery of efficient office practice with the control of corporate communication. The office manager would also exercise authority office machinery, combining it with the centralization and standardization of clerical work to make the office more like the factory.

This chapter contrasts the aspirations of the office management reformers to remake the American office with their actual achievements in the decade to follow. It draws heavily on the original survey records of an exhaustive investigation of office management and technology in dozens of America's largest offices, conducted around 1930 by the Women's Bureau of the Department of Labor. My account corrects two common misconceptions: that scientific office management was widely adopted among large, progressively minded firms and that the profusion of office machines facilitated or demanded the reorganization of office work according to the prescriptions of the reformers. In fact, even the largest and most clerically intensive firms, such as

[46] The most influential synthesis of political ideology, business and professionalism during this era remains Robert H. Wiebe, The Search for Order, 1877-1920 (New York: Hill and Wang, 1967). Alfred D. Chandler redefined the study of business history by presenting modern management structures as the key to efficient corporate planning and coordination, and so as the explanation of the eventual proliferation of the multi-divisional corporation. Chandler's fullest discussion of the role of middle managers comes in Chandler, Visible Hand, 381-414. However, Chandler never explores the professional identities of these men, although he acknowledges their vital role in the production of cost accounting information for executives and gives considerable attention to their structural position within the firm. Olivier Zunz grounds the corporation in social history, portraying it as the defining social institution of the new middle class. Unlike Chandler he credits middle management with a vital role in shaping corporate culture as well as executing its demands.– see Zunz, Making America Corporate, 6-9.

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insurance companies, seldom applied systematic management techniques to office work. The purchase of office machinery was, in reality, more often a symbolically effective alternative to managerial rationalization than its companion.

## Scientific Office Management

The office managers sought to win themselves executive status by redefining the manager as a kind of administrative engineer, and so claim for themselves a part of the enormous cultural authority granted to science, to rationality, and to efficiency during the Progressive Era. Science and efficiency alike demanded that authority over office work be taken from ignorant and old-fashioned departmental managers and given to skilled specialists. The office must become a factory of paperwork, with the office managers as its architects as well as its foremen. The most ambitious hoped use control over clerical systems to redesign the entire structure of the corporation in the name of administrative efficiency.

William Henry Leffingwell, the most prominent of the office management pioneers, began his own career as an office management consultant during 1914 in the offices of Chicago Ferrotype. Throughout his career, Leffingwell frequently acknowledged the huge debt he owed to Frederick Taylor whose Principles of Scientific Management had become a public sensation just a few years earlier. In a deftly reflexive maneuver, Leffingwell sought to apply the methods of the scientifically managed factory to the same kinds of clerical activity that supported scientific management itself.[47]

Leffingwell borrowed not just the minutiae of Taylor's methods but also his claims to managerial authority as an engineer. As a "consulting management engineer", Leffingwell worked for many of the best known systematically managed firms, including Curtis Publishing. He published prolifically in System, the leading business journal of the era, eventually becoming

[47] Taylor, The Principles of Scientific Management.

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its assistant editor. He wrote three major textbooks on office management, the last one of which was reissued in a revised edition as late as 1950 – sixteen years after his death. He served as president of the Taylor Society, a group devoted to the further of his idol's legacy. And he founded the National Association of Office Managers. In short he was his day's most prominent authority on matters clerical, and saw himself as the father of a new profession: Scientific Office Management. [48]

Leffingwell has been discussed at some length by a number of authors – primarily as a villain out to deskill and oppress clerical workers through the imposition of draconian work regimes and inhuman technologies. While undeniably valid, this picture remains seriously incomplete. My own analysis shifts the focus to the relationship of his efforts to build a profession of office management with the booming market for office technology, situating his efforts within the emergence of modern managerial and administrative cultures from the primal soup of engineering and systematic management. The gulfs of culture and status separating the management reformers from the executives are as fundamental and as historically interesting as those separating them from the clerks and had at least as much to do with the movement's ultimate lack of success. Many have suggested that Leffingwell's ideas were widely adopted – a suggestion I challenge here. Even Sharon Strom, author of the fullest and most nuanced study to date, claimed that, "scientific management techniques were applied as extensively to the office as to the factory floor"– accurate only if one assumes they were almost unknown in both settings.[49]

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[48] Leffingwell's first prominent publications included a series of articles outlining his ideas of Scientific Office Management published in *System* 30 and 31 (1916 and 1917). His three major works were Leffingwell, Scientific Office Management, William Henry Leffingwell, Office Management - Principles and Practice (London: A. W. Shaw Company, 1925) and William Henry Leffingwell, A Textbook of Office Management (New York: McGraw-Hill Book Company Inc, 1932). He edited a number of other volumes, including a collection of articles on office efficiency, a book detailing the use of predefined paragraphs to speed letter writing and an exhaustive guide to office equipment.

[49] Previous accounts have tended to speak in general terms of "office managers" or "employers" or "top managers" without ever really delimiting these different groups or asking how their identities changed along with those of the clerical workers themselves. The quotation is from Strom, Beyond the Typewriter,

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Leffingwell's goals were bold. He presented the Office Manager as one of the five most important executives in the firm. This may be seen in part as an attempt to restore to ambitious, business-minded male clerks the prospects and respect that they were losing as clerical practice and business management became separate careers. His ideal organizational chart, shown below, is striking in its simplicity.

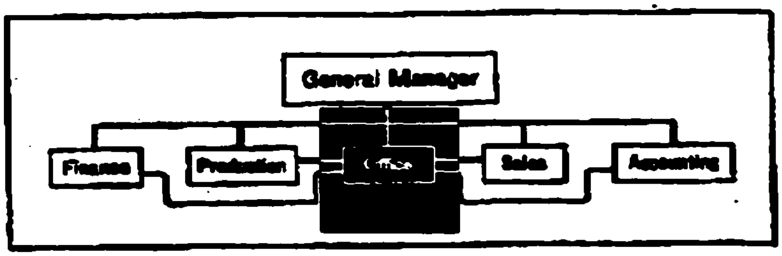


Figure 6: Chart showing relationship of office to other major departments of a business

**Figure 1: Leffingwell's model organization chart, showing "Office" as a business department of the first rank. Visual emphasis mine.**

How was this elite position to be justified? Clearly a body of technical expertise was vital to the establishment of a new profession. Equally clearly, no such body was currently in Leffingwell's possession. But this was precisely the beauty of Taylorism. Principles rewrote Taylor's own history to stress the universal and labor oriented aspects of his ideas and to downplay his hard won and very specific machine shop management skills.[50] Leffingwell's science of letter opening was no less absurd than Taylor's vaulted science of shoveling. Both required a commitment to measuring, experimentation, and the determination of the "One Best Way". Once that way was discovered, a clerk could be held to it through incentive payments just as easily as a laborer.

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3. See Davies, Woman's Place, Robert Edward MacKay, "Managing the Clerks: Office Management from the 1870s Through the Great Depression" (Ph.D., Boston University, 1985), 146-51, and Braverman, Labor and Monopoly Capital, 211-15.

[50] Daniel Nelson distinguishes carefully between that actual content of Taylor's systems and the public accounts which made him famous toward the end of his career. Nelson, Frederick W. Taylor, 169-70.

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By 1900 clerks already made up three percent of the American workforce, and their numbers had more than doubled by 1910 and continued to rise rapidly thereafter. This was caused in large part by the increasing scale of the largest firms. The erection of an organizational pyramid involved the establishment of a class of clerical workers with no reasonable prospect of moving more than one or two steps from their starting point. Such clerks had to be literate, trustworthy, respectable and willing to put up with low pay, truncated careers and humdrum work. The workers hired were invariably white, almost always native born and usually the offspring of skilled manual workers. From the 1880s onwards they were more and more likely to be women – whose restricted employment options made low pay a very relative thing and a lack of career progression the norm. Women soon accounted for almost all typists and stenographers, and as time went by they were increasingly hired as clerks, bookkeepers and office machine operators.[51]

This occupational downgrading was bad news for the ambitious, male clerk who aspired to better things. Antebellum businesses had most usually partnerships, founded and dissolved as the fortunes and ties of their owners shifted. Their owners were executives, officers, managers and sometimes foremen as well. In this world, a clerk was most likely a young man of reasonable social standing, seeking an education in the ways of the business or the professions. It had been a job with a certain status, and one that might plausibly lead to elsewhere. While drastic limits on female advancement helped keep some hope alive for male clerks, the experienced male clerk of the early twentieth century faced a steady loss of autonomy and erosion of occupational prestige.[52]

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[51] Zunz, Making America Corporate, 126.

[52] The social origins of early clerical workers are discussed in Irene de Vault, Sons and Daughters of Labor (Ithaca: Cornell University Press, 1990). For quantitative studies see Elyce J. Rotella, From Home to Work: U.S. Women at Work, 1870-1930 (Ann Arbor: UMI Research Press, 1981) and Lisa M Fine,

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Leffingwell's strategy was thus to remake the job of head clerk within the ideology of Taylorism, reuniting the minutiae of clerical activity with the engineering of administrative systems and organizational charts. To do this, Leffingwell needed to claim functional authority over all administrative processes, wherever they occurred in the firm. Just as Taylor made his knowledge of industrial production into a claim to managerial authority, so Leffingwell aimed to demonstrate a mastery of efficient clerical production so complete that senior managers would have no choice but to hand him control of their systems and the clerks in their departments. "If… coordination be considered as *the* major function of management", he wrote, "and if this coordination requires clerical mechanisms and cannot function without them, it follows that the problem of management through them constitutes in itself a major function and is unquestionably vital to the future of business." [53]

Leffingwell's signature recommendations included the following:

- Improved physical layout of office work (efficient flow of work),
- Division of tasks into simple parts, measurement and analysis of each part to determine "the one best way",
- Standardization of all procedures, forms, letters and equipment,
- Payment of production bonuses to supplement salaries and
- Use of appropriate machines and equipment to maximize efficiency of each task.

Leffingwell's point for point transfer of Taylorism duplicated his idol's distrust for the worker. Efficiency could only be achieved by placing control of every aspect of the job in the hands of a management expert. Workers were to be enticed into compliance through incentive pay – both carrot and stick rolled into one. "What can Leffingwell do for your office?" asked one

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Souls of the Skyscraper: Female Clerical Workers in Chicago, 1870-1930 (Philadelphia: Temple University Press, 1990).

[53] Leffingwell, Office Management, 109 (emphasis in original).

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advertisement for his 1917 book Scientific Office Management. The answer: guarantee savings of 20 percent of payroll when you used these methods to reorganize your office along scientific lines.[54]

Leffingwell attempted to boost his authority through assumption of the role of the scientific and impartial expert. Like Taylor, he claimed to be uncovering the natural laws of efficiency, which would brook no argument from anyone. But he rejected the idea of a massive profession of management consultants. This was a role too easily usurped by the quack and the agent of prefabricated office systems and machinery. "Experts from the outside are often employed.... I strongly advise against this practice, for the reason that to be really effective the work must be the responsibility of the management itself, and should be an integral part of the organization."[55] He used the scientific nature of the One Best Way to justify something even more ambitious – a profession of full time employees combining the technical expertise of the most knowledgeable consultant with the organizational clout of the senior manager.

Only the creation of unique, custom tailored systems could sustain this authority. Indeed, to Leffingwell the mere act of proposing a standard system revealed a consultant to be a quack with a patent remedy.[56] At the heart of Leffingwell's role of Scientific Office Manager was his idea that although a single empirical and scientific method of administration exists for any given company, the particular form of this method cannot be generalized across firms. (Historians too often misinterpret Taylor's insistence that there is "one best way" – a single optimal solution to a given problem in industrial organization – as meaning that, "one size fits all". Taylor and Leffingwell both believed that a prefabricated system was the mark of a charlatan.) All that could be directly transferred were the skills and principles of scientific experimentation needed to

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[54] System 36 (January 1919), 155.
[55] Leffingwell, Office Management, 101.
[56] Ibid, 103.

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determine it. Time study, job analysis and form design had to be conducted separately in each firm, and the results updated constantly. Indeed, Leffingwell insisted that the Office Manager must be free to question requests received for new reports, balancing clerical costs against the needs of the executives receiving them. One could not maximize the efficiency of the office, and hence serve the broader interests of management, while slavishly following the ill-considered whims of individual executives.[57]

According to their philosophy, the office was itself to become an engine, its working parts designed and monitored by managers. This vision matched the abortive Progressive conception of the engineer as an autonomous technical consultant within his own firm, free to follow his professional judgment. Indeed, this conception of manager as engineer explains Taylor's appeal to Leffingwell and his colleagues – though in fact Taylor was only one of a much larger cohort of managerially-oriented engineers. This mechanistic conception may be explained both by the importance of machinery in Victorian America and by the prominent role of mechanical engineers in early management thought. Many historians have used the term systematic management to refer to this more general movement of the late nineteenth and early twentieth centuries.[58]

Attempts during the 1910s to make engineering into a strong and independent profession along the lines of medicine withered when exposed to the realities of corporate control. Instead management became a separate role, as both David Nobel and Edwin Layton have shown. While the upward path of a successful engineer would lead into the ranks of management, this represented the assumption of a different kind of authority. Engineers frequently became

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[57] Leffingwell, Textbook of Office Management, 6.

[58] A recent and thorough account of the role of engineering in early managerial development is found in Yehouda Shenhav, Manufacturing Rationality: The Engineering Foundations of the Managerial Revolution (New York: Oxford University Press, 1999). Historians' use of the term systematic management originates with Joseph A. Litterer, "Systematic Management: The Search for Order and Integration", Business History Review 35, no. 4 (Winter 1961):461-76.

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managers, but they did not claim managerial authority directly through their expertise as designers of machines and mechanical systems. It was necessary to shed one identity in order to gain the other. During the 1920s, managers began to formalize this rift with the establishment of their own journals and societies.[59]

## The Office Management Movement

Leffingwell was only the most visible of a community seeking to apply systematic management techniques to all aspects of office administration. This community of experts included managers of well-known firms, academics in early business schools and the authors of textbooks and training materials aimed at the mass market. Of all the major figures, Leffingwell was perhaps the most extreme in his devotion to the principles of Taylor, minute attention to detail and insistence on the creation of unique systems. Some experts paid more attention to the strategic value of communication through reporting structures, and most were at least somewhat more sympathetic to the radical ideas of the personnel management movement, which enjoyed a vogue during the late 1910s and early 1920s. At this time the perennial "labor problem", seen variously as high turnover, worker unrest and low productivity, attracted a widespread attention against a background of strikes and business disturbance. Many viewed the twin programs of welfare capitalism (pensions, unemployment benefits, social programs) and systematic personnel management (testing and training of employees, systems of promotion, job standardization,

[59] The claim that, flawed as it was, Taylorism forced an examination of the role of technical expertise and professional authority among employees of bureaucratic organizations - in contrast the role of independent consultant on which engineer's codes of ethics were erroneously founded – is made in Layton, Revolt of the Engineers, 135. Noble, America By Design: Science, Technology and the Rise of Corporate Capitalism.

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grievance procedures and the other apparatus of bureaucratized employment) as a lasting solution to the labor problem.[60]

Two main organizations pushed forward the struggle to modernize office management along systematic lines: Leffingwell's own National Office Management Association (NOMA) founded in 1919 and the American Management Association's (AMA) Office Executive group, founded in 1923. The AMA was previously known as the National Personnel Association, and traced its roots to the Association of Corporation Training Schools. As this heritage suggests, the AMA group was more oriented towards personnel management and a somewhat broader vision of systematic management than was the Taylorite NOMA. But examination of the output of the two groups reveals striking similarities: in their shared vision of the expert office manager, in the nature of that expertise and in the content of their textbooks and articles.[61]

Leffingwell himself never strayed very far from his core interest in Scientific Management, preferring to stress personnel management as another opportunity to apply the same tools. This unchanged prescription was reflected in the title he gave this topic in his second textbook: "Standardization of personnel." To the end of his career, Leffingwell was still promoting scientific management, although with an increased appreciation of the "human factor"

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[60] The best account of the Personnel Management movement and its limited direct impact on industrial practice before 1933 is given in Sanford M. Jacoby, Employing Bureaucracy: Managers, Unions and the Transformation of Work in American Industry, 1900-45 (New York, NY: Columbia University Press, 1985), 137-205.

[61] Other well-known textbooks on Office Management included John William Schulze, Office Administration (New York: Ronald Press, 1919) and his J. William Schulze, The American Office: Its Organization, Management and Records (New York: Ronald Press Company, 1914). Schulze was a CPA and lecturer at New York University's School of Commerce, Accounts and Finance. The latter was America's first textbook of office management, and was based on his own experience as office manager of the Alexander Hamilton Institute. The latter included a full volume on Office Management in its twenty four volume series Modern Business. Alexander Hamilton Institute, Office Management (New York: Alexander Hamilton Institute, 1919). All covered essentially the same territory as Leffingwell - office equipment and machinery, selection, testing and training of employees, payment systems, filing and record systems and reports.

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(as well as the "One Best Way" to do the work one must find the "Person Best Fitted" to carry it out, and be prepared to win his or her cooperation).[62]

The use of fashionably labor-oriented language to promote a fundamentally mechanistic philosophy can be seen still more clearly in the work of Lee Galloway. Galloway, another key advocate of systematic office management, headed the department of Business Management at New York University. He also was active in the AMA and its predecessor, the Association of Corporation Schools. By virtue of his academic position, Galloway was perhaps more respectable and less strident than Leffingwell. He showed an appreciation of delegation that Leffingwell conspicuously lacked, and placed more stress on personnel management. Indeed, his major work Office Management: Its Principles and Practice does not mention Taylor or Scientific Management. Galloway was also more considered in his claims, acknowledging that many office jobs were almost impossible to standardize.[63]

Given these substantial differences in rhetoric and background, it is striking that neither his recommendations nor his view of office work differed greatly from Leffingwell's. His text covered much of the same ground as Leffingwell's, and similarly stressed the standardization of all kinds of work, materials and procedures. Like Leffingwell, he was a strong advocate of the division of labor and the payment of production bonuses. His book included the many drawings of efficient desks and chairs common to all office management textbooks of the period. Most of his advice was very much focused on the routine aspects of intradepartmental procedure and management, rather than the grand company-wide tasks he claims for the Office Manager.

As a more academic and more mainstream systematic manager than Leffingwell, Galloway included personnel management in his 1919 textbook - insisting that it was necessary to

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[62] William H Leffingwell, "What Is Scientific Management Anyway?" System (July 1929). He uses the same language in his 1932 Leffingwell, Textbook of Office Management.

[63] Lee Galloway, Office Management: Its Principles and Practice (New York: 1919).

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analyze carefully the qualities required to do a job and to test applicants to see whether they were suited to it. Yet Galloway shared a profoundly mechanistic view of management. Like Taylor he rhetorically transformed the whole business into a machine, a machine made of human and mechanical parts. The design of this machine was the responsibility of the office manager. Both its general structure and the workings of its individual mechanisms had to be adjusted when required to maximize its throughput. His argument for the importance of personnel selection was that office workers were akin to oil, because they would either clog or lubricate the machine depending on their quality. His one and only exemplary job analysis was, bizarrely for a book on clerical workers, for a "grinder" of metal and its recommendations concerned only "nationality" and "physique". (Poles and Lithuanians proved the best suited).He might have had a more realistic idea of executive authority, but he was still trying to legitimate it by stressing a technical mastery of efficient office production. [64]

Galloway too made explicit demands for a new kind of office manager, though he stressed the executive aspect of the job more convincingly than Leffingwell. He argued that the details of clerical work in particular departments (routine work, hiring and administration) were best left to department heads, unlike Leffingwell who advocated direct control over all clerical workers throughout the firm. The office manager was to control the coordination of all administrative activities that crossed departmental lines, heading a department which coordinated all other departments and set standards and systems for company-wide activities. Not only did this directly echo Taylor's idea of a planning department as the seat of expert power within the firm, but it also laid claim to the very definition of a firm's organizational structure.[65] Indeed, he

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[64] Ibid, 447.

[65] Galloway's call for a central department to coordinate administrative procedures and inter-departmental coordination clearly anticipated the systems and procedures movement of the 1950s discussed in Thomas Haigh, "Inventing Information Systems: The Systems Men and the Computer, 1950-1968", Business History Review 75, no. 1 (Spring 2001):15-61.

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explicitly claimed that efficient administrative production deterministically dictated the reorganization of the firm itself. "The new method reduced the time to three hours. The strain put upon the office activities had forced the management to remodel completely the organization - in response to necessity." [66]

By claiming a monopoly in expertise on efficient administrative systematization, the office managers were attempting something quite audacious. Systematization had a place at the heart of the ideology of early management professionalism. If specialist office managers could prize control of administrative systems away from general managers this would bring considerable power and prestige to their new profession, fulfilling Leffingwell's dreams. This was far easier said than done. On one hand, enough prestige still adhered to administrative systematization to make its reestablishment as a form of purely technical expertise an uphill struggle. On the other, managers invariably resented losing control of aspects of their own departments, and were reluctant to surrender control over their own administrative systems to so-called experts with little more to their name than an alleged science of better clerking. No wonder the office reformers found it difficult to claim technical authority over administrative systems. Despite a gradual shift in managerial priorities, general managers still relied on these techniques for a good part of their own professional authority.

## Technology and Office Management

Historians have sometimes placed Leffingwell and his colleagues together with office machinery vendors and senior managers in an alliance to deskill, routinize and mechanize the activities of female clerks. This is not without foundation: they were indeed enthusiastic advocates of the potential of office machinery, with Leffingwell even going so far as to edit an

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[66] Galloway, Office Management, 16.

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exhaustive 800-page survey of the field.[67]The success of the office machinery industry during the first decades of the century is undeniable. By 1929 the supply of machinery and equipment to the stores and offices of America was a well-established, highly professional industry with $217.8 million in annual production. The best-known office machine was, of course, the typewriter - ubiquitous in the American office since the 1890s. A wealth of specialist machines performed tasks like addressing letters, reproducing documents, adding and calculating. As the scale and complexities of office work increased, the ability to file and retrieve pieces of information became more crucial. The influence of such humdrum technologies as carbon paper, the paperclip and the vertical file was profound - and indeed contemporary management literature and advertising devote far more attention to filing than to any other technology.


**Figure 2: Filing cabinets were still exciting technologies during the 1920s, and the merits of rival systems were hotly promoted.**

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[67] The survey was published as William Henry Leffingwell, ed., The Office Appliance Manual ([n.p.]: Published for the National Association of Office Appliance Manufacturers, 1926).

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The true relationship, however, is far more nuanced. The office management reformers saw mechanization as one tool among many -- a means, not an end. They held that all tasks should be measured, experimented with, split into discrete components and given to specialized workers. The chaos they saw in less formalized offices was to be banished, replaced with neat hierarchies of tasks and systems. By designing an efficient overall system, and maximizing the efficiency of each tiny sub-task, huge advances in productivity were not just possible but certain. Clerks had to be taught how to hold their pens, and how to open envelopes. Forms and standard letters should be used wherever possible. Desks were to be redesigned to eliminate clutter and hiding places. These standardized and simple tasks were ripe for mechanization - but machines were not the only way to speed up the performance of individual tasks, or even always the best one. Mechanizing a bad system, they insisted, was a recipe for disaster. Neither Galloway and Leffingwell devoted more than five per cent of the space in any of their major textbooks to office machinery.

Office equipment suppliers, on the other hand, were quite happy to promote their products as ends in themselves. If the relationship of salesmen to experts was on some levels symbiotic (both reinforcing a shared discourse of system, efficiency, science and expertise), it was also parasitic. Their advertisements and salespeople promised the same modern scientific efficiency as Leffingwell, but did not demand the same disruption of existing patterns of organization. The machines had either had efficiency engineered into them, or constituted part of a prefabricated system installed by the firm's salesmen in the guise of efficiency experts. Everything from floors ("they selected floors that increase employee efficiency") through Barreled Sunlight paint ("....necessary to contentment, efficiency, more and better work.") to Neo-leum desks ("...actually demonstrated savings far greater than its cost.") was sold with this promise. Bookkeeping efficiency could be improved by using Baker-Vawter trays or Parsons business papers. Like the Milwaukee chair ("Scientifically designed after years of

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experimenting.... Statistics show that this amazing chair enables employees to double the work ordinarily done each day,") these artifacts had efficiency scientifically engineered into them and mass produced at the factory. Merely by purchasing them, that efficiency could be put to work in the office of your own company -- today.[68]

Such pseudo-scientific products came with their own pseudo-scientific experts. "For analysis THE CHEMIST..." blared one advertisement as a man in a white coat stared intently at a test tube, "...For Packaging - the Package Engineer.... In such matters business executives seek specialized services because the materials and equipment mean nothing unless used with expert knowledge.... Let [our Package Engineer] study your present methods and tell you how they match up with best modern practice." His services were free of charge, but of course were likely to involve purchase of the company's own boxes.

[68] All advertisements taken from System. Barreled Sunlight Paint - U.S. Gutta Percha Paint Company: Volume 37 ( March 1920), pages 602-603. Efficient Floors - Management Methods (Sealex Linoleum - Congoleum-Nairn Inc.): 61 (August 1932), page 443. Packaging Engineer: H&B Corrugated Fiber Shipping Boxes, The Hinde & Dauch Paper Company, Sandusky, Ohio. Volume 49, (April 1926), page 577. Baker-Vawter Company, Bentron Harbor, Michigan: Volume 49 (April 1926), 541 . Parsons Better Business Papers, Parsons Paper company, Holyoke, Mass, Volume 49 (February 1926), 256.

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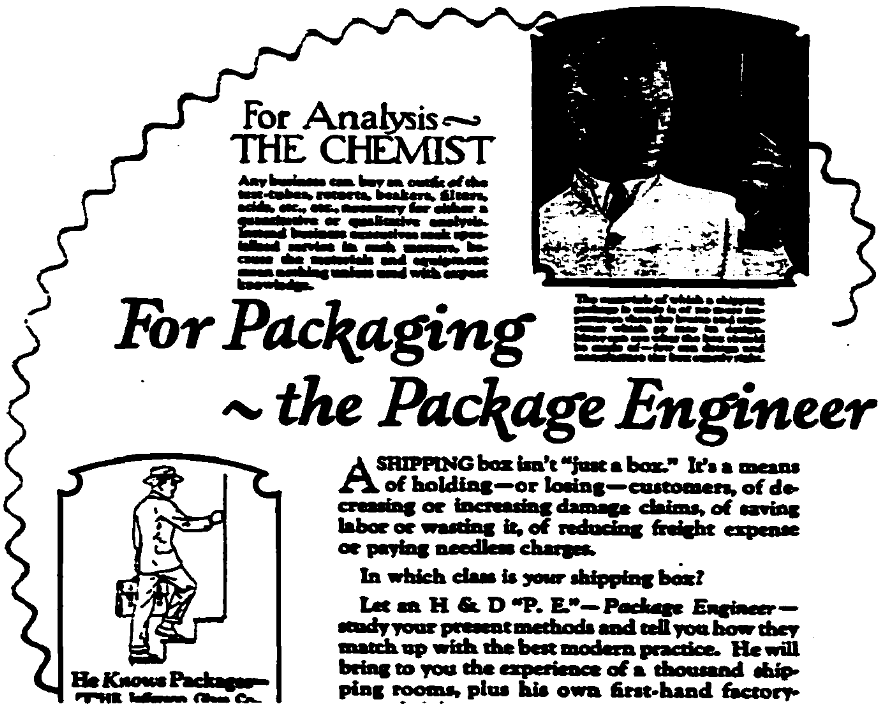


**Figure 3: Many office supplies companies promoted their salesmen as scientific or engineering experts. This advertisement 1926 advertisement for cardboard boxes touted the "package engineer".**

Even the power of system was packaged for easy consumption. By the 1920s, vendors of office machinery attempted to sell not single machines or even single major orders, but systems of office work in which their machines and supplies would play important roles. RAND Visible-Card Systems advertised their product with the image of an impeccably dressed young clerk showing department store owner John Wanamaker a card in a rack and saying "Just a second. There! - there are the facts. Now you can decide." Although this borrowed the efficiency concerns of the Office Managers ("...one clerk does the work of four"), it sold a standard system to executives with the message that their own authority and effectiveness would be enhanced as efficiency flowed painlessly into the firm. This message reached its most strident in a Depression era advertisement for a similar product ("... Acme visible records force their owners to use the facts - profit by them, save money by them, stop losses before they get started.... Acme always

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delivers what it promises. Its successful operation in your business will be automatic - as it has been in thousands of others.")[69]

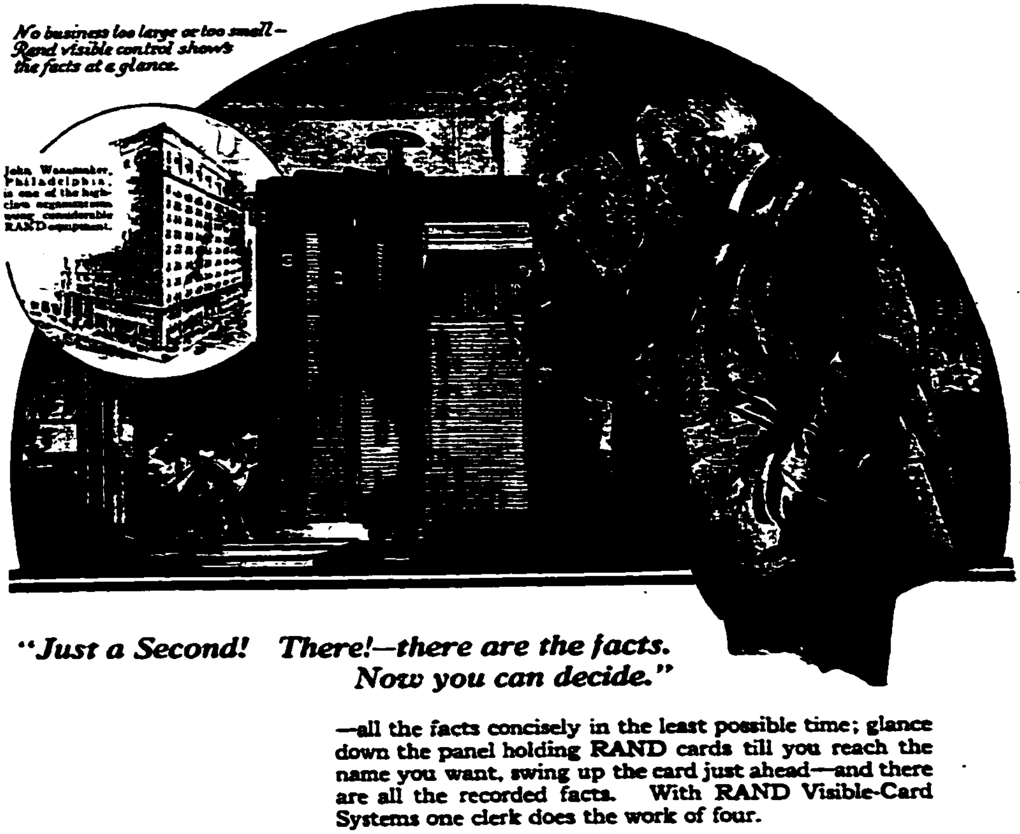


**Figure 4: Visible card systems were sold with the promise of easy access to "facts at a glance", as shown by John Wanamaker in this 1920 advertisement for RAND Visible-Card. (Note that the term "information" was not yet current in this context).**

Once such a system had been installed, further business would flow naturally from the firm's initial investment. Especially if the system included expensive and specialized machines, creation of such a system promised a profitable long-term relationship giving considerable power to the vendor. Companies such as Burroughs, which sold a range of machines to primarily corporate customers, began to build the kinds of close relationships to their customers for which IBM was later to become renowned. According to a British corporate history of Burroughs, its

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[69] Both advertisements from System. Acme Visible: Volume 61 (March 1932), page 183. Rand Visible-Card: Volume 37 (February 1920), page 349.

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salesman " became something of an efficiency consultant also.... he was selling methods rather than machines.[70]

One must take these claims with more than a little skepticism. Many firms, especially those selling filing equipment, liked to style themselves as expert business partners able to supply the right system for any office. The mystique of system transformed card and metal into a management tool with almost supernatural powers. Consider, for example, the Index Visible Company. This firm's key product was an index card punched with holes so that it could be mounted on metal strips. Its salesmen offered a free consulting service. During this exercise their man would enter the potential customer's office and observe work patterns, offering expert advice on improvement of systems, methods and general business practice. Needless to say the final report would advise the purchase of a full complement of Index Visible equipment. But more interesting is the company's usurpation of the iconic figure of the systematizing consultant. Its training manual shows an awareness of the power of the role – "Such a problem justifies a studied approach, a thoroughly planned attack, analytical research, and a carry through which will be complete, pertinent and constructive." Appearance was as important as substance. "Employee resistance is overcome, usually, by serious demeanor of the investigator at all times and by careful speech... Opinions should not be expressed until all the facts have been collected."[71]

In the classical version of this narrative, expressed in the inspirational business fiction of System, the work of Taylor and the books of the Office Management experts, the systematizer challenges every aspect of current practice, winning respect for his radical views through a few compelling scientific demonstrations. Not so the Index Visible consultant. Read between the

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[70] Bryan Morgan, Total to Date: The Evolution of the Adding Machine: The Story of Burroughs (London: 1953), 39.

[71] Two copies of the consultant manual and one copy of a sample report are stored in the Hagley collection of Remington Rand records. Acc 1825, Series III, Box 8, Folder 7, Box 8, Series III, Accession 1825 (Hagley Library, Delaware).

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lines, the guide advises a shameless pitch to executives – "an expressed favorable regard for the executives and company." One must avoid lingering for risk of becoming a nuisance – "executive interest cannot be sustained over a prolonged period". In one annotated copy, a paragraph laying out the standard Systematic Office Management agenda (insisting that workers receive training, testing and bonus payments) had been crossed out, placing these matters beyond the scope of the successful salesman. The surviving suggestions concerned light, noise and humidity – Progressive Era nostrums far less likely to offend management. In a touching display of impartiality, a sentence ending "...when recommending Index Visible" was amended to read "when recommending your solution."

A lengthy report prepared by the company in 1924 for the Chicago Engineering Works showed evidence of these guidelines. Its thirty-six page body was supplemented by flowcharts, floor plans and time study data - a model of empirical scientific presentation. But its tone was set from the start with the observation "It is not our intention to be critical. Some criticisms are offered, but these are relatively few compared to the many praiseworthy things which we could say regarding the splendid operating and control plans which are in effect in your office."

Leffingwell bitterly resented such tactics. How could his vision of a respected and trusted profession ever come to fruition when the coin of the true expert systematizer was cheapened by the common salesman?" For every business activity the seductive "systematizer" designed a little card system, which he applied to all companies alike. Some, still more enterprising, combined with their system work the sale of equipment and cards and loose leaves, and offered to do the "systematizing" for nothing, providing their merchandise was bought.... I have seen hundreds of dollars worth of forms for these systems, obsolete, because they were abandoned as soon as the spell of the brilliant salesman wore off." While Leffingwell confidently predicted that this era had

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already passed into history, the domination of the salesmen over the true office reformer was to continue unabated.[72]

## Management and Technology in Practice

How widespread were the practices office management reformers favored, such as incentive pay, training and testing of employees, standardization and grading of jobs? Even the largest offices showed little evidence of these systematic management practices. During 1930 and 1931, the Women's Bureau of the Department of Labor surveyed the clerical labor practices of hundreds of large service sector firms (primarily banks, investment houses, utilities, publishing companies and public utilities). For each of these firms, the Women's Bureau conducted extensive interviews and consulted personnel records to determine, among other things, the number of women employed in each clerical job, personnel management and welfare capitalism policies, pay and conditions, all office machinery in use and recent experiences with mechanization. The forms on which they collated information for each company provide a unique source of detailed information on actual conditions in many of the nation's most important clerical employers.[73]

The survey did not explicitly ask whether the firms had created the post of office manager. However, we can infer from answers to the other questions than many had. Office

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[72] Leffingwell, Office Management, 824.

[73] These investigations were eventually published in the Women's Bureau report series as Ethel Erickson, The Employment of Women in Offices (Washington: US GPO, 1934). Preliminary findings were published as Harriet A. Byrne, Women Office Workers in Philadelphia (Washington: US GPO, 1932). A supplementary report examined the background, age skills and training of office workers and of those seeking work in offices Harriet A. Byrne, Women Who Work in Offices (Washington: US GPO, 1935). The survey materials themselves are preserved as Records of the Women's Bureau, Box 211 (Compartment 2, Row 44, Stack Area 530), RG 86 (National Archives II, College Park, Maryland). My analysis here is based on examination of 90 firms - comprising almost all of those surveyed in Philadelphia and New York. (Only the small group of advertising firms included in the New York survey were excluded). Answers to questions on employment policies and practices mainly relate procedure in 'normal times', so although adaptations to the Depression are sometimes mentioned my analysis concentrates on these procedures. Of course, normal times never quite returned, and so the information is a better snapshot of mid-1929 than of the 1930s.

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managers (a few with the older title of "head clerk") were reported to have at least some involvement in the hiring of clerical workers in nineteen of the firms (21 percent). A further seven firms had sent office managers or their assistants to be interviewed by the Bureau's investigators, so clearly at least twenty-six (29 percent) of the firms had created a post of office manager.

Despite the relative popularity of this title, the work of these office managers can have had little in common with Leffingwell's lofty prescriptions. Only ten per cent of the firms conducted formal training for any of their clerical workers, and even those companies had rather limited or specialized programs. All the office management experts of the era, Galloway in particular, insisted on the central importance of programs in which clerical workers received formal training sessions from experts outside the run of normal work.[74] Likewise only twenty-eight per cent of the firms conducted any testing whatsoever of their applicants, and those tests were far more likely to involve a cursory medical examination than the kind of personality, aptitude or clerical performance evaluations advocated by the experts. In contrast, eighty seven per cent of the sample regularly hired women with no office experience, and sixty eight per cent of the sample routinely hired from employment agencies (including almost all the New York firms - those in Philadelphia were more likely to have arrangements with local schools). Very few of the companies had the kind of elaborate job classification and promotion ladder systems advocated by systematic management experts of the period.[75]

The incentive scheme was a crucial part of the recommendations of all American office efficiency experts during the period, and must be central to any suggestion that Taylorism itself

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[74] Galloway, Office Management, 464-520. The importance of training was a constant theme in general scientific management literature.

[75] The social institutions surrounding the training and hiring of different kinds of Philadelphian workers (including clerks) are discussed in Walter Licht, Getting Work: Philadelphia, 1840-1950 (Cambridge, MA: Harvard University Press, 1992).

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was widely imposed in the American office. Despite this, only 9 percent of the firms examined offered any incentive system. Although several more reported they were considering introducing bonus schemes, equal numbers had already tried bonuses and subsequently abandoned them. One firm reported that this was because workers were taking the payments for granted. Most of the firms that did pay bonuses restricted them to a handful of mechanized jobs, such as bookkeeping machine operators, covering only a small fraction of their clerical workforce. Only Curtis Publishing, literally a textbook example of Scientific Office Management, included most of its clerks in these schemes.

Taken together, these findings show that clerical workers had become something of a commodity -- a standardized, interchangeable part rather than a resource to be husbanded, refined or motivated. Standardization across schools, agencies and training institutions relieved office managers from the need to test carefully and select applicants, or to offer the kind of formal training programs common among more specialized employers such as department stores. This kind of general standardization again proved inimical to the attempts of the experts to gain authority through the imposition of local, specially tailored standards and systems. Thus in this case the removal of much of the specific knowledge and craft training once expected for clerical workers actually served to undermine rather than strengthen calls for scientific management – in contrast to the deskilling thesis advanced by Harry Braverman and his followers. [76]

The survey uncovered very little evidence of the kind of systematic reorganization of clerical work advocated by the experts. Only one clear example was reported, and that at the only public institution surveyed - the Federal Reserve Bank. In its transit department it had halved the workforce and reduced turnover among the women doing routine work. The reorganization involved a formal training program, different system of work allocation and introduction of new

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[76] Susan Porter Benson, Counter Cultures: Saleswomen, Managers, and Customers in the American Department Store, 1890-1940 (Urbana, IL: University of Illinois Press, 1986).

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machines. But, despite detailed questioning, from the Bureau's investigators, only a handful of firms admitted having laid off even a single woman as a result of clerical mechanization, though many others had transferred or retrained workers as a result.

These findings are still more striking because they cannot be explained away as a result of looking at small firms or backward, conservative industries. For example, when Robert McKay, in an unpublished Ph.D. dissertation on office management, suggested that Scientific Management had very little practical impact on typical offices he mentioned the smallness and conservatism of most offices as one of the primary causes of this.[77] But in this case, all of the firms were in the service sector, then the most modern and rapidly growing sector of the economy. Clerical work was a primary activity of all the firms, not merely a minor administrative overhead on a business oriented towards manufacturing or resource extraction. The mean size of the offices surveyed was 587 clerical workers, and fourteen of them had more than one thousand - hardly too small to support systematic office management. Yet only four of those largest firms, and eight of the overall sample, adopted anything like a comprehensive implementation. Those that did were well established as leaders in progressive management, including at least one (Curtis Publishing) reorganized by Leffingwell himself. Four of the others (Henry L. Doherty & Company, Aetna Life, the Federal Reserve Bank and the Philadelphia Electric Company) appeared in the top twenty of a list compiled by Sharon Strom of the most active participants in the American Management Association office management group between 1924 and 1939, and so must be considered exceptional in their commitment.[78]

Commitment to systematic management in the office appears to have been a matter of corporate culture and individual management style rather than part of a more fundamental upheaval in the organization of clerical work. Regression analysis shows that even those few

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[77] MacKay, "Managing the Clerks".
[78] Strom, Beyond the Typewriter, 263.

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firms practicing systematic management were neither significantly more feminized, more likely to conduct welfare capitalism programs or any more aggressive in their use of office machinery than would otherwise be expected given only their industry and the total size of their clerical workforce. Their breakdown of women clerical workers by job type was almost identical to that of the sample as a whole and did not reflect a shift toward the increased use of women beyond commonly accepted female jobs such as typists. This makes it hard to view the thorough application of systematic management as an important factor in the mechanization and feminization of office work.

This is not to suggest that any of the firms examined were altogether without management systems. In fact, it seems inconceivable that these huge banking, insurance and investment concerns had failed to institute accounting systems and put in place formal procedures to deal with customer billing, policy renewal, statement preparation and the other key administrative operations involved in their daily operation. Such firms could not be administered without a sea of paperwork. What is clear is that the specific measures proposed by the office management reformers – such as clerical efficiency measurement, strong personnel management activity, rigorous job analysis, and centralization of responsibility for administrative matters – had not been widely implemented.

## Bookkeeping Machinery and Managerial Systematization

The survey materials of the Women's Bureau also record the answers executives gave when questioned as to their use of machinery and its impact on employment practices during the 1920s. The two kinds of machine they asked most directly about were bookkeeping and dictating machines, giving an exceptional insight into the actual use of these office technologies.

Bookkeeping and billing machines both combined elements of calculator and typewriter technology to produce a machine that could type out accounting records, invoices, receipts, bills

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and other financial documents, producing totals as it went. The first bookkeeping machines were marketed early in the century and were used primarily for billing purposes. They did not become commonplace until the First World War, during which the shortage of men speeded the introduction of machinery and introduced many women to bookkeeping machine operation.[79]

Despite this late start, by 1930 the bookkeeping machine was second only to the typewriter itself as the most vital and ubiquitous piece of office machinery. Not only were they used more widely than any other machine included in the survey (seventy three per cent of firms sampled), but also more intensively. More female clerical workers (seven per cent) were full time operators of some kind of bookkeeping machine than of all adding, calculating, addressing, dictating and tabulating machines combined.

The amount of financial data administered by corporations increased hugely in the early twentieth century. Causes included the development of cost accounting techniques, expansion of the financial industries, a massive increase in reporting requirements for taxation and regulation, and expansion of public accounting. With its separation from accountancy, women came to swell the ranks of bookkeeping. Strom suggests that notions of women as "light manufacturing" workers made the mechanization of their work seem natural and acceptable. Systematic management favored the use of cards, forms and other easily filed and separable kinds of records over traditional bound ledger based systems. A certain natural affinity existed between the use of bookkeeping machines and the modernization and systematization of accounting systems. Meanwhile, toward the top of the company, the 1920s saw accountants inching toward executive status via the new office of controller, responsible for the husbandry of the firm's resources

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[79] Erickson, The Employment of Women in Offices.

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through budgets, measurements, standards and reporting systems. These were known collectively as the "control system" of the business – another mechanical metaphor. [80]

Bookkeeping machines thus deserve close attention. Not only were they widely and intensively used, but they have also been linked by historians to the routinization and systematization of clerical work and its designation as a task suitable for women. Analysis of the Women's Bureau materials shows that some firms did use the machines in this manner, although the technology was deployed in others with little alteration of previous labor practice. But, crucially, few firms introduced the machines as part of a comprehensive systematic management program. Indeed, the evidence suggests that apparently similar firms could reach opposite conclusions about the characteristics of the same technology and the jobs to which it was suited.

The simplest and starkest account of the introduction of bookkeeping machines was given in notes on the Macher Insurance Company: "1 Underwood Bookkeeping machine first bought about Jan 1 1928. It replaced two men and one woman ledger clerks. 1 man was given a different job and the other two laid off. The bookkeeping machine operator brought in was a young girl with very little bookkeeping knowledge. The Underwood Company trained her and sent her to the Company. Two months ago, the old Underwood brought in 1928 was replaced by the latest Underwood bookkeeping machine."

The degradation of work could not be more clearly demonstrated by Braverman himself. Men and women replaced by a girl; craft skill replaced by machinery; new technology replaced rapidly by even newer technology. Although bookkeepers were undeniably less prestigious than accountants, a number of firms pushed routine work further down the status hierarchy by transferring it to women trained only as clerks or machine operators. Philadelphia Gas Works

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[80] On the emergence of the controller and its separation from the treasurer, see James L. Pierce, "The New Image of Controllership", The Financial Executive 31, no. 1 (January 1963):13-15, 19, 36, 38-39.

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outlined a similar story, it used twelve "girls" to replace sixteen men, each of whom had been paid thirty five to fifty per cent more.

But most companies told different, or at least more subtle, stories. Most of the larger companies in the Women's Bureau survey introduced machinery into one department at a time. Many of the firms used just one or two machines. Different parts of a firm often devised their own accounting schemes – reducing scope for centralization and standardization of the work. Even the association of the machines with women was neither fixed nor universal. The Philadelphia National Bank considered bookkeeping machine operation to be men's work—a good beginner's job for those who would later train to become accountants or tellers. The American Baptist Publishing Society had just one machine, which had "always" been operated by men. Other firms simply gave the machines to their existing bookkeepers and continued with business as normal.

Machines were often introduced as part of a reorganization in which bookkeeping methods were improved, making direct comparisons of old and new methods impossible. Such a reorganization might take place as a result of a merger or to keep pace with rapidly expanding volumes of business; its result was more often to give better records and reports than to increase throughput of the same records. For example, one firm reported that six "girls" did the work of three men but produced better records. Although many companies agreed that bookkeeping machines represented a major step forward in efficiency, few were able to quantify this and almost none had actually laid off people as a result of their introduction. This inability to point to actual savings suggests that the rigorous analysis of costs favored by systematic office management experts was rare in practice.

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**Figure 5: A Remington bookkeeping machine of the 1920s. Bookkeeping machines combined typewriter technology with adding and calculating machine functions.**

Several insurance firms reported experimenting with the machines in small numbers and finding them to be of little use. A few had never even tried them. Even some extremely large firms with a general interest in systematic management did not use bookkeeping machines. Regression analysis, adjusted for industry and size of firm, showed no clear statistical relationship between the use of bookkeeping machines and the adoption of systematic management practices, or the feminization of clerical workers. Even a crucial technology like the bookkeeping machine, intimately tied to administrative and accounting systems, neither demanded nor strongly favored the adoption of the systematic office management agenda.

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The level of systematization demanded by the machines was not substantially greater than that imposed by manual accounting systems (such as the ledgers sold by Rand and countless other firms). This is not to say that most of these firms did not realize savings as a result of installing their machines. To the contrary, their widespread use implies considerable effectiveness. But when introduced piecemeal, with no will to remove workers and no means to measure efficiency, the machines did not provide a demonstration of the power of Scientific Office Management. Even where a drive was mounted to impose a comprehensive and standard system, there is no evidence that this relied upon, or aided in the establishment of, a strong office manager. In fact, such systems were more likely to be driven by members of a more successful emerging profession: corporate accountancy.

Both accountants and old style systematic managers claimed authority over a company's financial systems. During the 1920s the professionalization of accounting was well underway, and so accountants were in some ways rivals to office managers in the imposition of system. But it was during this period, driven by the rise of public accounting and new legal requirements for auditing and reporting, that accountants turned away from "scientific" claims to authority and the pursuit of radical innovations in accounting. Managerially-oriented cost accounting systems, individually designed in the tradition of engineering management to provide useful information for the running of a particular business, were replaced by financially oriented systems in which all internal costs had to balance with the ledger of the business as a whole. Standard accounting measures were also crucial to the management of diversified corporations.[81]

Thus the movement toward company wide systems was also one toward standard systems. Because the process was driven from above (by senior managers) and outside (by

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[81] For shift from managerial to financial accounting see Paul J. Miranti, Jr., Accountancy Comes of Age: The Development of an American Profession, 1886-1940 (Chapel Hill, NC: The University of North Carolina Press, 1990), ch. 4 and H. Thomas Johnson and Robert Kaplan, Relevance Lost: The Rise and Fall of Managerial Accounting (Cambridge, MA: Harvard Business School Press, 1987).

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regulators and auditors) the accountants with their special authority over financial systems were well placed to benefit. In contrast, no amount of special expertise in the efficient management of clerical production could give office managers a credible stake in the design and control of corporate control systems. By supplying expert salesmen to advise on their use, by offering ready made systems to adapt as required, and by supplying a wide range of standard forms the bookkeeping machine suppliers played their own part in the adoption of standard systems, and hence helped to undermine the office managers' claim to unique authority.

## Dictating Inefficiency

The bookkeeping machine often failed to accompany the kind of definite labor savings, standardization and aggressive efficiency anticipated by office management experts. But the same firms' experiences with dictating machines positively flouted the teaching of Leffingwell and Galloway. As implemented, the symbolic importance of this technology to executives completely superceded its economic benefits. Indeed, the appeals to vanity and modernity used to sell the machines actually mitigated against their systematic use.[82]

Dictaphones were made by the Dictaphone Sales Corporation, and Ediphones by the Thomas A. Edison Company. Both used wax cylinders rather than discs for recording. It was as a tool for business that the phonograph was first developed to a commercial state, but widespread adoption proved slow - to its advocates, the technology was forever on the verge of a breakthrough which somehow never quite arrived. These advocates included Leffingwell and, as quoted below, Galloway. "The most interesting development in recent years in connection with

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[82] The use of dictating machines in the offices of the 1920s has previously been explored by Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970", 55-58. Though I was not aware of her research when I conducted my own, our conclusions are broadly similar. The same issues are also treated in David Morton, Off the Record: The Technology and Culture of Sound Recording in America (New Brunswick: Rutgers University Press, 2000), 74-107.

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correspondence has been the introduction of the dictating machine. Its scope is not yet appreciated. It is likely to bulk almost as large as the telephone in business, in the future."[83]

Advertisements for the machines promised more efficient use of time and money. Unlike billing, adding or mailing machines, dictating machines were to be used by executives themselves. Advertisements and salesmen could therefore make a direct appeal to executive vanity, playing on executives' sense of their own worth and creative genius. Executives could dictate on demand and have the recording typed up immediately by one of a pool of dedicated operators. This allowed the busy executive to start up his machine and unleash a stream of messages at any moment inspiration struck him, without the need to wait for a stenographer to arrive or waste his time on human interaction. He could deal directly with an efficient machine, an embodiment of rationality and control waiting reassuringly in his office. The human operators, working on transcription units, were hidden in another part of the building.[84]

Office management experts saw a different kind of efficiency in the machines. They hoped primarily to increase clerical, rather than executive, efficiency. What excited them were the possibilities for specialization, division and centralization of work that the machines opened up. Machine operators would have no need for expensive stenographic skills, and could become expert in the specialized task of transcription. Neither would they have to wait for executives to be ready to dictate, which wasted much of the working day of a stenographer. Instead they could work continually transcribing cylinders delivered by messenger boys, their output could easily be measured and rewarded, and the same job as before could be done with many fewer women. The machines introduced a new task, that of shaving the cylinders for reuse, and Leffingwell used several pages of text and pictures to show that this task could be most efficiently done by

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[83] Galloway, Office Management, 556.

[84] The selling of dictating machines, and the special pleading made for them by office management authors, is discussed in Adrian Forty, Objects of Desire: Design and Society Since 1750 (London: Thames and Hudson, 1986).

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messenger boys during slack periods. Characteristically, Leffingwell warned against unsystematic use and superficial expectations: "With all these advantages so well known, it is somewhat difficult to understand why so many installations of dictating machines are failures. In my opinion it is entirely due to the defective manner in which the new idea of the machine is 'sold' to both dictators and operators. That is, it is almost entirely a matter of faulty psychology."[85]

Of course, as a more pragmatic textbook author admitted, this also had the disadvantage of removing from each department control over its own correspondence, meaning that the stenographer may not have understood the letter's contents well enough to do a good job. One would also expect departments and individuals to resent political loss of control and personnel to another section of the firm. Executives would lose the social prestige and intelligent assistance of a personal secretary while having to retrain themselves to speak clearly and exactly. This may explain evidence that even firms with central stenographic departments did not necessary employ all, or even most, of their stenographers in these units. Most firms surveyed by the Women's Bureau made some use of dictating machines, yet very few used dictating machines intensively or systematically. Even in the firms making use of the machines, general stenographers outnumbered specialist dictating machine operators by more than seven to one. These figures suggest that while the machines had obviously found a niche of some kind, they were universally supplementing rather than replacing the work of stenographers.[86]

Some firms added them gradually, others purchased in relative bulk. Few appeared to have had particularly clear reasons for introducing the machines. The interview records clearly reflect the dominance of the machine advertiser's vision of executive convenience over the office

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[85] Leffingwell discussed the centralization of dictating operations in W.H. Leffingwell, "Shall I Have a Central Typing Department", System 35 (1919), 231-235. The quotation discussing slow uptake is from Leffingwell, Office Management, 465.

[86] Schulze, Office Administration.

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management experts' concern with administrative efficiency. Although many firms mentioned efficiency as a goal, only one was able to provide an estimate of savings realized. Theodore Presser Company echoed the message of executive empowerment used in advertisements, claiming that the machines were "for the sake of convenience, so that a man could dictate at any time that he wanted".

Enthusiasm for the machine clearly varied from person to person at most of the companies. Some users were enthusiastic, but the overall picture that emerged was one of apathy mixed with pockets of active resistance from both executives and operators. The interviewee at the F.A. Davies publishing firm in Philadelphia boasted that, "he could dictate enough in one hour to keep a girl busy for three days" and wished that all the men would use them. But even here, department heads refused to use the machine. At the General Accident Fire & Life Insurance Company, "executives, especially older ones, do not like to dictate to machines". The treasurer of the Philadelphia Company for Guaranteeing Mortgages was decidedly unimpressed with the trial machines that had recently been installed there. "A super-salesman has persuaded our executives that Ediphones can be used here at a saving, but my machine is going back next week," he remarked. A bank introduced Ediphones because "the executives were sold on them" and had been convinced that the ability to dictate at any time was essential. When they tired of their new toys the machines were transferred to lesser managers who dealt primarily with correspondence and might find them useful. Two of the firms formerly had several machines, but their executives did not like to use them and each was left with one die-hard user and a part-time operator.

Many companies had installed machines in the past but abandoned their use completely. "Hard on the dictator they say. Prefer to depend on stenographer for most any work that required thoughtful composing of letters" was the comment of the one. The most dramatic example was that of U.S. Fidelity (Philadelphia), which installed fifty machines (the largest group reported by

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any company) and later scrapped all but one or two of them ("They were not successful for the work of this company.") Other firms simply reported that the promised efficiency had not been forthcoming.

The few firms with an unwavering commitment to the technology were able to enforce its use on the clerical staff despite the unpopularity that accompanied its general use. The Insurance Company of North America had faced "all kinds" of initial problems, finding that the "girls did not want to operate the machines". Having forcibly turned-over their entire force of operators twice, the company happily reported that the third batch of eight "girls" was now doing the work of twenty-five stenographers. Likewise, the Hartford Accident and Indemnity Corporation was unable to persuade seventeen of its stenographers to retrain as machine operators, and appears to have finished up hiring three trained operators and two former typists instead.

In general, however, lack of enthusiasm for the machines on the part of executives scuppered the hopes of office management experts for efficiency gains. The centralization and pooling of clerical work was crucial to their plans, but although one might have been able to impose unpopular work patterns on stenographers in the name of efficiency one could hardly impose them on one's superiors. A few firms, including New York Life, had central stenographic departments but had not bothered to centralize use of their handful of dictating machines, leaving these with their enthusiasts. In fact, the office management experts held that attempts to experiment with the use of machines by introducing them piecemeal were bound to prove misleading. Firstly, such an experiment would inevitably be distorted by its artificial nature. Only the conversion of an entire department could provide meaningful results. Secondly, if machines were adopted in this fashion then the chance to redesign systems and procedures around the

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possibilities opened by technology would be lost – and hence so would the opportunity for genuine improvements in efficiency.[87]

Like many other kinds of technology, dictating machines were not inherently efficient. They allowed a certain kind of work to be done rapidly, but that work was qualitatively as well as quantitatively different from conventional stenography. To realize an increase in efficiency, the dictating machine demanded centralization of transcribing work, the weakening of social ties between dictators and stenographers and the imposition of a very dull and routine work pattern on the machine operators. Most executives were unable or unwilling to make that adjustment, not least because it demanded a personal sacrifice of prestige. However, used in an ad-hoc manner the machines were popular with certain managers as a supplement to traditional stenography and a tangible embodiment of modern efficiency. As used, the dictating machine was a source of symbolic efficiency and practical inefficiency.

## The Fate of Systematic Office Management

The dawn of a golden age of office management seemed to hover eternally just over the horizon. The capable, respected executive office manager with authority over all clerks, all administrative procedures and all aspects of organizational interconnection was to remain a figment of Leffingwell and Galloway's imaginations. Both men were successful in as much as they sold a good number of books, became well known in their field and were called upon for their professional services. They were unsuccessful in their broader goal of establishing the office manager as an executive rather than an administrator. Where office manager became a recognized job, it was as something between a departmental personnel manager and a head clerk. In 1929, forty members of the National Association of Office Managers were asked to rank their duties in order of importance, from one to twenty-three. When the results were tallied, controlling the

[87] L Urwick, Organizing a Sales Office (London: Victor Gollancz, 1928), 187-88.

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office budget or the budgets of other departments ranked only eighteenth and nineteenth in importance; planning for the office came last. The most important duties of the average office manager were far more mundane – those of a supervisor rather than an executive. Ranked first in the survey was the hiring and firing of "clericals" (chosen by 17.7 percent of the sample as their most important duty). Next in importance came buying office equipment (11.9 percent) and establishing office routine (also 11.9 percent). [88]

At the same time, we should acknowledge that even the fact that a sample of forty office managers existed, and that there was an association to poll them, represents a form of success for the profession. Although Leffingwell failed to live up to his own rhetoric, that rhetoric may itself be seen as a tool that was essential to achieve the level of success he enjoyed, rather than as a sensible yardstick against which to measure his achievement.

Leffingwell himself lamented the slow pace of change in his 1926 manual. His suggested solution was simply to work harder and more scientifically to convince the skeptics. His prose held a hint of desperation, even as he continued to assert his faith in "the brilliant future for those office managers who have arrived at the recognition of the office as a major function of business and the equal importance of the work of office management with every other business activity." He blamed the lack of respect for clerical work on the part of senior managers, and their consequent failure to take seriously the office manager. "The main reason for the general low standing of the office manager in the business world is to be found in management itself. The chief executive of a company as a rule does not regard the office as a very important part of his business, though he is usually quick to blame the office manager for many of his troubles." This, he admitted, prevented the building of a credible profession, because any man with executive

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[88] MacKay, "Managing the Clerks".

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potential who somehow strayed into the field would be sure to transfer out at the first possible moment.[89]

His last major work, a new textbook presenting his material in a more coherent and slightly less verbose manner, appeared in 1932. He reproduced exactly all his earlier rhetoric and complaints about the role of the office manager, but added a remarkable coda in which he renounced the term itself. What had once seemed a bold and modern replacement for the inadequate "Head Clerk" was now irrevocably tainted by failure. "The title of 'office manager' must also give place to another - it is no longer sufficiently comprehensive and it represents, in the minds of the other major executives, a minor position to be occupied by an unimportant, low-salaried, small-minded, petty-detail man, with no perspective and a limited knowledge of management."[90] His new term, "Manager of Clerical Activities," was not widely adopted.

Nor were matters to improve before the end of World War II. Leffingwell died in 1934, but his final textbook was posthumously revised in 1943. Needless to say, the future remained bright. Even its final version, published in 1950, continued to preach the virtues of Scientific Management. Well into the 1950s, office management textbooks continued to introduce their subject with praise of Taylor, Leffingwell and Scientific Management, and continued to boast that careful study was gradually uncovering the empirical truths behind administrative practice. They continued to treat layout of the office, procedures, forms, filing and office machinery as central to the Office Manager's job. At the same time, their authors gradually acknowledged that the Office Manager was more a "service executive" than a strategic thinker, and that he should expect to report to a comptroller or vice-president rather than be demand to be one. The dream of executive power through administrative systemization passed instead to a new group shaped by the administrative challenges of World War II - "systems and procedures" specialists within

[89] Leffingwell, Office Management, 108 and 15.
[90] Leffingwell, Textbook of Office Management, 401.

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corporate-level staff management. These men were keen to claim descent from Taylor but insisted that they were the first to bring the insights of his factory work to the office. Leffingwell was never mentioned in their circles. As Leffingwell finally came to fear, the office manager of today is a mere clerical supervisor – powerless in the face of technological specialists with their own plans for organizational transformation.[91]

## Leffingwell's Legacy

Almost no firms adopted grand, custom-engineered Office Management systems to manage their clerical production. When executives voted with their checkbooks, they ultimately favored the tangible and unthreatening presence of office machinery and the calculated flattery of its salesman over the radical claims of the scientific manager. By acknowledging, the managerial marginality of groups such as the office managers, something that earlier accounts have often been unwilling to do, we expose the historically contingent nature of the professional hierarchies that emerged between different kinds of managerial and technical specialist. Despite its limited success, the office management movement raised fundamental questions about the nature of managerial authority and the limits of technology, efficiency and "system" as a tool for organizational transformation.

Was systematic office management ignored simply because its program of measurement, standardization and centralization was impossible to carry out in the non-routine setting of the office? This is unsatisfying as an explanation, because offices with several hundred clerical workers do involve substantial amounts of highly structured activity. Most tasks can be reduced

[91] For example, all the textbooks cited below continue to claim the mantle of Scientific Management and either dedicate the book to Leffingwell or thank his National Office Management Association: Harry L. Wylie, Merle P. Gamber, and Robert P. Brecht, Practical Office Management (New York: Prentice Hall, 1937), William Henry Leffingwell and Edwin Marshall Robinson, Textbook of Office Management (New York: McGraw-Hill, 1950) and C L Littlefield and R L Peterson, Modern Office Management (New York: 1956).

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to a simple and efficient routine - if sufficient investments of time and money are made and substantial loss of flexibility is accepted. Think, for example, of the more recent accomplishments of McDonalds restaurants and telephone call centers.

A better explanation is that firms were able to ignore systematic office management techniques because clerical workers were cheap enough to use inefficiently. Taylor's minute attention to machine shop productivity was justified not because of the savings in wages but the more productive use of the huge amounts of capital invested in the machines. Here is where Leffingwell's belief in the universality and managerial orientation of Taylorism led him astray. The machine shop was a vital part of a factory, making its mastery a source of considerable prestige within the engineering and management communities. These machines were very capital intensive, and so their efficient use provided added profits far beyond those derived from reduced wage bills. It was Taylor's status as the foremost production engineer of his day that originally made companies willing to turn their factories over to him as a consultant. Once given control, he was able to argue that delivery of the promised production efficiencies demanded systematic reorganization of inventory management, supervisory techniques, incentive systems and the other elements of the emerging Taylor System. But even so, Taylor ultimately failed in his attempt to extend the technician's reach from the machine shop into the executive suite.[92]

The office, on the other hand, was seen by ambitious managers as a backwater. While Taylor began with authority over machines and tried to turn this into control of managers and workers, his would-be acolytes began with supervision of clerks. The expensive time of expert consultants and bright young managers was hard to justify through the more efficient use of desks, chairs, and poorly-paid file clerks. Such costs would compound themselves, because once

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[92] See Frederick W. Taylor, "On the Art of Cutting Metals," *Transactions*, American Society of Mechanical Engineers, 28 (mid-November 1906). Its reception and promotion are discussed in Kanigel, The One Best Way : Frederick Winslow Taylor and the Enigma of Efficiency, 387-89.

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a system was put in place it required continued expert involvement to update it to changing needs. Because clerical workers had standard skills and were largely interchangeable, there was no urgent need to test or train them. Knowing the most efficient way to open an envelope could never compare to knowing the most efficient way to cut metal.

This is better, but it is only half the answer. For if clerical efficiency was a matter of such indifference, why was it virtually the only message used to sell any piece of office equipment or machinery, from paint, desks and floors to paper, adding machines and files? We must step back from the perspectives of the actors themselves and recast "system" and "efficiency" as cultural resources drawn upon in pursuit of many different ends, rather than as an empirical property of one or another approach to management.

Office management experts certainly tried to use their technical mastery of systems and machines to legitimate their claims of substantial organizational power. In practice, the reverse process by which equipment salesmen traded on the cultural power of system and expertise was more powerful. It was this availability of alternative sources of efficiency that undermined hopes of fundamental reorganization. The reformers' vision of expert power through the widespread custom design of systems according scientific principles could not stand up to the seductive charms of ready made machines and systems. Because efficiency was already supposed to have been engineered into them, the machines could be dropped into place, or integrated into existing work without the mess and controversy of systematic change. Even the figure of the expert consultant was thoroughly appropriated, and used to sell standard systems and machines. The rhetoric of the systematic Office Management experts could boost demand for the quick-fixes and machines of others, but was not powerful enough to engender the small revolution they sought or to grant them the executive status they sought. There is a certain irony here, for a movement attempting to claim the authority of engineering and the ability to transform the office into a well run machine was eclipsed by an industry selling actual machines. How could the vagueness of

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metaphor stand against the tangible, physical presence of a bookkeeping machine or a Dictaphone? Lacking Taylor's authority over the machine, they were ultimately at its mercy.

Over and above these considerations, administrative efficiency remains very hard to measure – unlike the more tangible output of the factory. Indeed, a heated debate still rages today over whether the trillions of dollars spent on computer systems have made business more or less productive. Leffingwell's measurement and production bonus techniques now seem hopelessly clumsy and simple-minded, but attempts to simplify the physical flow of paperwork, standardize and improve forms and prune unnecessary reports have employed an every growing army of consultants from the 1950s to the present. As such choices so often are, the choice facing top managers was never really one between science and tradition, or between efficiency and anarchy. They chose between different sets of experts, each with rival claims to efficiency and science.

The reformers sought to bridge the gap between the efficient performance of clerical work and the design of the administrative and communication systems of which it is a part. This gap opened with the separation of clerical and managerial duties, and was growing ever wider. It could therefore only be bridged by having clerical and executive decisions made by the same person, and having that person dictate in minute detail the performance of clerical tasks. It demanded a functional centralization of all administrative work, which by its nature must physically take place across the entire firm. However, long-term trends in organization led away from centralization of such tasks, and the messy lines of command created by experiments in functional management. This trend saw its ultimate expression among a celebrated handful of pioneering companies such as DuPont and General Motors that moved to structure their divisions by market or product, rather than by function. The humdrum aspects of office management, like all operational decisions, were increasingly delegated to junior managers within specific divisions. In contrast, the strategic aspects of office management, including corporation-wide standards for information flow and structuring of communications between divisions, were

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redefined as the core functions of senior corporate management – and so would not be trusted to a technically oriented office management specialist. What centralization did come to the management of office workers was achieved via personnel departments, not executive office managers. This failure illuminates the final separation of executive management from routine administration.

As we shall see in the next chapter, the Second World War and its aftermath provided fertile ground for the growth of administrative specialties and their organization in separate, staff departments. The organization Leffingwell founded, the National Office Management Association, attempted to involve itself in the new field of administrative computing in the 1950s and 1960s, although without great success. During the same period the American Management Association followed its pioneering discussions and reports on office management with a leading role in the popularization of electronic data processing and the dissemination of a new conception of the computer as the heart of a new "Management Information System". Like office managers, the operations research and data processing specialists, whose importance within the corporation has increased steadily since the 1950s, claimed to hold universally applicable expertise in information processing techniques. The added mystique, expense and complexity of computer technology proved a more stable basis for such claims than had expertise in bonus payment schemes and form design.

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# 3. SYSTEM MEN AND MANAGEMENT SCIENTISTS

## Management in the 1950s

The corporate computer department did not spring, fully formed, from the head of IBM. Although the technology of the computer was new, the tasks it performed where not. Neither were the ideas surrounding it. This chapter, and the one that follows it, explore three occupational groups during the first half of the 1950s, in the years immediately prior to the general application of the computer to business administration. The three groups were the so-called "systems men" (staff experts in administrative techniques), punched card technicians and operations researchers. Each came to identify closely with the computer, and each group was largely assimilated into corporate computer departments over the course of the 1960s. Their origins, however, were quite distinct. Indeed, it is only by understanding their different cultures and concerns that we can hope to make sense of the corporate computer department as it eventually develops, or of the schisms and controversies that continued to envelop the computing field.

Like the office managers of the 1920s, each of these groups made deliberate and vigorous attempts to establish itself as truly managerial. In this they followed Leffingwell's attempts to achieve managerial recognition on the strength of expertise in the techniques and technologies of efficient administration. They faced the same many of the same problems, and adopted many of the same tools. Each of the new groups in one way or another managerially marginal, and each tied its identity and aspirations to the establishment of a particular corporate department. Each formed one or more professional society, published journals, held conferences and attempted to raise the status and consciousness of its practitioners. Yet despite these common aspirations, the approaches taken by the three groups, and indeed their conceptions of professionalism and management, differed sharply from each other and from the office management pioneers.

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The 1950s were a crucial decade in the evolution of corporate management, a period during which many of the innovations that were to characterize the American managerial system of subsequent decades were spreading widely but were not, as yet, entirely standardized or completely understood. From the modern concept of the MBA to the distinction between line and staff management, much of what we now see as unremarkable was new and exciting. These large scale transformations involved millions of individual adjustments and realignments of identity, during which many new and existing groups sought to boost their own position within the emerging corporate order.

To understand how the systems men, operations researchers and punched card technicians saw their world and though about their own relationship to management, we must therefore consider for a moment the more general shifts occurring within corporate America during this era. American business grew by leaps and bounds during the 1940s and 1950s. National economic mobilization to support the war effort was followed by successful re-conversion to satisfy consumer demand pent-up since the onset of the Depression. Following re-mobilization during the Korean War, the new cold war economy combined elements of the wartime defense and scientific spending by the government with this consumer-driven growth. These good times were reflected in the fortunes of individual firms, many of which expanded and diversified well beyond their pre-War boundaries. Large, technologically focused firms thrived.

Widespread adoption of the decentralized, multidivisional structure was another development of these years. Although business historians are well aware of the pioneering efforts of firms such as DuPont and General Motors in the development of this mode of organization, it remained something of a novelty until the 1950s. Its adoption reflected a new level of self-

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conscious attention to corporate form, the role of managers and the techniques of administration within the world of business. With it came a new concern with the role of the manager.[93]

Not everyone was thrilled by these developments. Especially when looked at from the outside, the corporate world of the 1950s could appear a terrible place. It looked that way to muckraking sociologist C. Wright Mills, author of the highly influential 1951 work White Collar: The American Middle Classes. Miles called the white-collar man "more often pitiful than tragic... he is pushed by forces beyond his control, pulled into movements he does not understand.... never talking loud, never talking back, never taking a stand." The defining characteristics of this class were its mediocrity, its "terrible alienation," its lack of dignity or historical purpose, and its domination by others.[94]

Mills explored the class position of the new white collar workers, and in particular the relationship of managerial work to traditional professions and to clerical work. He argued that an old middle class of independent professionals and entrepreneurs had been replaced by a new middle class of pitifully dependent corporate employees. At the bottom of this class, regimented clerks and salesmen replaced small business men. The old, independent professions of medicine and law had been "surrounded and supplanted" by new, bureaucratic professions as "a result of the technological revolution". Mills diagnosed "the victory of the technician over the intellectual" and a parallel development in the lower ranks of management where "the middle-class man no longer owns the enterprise but is controlled by it." But Mills also rejected the idea that management formed a distinct class, insisting that an executive "*is* a powerful member of the propertied class." Dismissing the idea that the separation of management from ownership had

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[93] Neil Fligstein, "The Spread of the Multidivisional Form Among Large Firms, 1919-1979", American Sociological Review 50(1985):377-91.

[94] C. Wright Mills, White Collar: The American Middle Classes (Oxford, UK: Oxford University Press, 1951), xii.

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created a "managerial revolution," he wrote "'[T]he Managers' are often thought of as scientific technologists or administrative experts having some autonomous aim. But they are not experts in change of technology; they are executors of property." For Mills, therefore, the executive would always be a mere extension of capitalist control – having more in common with owners than with technicians, middle managers and white collar workers.[95]

Another critic was journalist William H. Whyte who wrote in The Organization Man of the terrible conformity and monotony of corporate life. Completing the trilogy was Wilson Sloan, with his book The Man in the Gray Flannel Suit. These remain our dominant images of corporate life during the era – rank upon rank of identically dressed junior managers with hats and briefcases, working their way up the greasy pole through passivity, conformity and intellectual vacuity. (In popular culture, the familiarity of these images of the corporate past have been greatly strengthened by advertising agencies and management speakers using them as a foil to the new, hip, postmodern and altogether technologically advanced styles of life and management supposedly associated with the information society).[96]

The onus was therefore on those who saw the modern corporation as a force for moral and cultural progress as well as material betterment to spring to its defense. Peter Drucker, the first and most intellectually engaged of the post-War management gurus, made the manager into a profound and heroic figure. While Taylor had respected management only in as much as it followed the scientific dictates of efficiency, Drucker celebrated the manager as a leader of men and the recipient of a considerable social powers and responsibilities. Drucker gave business leaders not only the self-image of the modern manager, but also discovered – in the offices and plants of General Motors – the shape (or as he put it, "concept") of a new kind of corporation.

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[95] Ibid, pages 102-120 and 160.
[96] William Hollingsworth Whyte, The Organization Man (New York: Simon and Schuster, 1956).

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Intertwined with the decentralized corporate institutions of General Motors he found a new and more exalted kind of modernist manager, charged with a historical mission to improve society.[97]

General Electric served as another exemplary institution, in its commitment to decentralized organization, its faith in the power of managerial education, and its attempt to create a class of managers equipped with the tools to manage any part of the company. Talented young managers were educated at Crotonville, its internal business school. As they rose through the ranks they were liable to be moved many times, to different plants, different states and, for the most successful, fundamentally different businesses. According to the company's president, Ralph J. Cordiner, in his 1956 book New Frontiers for Professional Managers, the hallmark of the modern manager was expertise in management itself, rather technical knowledge of the internals of gas turbines, lamps or electronics.[98]

For enthusiasts such as Drucker and Cordiner, the corporation was a powerful engine for progress, and the professional manager was its driver. Its formal structure was elaborate and hierarchical, but this very explicitness created clear avenues for advancement. The ambitious young man could seek his fortune in the fundamentally meritocratic world of management, where meeting carefully defined objectives would trigger promotion to the next level. The corporation created its own opportunities for internal advancement, even as it diminished the prospect for entrepreneurial success outside its bounds. As a result, managerial culture turned inward. Managers were expected to develop loyalties to the firm as a whole, rather than to specific divisions. Social hierarchies firmly rooted in one's place in local society were partially replaced

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[97] Drucker's most important early works were Peter Ferdinand Drucker, Concept of the Corporation (New York: John Day, 1946) and its sequel Peter F. Drucker, The Practice of Management (New York: Harper & Brothers Publishers, 1954). An intelligent summary of his career is given in Jack Beatty, The World According to Peter Drucker (New York: The Free Press, 1997).

[98] Ralph J Cordiner, New Frontiers for Professional Managers (New York: McGraw-Hill, 1956).

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by the firm's internal castes – plant, divisional, group, and corporate managers. Within these broader categories were managers of important divisions, managers of small divisions, well connected managers, managers who would never be promoted. And beneath all these managers, were endless ranks of engineers, technicians, clerical workers, factory workers. These fell into different classes – white collar versus blue collar, skilled vs. unskilled, hourly paid vs. monthly paid.

Attempts to transform management into a more self-conscious and professional occupation led the Harvard Business Review to publish articles during the 1950s and early 1960s on topics such as the "philosophy" of management, the social responsibility of business and the relationship between capitalism and Christianity. This increased focus on the higher qualities of the American business system was in part a reaction to the political situation during the 1950s. The insidious threat of global communism demanded a moral justification of the superiority of corporate capitalism as more than mere self-interest. Within management theory, the rise of the Human Relations school placed a premium on the achievement of industrial harmony through increased attention to the psychological and human needs of workers. At the same time, American business was learning to live with big labor, and both cooperated in their defense of the American system. Some influential firms, such as Kodak-Eastman, relied on expanded programs of benefits and welfare capitalism to ensure the loyalty of their employees and stave off unionization.[99]

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[99] The more intellectually inclined segments of the business press, particularly the Harvard Business Review, paid particular attention to the human relations movement. See, for example, William Foote Whyte, "Human Relations Theory: A Progress Report", Harvard Business Review 34, no. 5 (September-October 1956):125-32. These articles appeared as part of a broader push to demonstrate the moral superiority of the American business system at a time when Soviet accomplishments appeared to threaten it. In this newly introspective mood, the HBR published George Albert Smith, Jr., "Questions the Business Leader Should Ask Himself", Harvard Business Review 34, no. 2 (March-April 1956):49-56, Thomas C Cochran, "Business and the Democratic Tradition", Harvard Business Review 34, no. 2 (March-April 1956):39-48, Harold L Johnson, "Can the Businessman Apply Christianity?" Harvard Business Review 35, no. 5 (September-October 1957):68-76, Raymond A Bauer, "Our Big Advantage: The Social

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Drucker had heralded the emergence of new forms of corporate organization, as well as a new managerial class with a broader conception of its own historical responsibilities. By the early 1960s, managerial interest seemed much stronger in the former than the latter. Alfred Dupont Chandler's publication of Strategy and Structure was both a search for the origins of this new concept of management and an influential crystallization of its assumptions. The book described the process by which a small number of innovative managers, most importantly at DuPont and General Motors, had invented a new form of multi-divisional organization during the 1910s and 1920s. The organization chart, insisted Chandler, was not something that managers should take as a given. Rather they should determine the overall strategy of a company and design an organization structure capable of realizing this strategy. If the strategy called for the company to produce products for several distinct markets (either geographically separate or distinct in terms of their requirements) then a decentralized, multi-divisional form would prove the most effective. This conception of the professional manager as someone concerned above all with the definition of strategy, and the creation of structures and mechanisms to steer the company towards it, proved widely influential. Chandler suggested that the successful organization builder was likely to have formal education (often in engineering) and a "rational, analytical outlook." While Chandler used many archival documents and interviews to tell his story, his abiding interest in the executive's view of corporate organization has been traced to his first hand experience of organization in the U.S. Navy and his family's long association with the

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Sciences", Harvard Business Review 36, no. 3 (May-June 1958):125-36,Charles A Nelson, "The Liberal Arts in Management", Harvard Business Review 36, no. 3 (May-June 1958):91-99 and Benjamin M Selekman, "Is Management Creating a Class Society?" Harvard Business Review 36, no. 1 (January-February 1958):37-46. On post-war welfare capitalism see Sanford Jacoby, Modern Manors: Welfare Capitalism Since the New Deal (Princeton, NJ: Princeton University Press, 1997). On the attempts of business during the 1950s to present itself as central to the virtues of the American way of life see Elizabeth Fones-Wolf, Selling Free Enterprise : The Business Assault on Labor and Liberalism, 1945-60 (Urbana, IL: University of Illinois Press, 1994).

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DuPonts. Like Drucker, Chandler found something heroic inside the gray flannel suit and something noble in the ziggurats of the managerial hierarchy.[100]

## The Systems Men

In 1944, a number of corporate staff specialists met in Philadelphia and began the process of setting up a new organization that would further the acceptance of modern administrative techniques. The Systems and Procedures Association of America (SPA) received its charter in 1947. The members of the association called themselves the "systems men". Its leadership saw the systems men as vanguard of a broader systems movement within corporate administration, intended to bring the proven methods of Frederick W. Taylor, industrial engineering and the new "management science" to the neglected and sleepy world of white collar work. The systems men considered themselves administrative generalists, aspiring to true managerial power as the trusted assistants and advisors of top management. Their challenge was to promote their putative mastery of administrative mechanisms as simultaneously being a well-defined professional area of expertise and a truly managerial activity.

For the systems men to succeed in their mission of collective mobility into the upper ranks of management, they had to win recognition by executives as more than just clerical specialists and narrow technicians. Like scientists and engineers, the systems men claimed to possess a body of objective knowledge and techniques qualifying them to make superior decisions within a particular technical domain. But their task of legitimation was uniquely difficult because their claimed domain was management itself. To succeed, they had to shift the

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[100] Chandler, Strategy and Structure. On Chandler's background, see David A Hounshell, "Hughesian History of Technology and Chandlerian Business History: Parallels, Departures, and Critics", History and Technology 12(1995):205-24. For a reaction against the claim that management should become more professional by adopting ethics, a service motivation and social responsibility see Paul Donham, "Is Management a Profession?" Harvard Business Review 40, no. 5 (September-October 1962):60-68.

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barriers between the technical and the managerial erected during the early twentieth century to protect and demarcate managerial authority from that of engineers.

Economic mobilization during the Second World War had brought an incredible increase in industrial output and placed a premium on the integrated planning of production and distribution. Work simplification, printed forms, organizational charts, process charts, and instruction manuals were put to service on an unprecedented scale. This wartime experience impressed many administrators with what could be accomplished when organizational structures and procedures were carefully crafted toward the achievement of specific ends, rather than accreting slowly over time. According to Leslie Matthies, one of the most prominent systems boosters of the 1950s and 60s, with advent of war attempts to boost production ran into a "mass of red tape and confusion" caused by inefficient paperwork and procedures. "All of a sudden a man who knew anything at all about systems work was in demand. People, from shoe clerks to mining engineers, had to be made into systems engineers overnight. These neophytes were expected to design organizational charts, set up operating manuals, survey paperwork systems, install complicated office machines and design forms on which millions of man hours were to be expended." In at least some firms, the war served only to strengthen pre-existing efforts: other writers sometimes credited the increase in paperwork caused by the New Deal programs of the mid-1930s with a seminal role in the creation of clerical methods work as a staff function.[101]

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[101] See Leslie Matthies, "The Systems Side of the Story", Systems and Procedures Quarterly 3, no. 1 (June 1952):4-6, 18. For the importance of the New Deal, see R. L. Ornsby, "Are Methods Men Selling Themselves Short?" Systems and Procedures Quarterly 4, no. 4 (November 1953):3-5,15.

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If he manages through systems, the boss will have time for leadership.

**Figure 6: The systems men presented themselves as the trusted assistants to top managers.**[102]

But while the systems men had convinced each other of their worth, they had a great deal of work still to do before their place in the firm was assured. As Matthies continued the story, "By the time Word War II ended, management all over the United States had a god (sic.) taste of what systems activity could do for industry, yet in many cases they fired the systems department wholesale right after VJ Day." Ever the optimist, Matthies viewed this dispersal as a chance for good systems men to spread the gospel to new employers.

The association's leadership was dominated by heads of the systems and procedures departments of large and very large industrial firms. For example, in 1950 its two vice presidents worked for General Foods and Montgomery, Ward & Company. Its president, Raymond Cream, was from the ill-fated Baldwin Locomotive Works. Consulting and professional services firms were never without some representation though -- Cresap, McCormick & Paget (a leading

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[102] Leslie H Matthies, Personal Effectiveness for the System Man: From the Systemation Letter (Colorado Springs: Systemation, Inc., 1968), 104.

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management consulting firm) supplied a director and Price Waterhouse an assistant editor of its journal. Other leaders in this era came from the oil, finance and insurance industries.

The career of John Haslett, manager of methods and procedures for the Shell Oil Company, was a model for his contemporaries. Haslett was a prominent systems man for more than two decades. He helped to found the SPA, was the first editor of its journal and served for a time a vice president. Haslett went to Shell in 1947, after working in the Army during the war to set up shipping controls and procedures. At Shell he pulled together initially uncoordinated efforts in office procedures, reports management and office equipment to establish broad authority over administrative methods. The result was an increased centralization of clerical work, with greater use of specialized and automated machinery such as punch-card systems. Haslett was a frequent speaker and writer on systems management, generalizing his own experiences into a professional agenda. Many of Haslett's articles were concerned with the inevitable evolution of the systems man and the systems and procedures department, from narrow methods specialist to systems-oriented analyst.[103]

The terms, "systems," "procedures," and "methods" covered similar ground. In the early days of the SPA "methods" was the best established of these terms in corporate use – the methods analyst might be known less formally as a methods man and work in a methods department. But to the systems men, "methods" was a restrictive term – suggesting too much of a focus on detailed execution and not enough on broader managerial issues. According to Richard F. Neuschel, the intellectual leader of the systems and procedures movement, a procedure specified what work should be done, when and by whom – whereas a method specified only how to do the work. "Systems" implied a much broader mandate, although its exact meaning was unclear. Neuschel defined a system as "a network of related procedures." System was, however, clearly

[103] For a profile of Haslett himself, see Arnold E. Keller, "The Man Behind Systems at Shell Oil", Business Automation 7, no. 2 (February 1962):20-24.

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the highest-level term of the three, the most managerially relevant and the one closest to consideration of overall organization. As Haslett wrote in 1950, "The systems man can no longer be solely methods minded. He must be management minded."[104]

This systems movement took place almost entirely within the social world of corporate management, and the immediately adjoining fields of business schools and consulting firms. (Although military experience was a formative influence on this movement, military administrators do not appear to have been frequent participants in the SPA). Nevertheless, it was an attempt to achieve upward group mobility for a class of managerial technicians, from narrow technical specialties to a broad staff authority over corporate management. Its partisans tied their fortune to a new corporate function, focusing all their attentions on the creation of a new box in the right place on the organization chart. They were concerned above all with the establishment of the systems and procedures department as a respected, autonomous and well-funded group – able to sweep away antiquated methods and spread efficient practice throughout the firm. The papers given at their International Systems meeting and published in their magazine Systems and Procedures Quarterly exhibit a fixation on questions of status and power – the name of this group, to whom its leader should report, how large it should be, what work it should undertake and how top management could be convinced of its utility. As the Controller of General Foods told an assemblage of systems men in 1951, "Many of you seem more concerned about to whom you report than about the results you are attaining--you also worry about your title."[105]

Although many SPA members worked in departments with name like "Organization and Methods," "Office Methods," "Business Procedures," or "Administrative Services," they all

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[104] J. W. Haslett, "The Coming Revolution in Paperwork", Systems and Procedures Quarterly 1, no. 1 (March 1950):1, Richard F. Neuschel, Streamlining Business Procedures (New York: McGraw-Hill Book Company, 1950), 10.

[105] Wayne C. Marks, "The Systems and Procedures Function", Systems and Procedures Quarterly 2, no. 1 (March 1951):3-5, 8, page 3.

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considered themselves and their colleagues "systems men," and when they talked about the desirable form of their department they overwhelmingly called it the "Systems and Procedures" department. The systems men saw this broad and powerful department as the natural endpoint of the evolution of their own departments, whatever their current name or responsibilities. They looked to each other for reassurance and guidance, not to others within their own organizations.[106]

Most SPA members worked in corporate staff positions, though consultants and business school professors played an important role in setting its agenda. They were frequent presenters at the association's meetings, and shared both its concern with improved administrative techniques and its promotion of a strong systems and procedures department as the vehicle for spreading these techniques. Many of the most vocal figures of the systems movement moved backward and forward between corporate positions, academic jobs and private consulting practice. (In this chapter I use the term "corporate systems men" to refer to those employed within corporate staff positions, and the more general term to include academics, consultants and business equipment suppliers who were members of the SPA or who were closely allied with it). Even Haslett himself became a consultant in the end, after two decades with Shell. Successful systems men seem to have trodden the path to consulting far more readily than that to top management – despite their frequent assertion that systems work should be the best grounding for future executives.

## Tensions of Line and Staff

It was their insistence on systems as a corporate, staff level function that truly separated the systems men of the 1950s from the office managers and systematic managers of previous decades. To quote the association's treasurer, "There is nothing new about systems and procedures; the only new thing is the staff activity concept." The systems men were staff experts

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[106] Haslett, "The Coming Revolution in Paperwork".

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and internal consultants – though in practice most worked somewhere in the depths of the accounting department. They tried to separate technical expertise in the efficient use of administrative techniques from the executive role that had formerly accompanied this mastery.[107]

The separation of line and staff management functions was not altogether new during the 1950s, but neither was it entirely familiar. Its practical usage within some corporations preceded its general theoretical acceptance. The definitive statement of the concept, and one frequently referred to by the systems men, came from Lyndall Urwick in his 1943 classic The Elements of Administration. When he published this book, Urwick had been a leading British management writer for several decades. His background included studies of office organization and the leadership of a European organization called the "International Management Institute". The book's aim was to discover a kind of periodic table of fundamental managerial axioms by arranging the ideas of various management authorities in a matrix. Urwick thus claimed to have identified a core body of administrative knowledge that would serve as the basis for a new, more technical and more professional approach to management.[108]

> The art and science of administering the social groups, large and small, which are increasingly characteristic of our civilization, has emerged during the past quarter of a century as a technical skill. To-day, prolonged experience of a particular kind of group is of substantially less importance as a qualification than an ability to administer per se..... This development of a technique of administration, a body of professional knowledge without which those who attempt to manage people appear increasingly amateurish, is likely to have a profound effect on our institutions...[109]

This was very close to the image the systems men held of themselves as being technical experts in management techniques. In his discussion of "organization as a technical problem" Urwick likened the design of organization structures to the craft of the mechanical engineer.

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[107] A. L. Mettler, "An "Old Shoe" Concept of Systems", Systems and Procedures Quarterly 1, no. 2 (June 1950):1-3.

[108] L Urwick, The Elements of Administration (New York: Harper & Brothers Publishers, 1943).

[109] Ibid, 7.

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"[T]he mechanization parallel can be very helpful in discussing organization. Another name for it, of course, is 'the engineering approach'." Indeed, he saw the future of management control in a blending of the techniques of engineering and accountancy. "The engineer began to apply his scientific training to accountancy problems. He appreciated how financial figures might add to his own knowledge of the process he was trying to manage and to formulate, however vaguely, a demand that all the accounting processes in any particular undertaking should be geared together as parts of a single system."[110]

Management discussion had long involved the discussion of different forms of organization. Frederick Taylor, for example, favored a strong central planning office coupled with a complex system of functional authority. A worker would be responsible to a number of different bosses, each responsible for a particular functional area (such as timekeeping or machine speeds). Others placed more stress on the "military" model of a strong hierarchical system of ranks in which each employee had only one direct boss. This made for a clean line of command and responsibility, since the risk of conflicting orders was removed. Urwick's contribution here came as part of his more general quest for synthesis. He suggested that both direct (line) relationships and function (staff) relationships were important, complementary and should be formalized at once. He dismissed reliance on either of these techniques in isolation. "It is a common delusion that a successful organization can be built up by applying one or other of the principles or methods enumerated, to the exclusion of the others. Writers on business talk of the 'staff and line form' of organization, or the 'functional form' of organization. Such views suggest a lack of observation of actual undertakings."[111]

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[110] Ibid. The first quote (on the engineering approach) is from page 35. The second (on the combination of engineering and accountancy) is from page 101.

[111] Urwick, The Elements of Administration, 68.

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The need for this separation of line and staff was most acute within large organizations, and in particular large organizations combining a number of different factories or divisional operations with a single corporate headquarters. In this hybrid form, each worker had only one direct supervisor, as in the military model, known as a "line manager". On the other hand, specialist staff managers would be granted an advisory role in dealing with some functional areas like personnel management or accounting. Urwick actually differentiated between functional relationships (currently ad-hoc, formed on the basis of knowledge) and staff relationships (in which the staff member did not hold power in his or her own right but acted on behalf of a superior, as a personal assistant). This sense of staff was the closest to its military origins, and did not imply particular functional expertise. Its use in business was, according to Urwick, both novel and difficult. (He stated that, "[i]n view of the delicate character of staff responsibilities, friction is inevitable unless they are formalized and explained carefully to all concerned. They have been applied very little by business up to the present.") The systems men often tried to portray themselves as staff members in this sense, closely assisting top management in the pursuit of important goals. In practice, however, their authority was more closely confined to specific areas of functional expertise – giving rise to a continuing fuzziness in their invocation of staff authority.[112]

With the shift to a multidivisional model of operations, staff specialists could work as managerial assistants within particular divisions, or within the central corporate management group. The systems men much preferred the latter. The manifesto of the systems movement was

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[112] The quote is from ibid, page 67. The term "line" is actually derived from the nineteenth century railroad industry, one of the first to implement such separation, because a railroad worker's primary responsibility was to a particular railroad line. The term "staff" had a long military history as a description of officers serving as assistants to generals and other commanding officers, sometimes performing specialized duties. It is believed to be of Teutonic origins, with the General Staff of the German army serving as a strong turn of the century example. See the OED2 definition of staff ($n^1$), particularly sections III.21, III.22.c and III.25.a.

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provided by Richard F. Neuschel in his 1950 book Streamlining Business Procedures. After spending the 1940s educating himself in clerical procedures for inventory handling while an employee of Sperry Gyroscope, Neuschel joined the management consulting firm McKinsey & Company. The book worked deliberately and persuasively to present better administration as crucial to organizational effectiveness. Neuschel's recipe for a "procedures research department" made intradepartmental coordination its crucial goal rather than the worthy yet narrow improvements in clerical efficiency he associated with specialist office management. The true "pay dirt in procedures research" would be uncovered only when the systems man addressed vital structural matters such as "the relationship between jobs and organizational units" and structural barriers to overall profitability. Neuschel firmly subjugated his analysis of specific tools and "work aids," such as surveys, flow charts and tabulating machines to this higher end.[113]

Neuschel used a broad conception of systems work, focused primarily on problems of interdepartmental coordination, as the foundation for his discussion of the proper location of the systems department. He quickly dispatched the idea that systems work could be accomplished on a line basis. A line manager could have neither the time, nor the specialist knowledge of techniques and machines to accomplish effective systems work. Furthermore, a staff specialist was more likely to be objective, and less "inhibited by tradition, habit or personal incentive." He then turned to the question of what kind of staff function systems work should be. His argument rested on the idea that, like any other group, systems men should report to the person with overall responsibility for the results of their actions. As he put it, "interdepartmental procedures are primarily a mechanism of coordination. Responsibility for coordination rests with the leader of the groups to be coordinated." Because its task was interdepartmental coordination, this ruled out reporting to the manager of any particular department. Neuschel also held that problems of

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[113] Neuschel, Streamlining Business Procedures. On the importance of reporting to the chief executive see 53. For his faint praise of the office manager see 49-50.

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conflict, duplication of effort, and skewed viewpoints would afflict any attempt to tackle this work through a committee.

The search for a suitable home thus moved further up the organizational chart. But Neuschel used the same argument to challenge the notion that the systems and procedures department should report to any kind of "functional division" – either to the controller or to an office management specialist. While admitting that an office manager might have experience with the efficient execution of office work, he insisted that this could at best amount to a knowledge of "methods," and encompassed neither procedures nor systems. As he put it, "development of interdepartmental procedures as a coordinating device requires substantially more than specialized skill in determining the best mechanical or manual means for performing office work... service of this character clearly does not encompass coordination of effort among operating groups." [114]

Systems and procedures groups often reported to the corporate controller, because of his general responsibility for administration. Sometimes this was directly, often it was via an assistant such as a deputy or a head of accounting. Neuschel was somewhat better disposed toward the idea of reporting to the controller, especially in paperwork-oriented industries such as life insurance where the controller might have been granted general responsibility for administration and the preparation of control data as "chief of staff" for the top manager. But he cautioned that this very authority might strip the controller of the objectivity needed to do the job: "[a]s the scope of the comptroller's operating responsibility grows, his department becomes merely one of the functional groups to be coordinated." [115]

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[114] Ibid, 50.

[115] Ibid, page 52. The position of Controller was created during the 1920s and 1930s in many corporations. It supplemented the better-established treasurer post, taking on the more administrative aspects of the firm's finances like accounting, taxes and payroll. By the 1950s many corporate controllers were on the same organization level as the treasurer. Controllership represented a move by accountants

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Through this elegant process of elimination, Neuschel reached the conclusion that the systems group must report directly to the top manager. Rather than usurping the authority of line managers, the systems men would be staff experts of the truest kind – the advisors and assistants of the most senior executives. With considerable flair, he presented this as the only means to "retention of responsibility by the chief executive," so that responsibility and authority would remain properly aligned. Although this logic was seized on with gusto by the systems men themselves, it was not as compelling to executives themselves. More than a decade later Systems & Procedures Journal still had to inform its readership that, "Statements to the effect that the systems functions should report to a top executive level have been made so many times that it is not surprising the impression exists that this idea is generally accepted. It is, however, very doubtful that anything approaching a majority of top management people hold this idea acceptable for their own companies."[116]

Neushel's message to the systems men was to think in high level, truly managerial terms about the functioning of the company as a whole. Following this message, the ultimate goal of many systems men during the 1950s was the adoption of a Management Improvement Program (MIP). The objectives of such a program were explained in 1950 by John B. Joynt, another senior SPA member with a rich background. Joynt headed Industrial Engineering for the American Enka Corporation, and had previous worked as a consultant (for Cresap, McCormick and Paget), in the armed forces during the war (the Control Division of the Army), and in government during the immediate post war period (director of Administrative Management Service for the Veterans Administration). The MIP involved chartering the systems and procedures staff to conduct an

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towards operational management, since although still a staff executive the controller was responsible for the husbandry of the firm's resources through budgets, measurements, standards and reporting systems - collectively known as the "control system". W. F. McCormick, "The Corporate Treasurer's Role", Financial Executive 31(January 1963):27-32, Pierce, "The New Image of Controllership".

[116] Richard W. Pomeroy, "The ? Box", Systems & Procedures Journal 14, no. 6 (November-December 1963):29.

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analysis of the major functions of the company and their systems. "In developing an organization manual certain functions may be eliminated or changed to a considerable extent." Only then, argued Joynt, could meaningful work simplification and measurement measures be put in place. "The individual programs blend logically into a smooth, well synchronized, company-wide management improvement program." [117]

A transcript of a 1958 seminar of systems and procedures department heads run by William C. Gill of Douglas Aircraft (a systems man with particular expertise in forms control) provides a rare insight into the problems presented by this relationship between staff and line. Gill himself, along with a number of his fellows, felt that, "[s]ystems, centrally organized, cannot be concerned with the content of departmental procedures matters." This fitted with Neuschel's call for a corporate systems group to focus purely on issues of interdepartmental systems. Gill argued that its responsibility here should be limited to making sure that these internal procedures complied with company policy – although as another participant pointed out, this would be difficult to do without looking at them. Time to issue and certify a new procedure varied between one and three months, giving rise to the question of what to do in the interim when a new "crash" procedure was required on an emergency basis. Some favored temporary agreements to allow their use while the official version was prepared ("we were getting temporary agreements between two or three department heads and I was being cut out of it").[118]

This kind of discussion demonstrates the problems inherent in trying to exercise institutionalized control of managerial procedures used by line managers from a theoretically "advisory" staff position. Systems men often lamented that a lack of support from top

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[117] John B. Joynt, "Planning Procedures for Profit: A Program for Administrative Cost Reduction through Improvement in Management", Systems and Procedures Quarterly 1, no. 1 (March 1950):4-10, 14-16, page 16.

[118] William C. Gill, "Managing a Systems Group in Defense Industries", in Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, ed. Gibbs Myers (Detroit: The Systems and Procedures Association of America, 1958).

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management made it impossible for them to enforce their ideas. Some argued that, as the guardians of the overall corporate interest, they should be given authority to unilaterally impose new systems, or at the very least should expect that top management would reliably side with them and push their ideas into use over the objections of the managers involved. To Neuschel, this whining was a sign of incompetence. "I have heard a number of staffs complain bitterly that they lack sufficient management understanding or support to put their programs over. I have heard others lay the blame on company politics.... we probably would all agree that the principle cause in each of these instances is incompetent personnel."[119]

The systems men loved to paint themselves as guardians of the overall corporate interest, against the selfish parochialism of departments. As the SPA's president remarked in his 1958 Keynote address "Systems underlies and is a part of every management action, directly or directly, consciously or unconsciously." Unfortunately, corporate management often failed to appreciate this. The leaders of the systems movement had defined the responsibilities of top management in a way that did not correspond with that held by most top managers themselves. Thus when systems men complained of not being taken seriously, as they frequently did, they did not just lament the insult to their profession, but seize on the slight as evidence that a manager had failed to understand his or her own role in the new order of things. "[M]anagement improvement... by implementing and installing better systems and procedures" was seen as a "duty" that executives could delegate but could not evade.[120]

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[119] R. F. Neuschel, "Development of Competent Systems Personnel", Systems and Procedures Quarterly 1, no. 4 (January 1951):24-28, page 24.

[120] The keynote speech is recorded in F. Walton Wanner, "Design for Controlled Professional Development", in Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, ed. Gibbs Myers (Detroit: The Systems and Procedures Association of America, 1958), 17. The latter quote is from Milton Reitzfeld, "Marketing the Systems Function", Systems & Procedures Journal 16, no. 6 (November-December 1965):30-35, page 30.

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The answer was to "sell" systems to corporate executives and line managers and to "educate" them as the power of the new approach. As Neuschel put it in 1950, "At least during the [systems] staff's first year of operation, its attention must be concentrated largely on gaining acceptance--on 'selling' its services...." The products to sell were not only individual reports and recommendations, but also the very worthiness of their profession. Another insisted that, "[t]he successful systems manager sells his program, his staff, himself, every minute of every hour of every working day." The amount of attention they gave at their conferences to quite basic techniques in effective presentation and report writing support their laments that most systems men lacked an ability to communicate effectively with management.[121]

Leslie Matthies eventually turned this sales job into the focus of his career. For most of the 1950s he was supervisor of Administrative Services for the Anaheim division of Northrop Aircraft. In this capacity he presented papers at systems conferences on basic communication, and taught a course on business English at Los Angeles City College. He was very active in the SPA, running its 1957 national conference, serving as president of the Los Angeles chapter and winning election as a national director. In 1958 he received the association's "Systems Man of the Year" award. But by 1960 he had quit Northrop, to head his own "Foundation of Administrative Research" in Tulsa, Ohio. Here he lectured on systems matters, offered a one year "Professional Systems Course," published a regular newsletter Systemation and wrote well illustrated educational booklets intended to spread professional awareness among systems men. In his various publications and speeches, Matthies returned again and again to the special nature of staff

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[121] Neuschel, Streamlining Business Procedures, 85. The quote on selling is taken from Reitzfeld, "Marketing the Systems Function", page 31. This sentiment was eternal -- see also Allen Y. Davis, "Selling the System", in Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, ed. Gibbs Myers (Detroit: The Systems and Procedures Association of America, 1958), Victor H. Roman, "The Systems Organization Must Be Sold", Systems & Procedures 8, no. 1 (February 1957):12-15.

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work and the need for the systems man to work cooperatively with line managers and to sell his ideas to them.[122]


Preach the basics of systems to all within your hearing.

**Figure 7: Throughout his career, Matthies constantly returned to the need to "sell" the benefits of systems work to all who would listen within one's own company.[123]**

Such a sales job could prove wearing and frustrating. Gill reported, "I've seen management actually exuberant about a systems program, and then the first test you put those guys to, the first time you really need that support, it's gone.... You have to sell them at the top,

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[122] See, for example, Leslie Matthies, "The Systems Function in Management", in Ideas for Management: Papers and Case Histories presented at the 1962 International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1962), Leslie H Matthies, "Systems: Functions, Relations, Pitfalls", Systems & Procedures Journal 16, no. 2 (March-April 1965):45-49.

[123] Matthies, Personal Effectiveness for the System Man: From the Systemation Letter, 45.

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you have to sell to the bottom, and you have to sell to the middle, and then by that time you have to sell again to the top - it's like trying to keep three balloons under water at once with two hands; when you push one down another one pops up." [124]

Others suggested that problems ran deeper than mere communication. Put simply, when a systems man came to study a department little good was likely to result for its manager. "[T]he inherent nature of systems work tends to make analysts unpopular if for no other reason than their ultimate function which requires criticism of the way a man is doing his job," claimed one systems man with an accounting background. Some commentators acknowledged that systems men were often poorly trained and disinclined to put in the work required to understand the needs of perfectly competent operating managers. Most, however, placed the blame on what an anonymous 1952 editorial called, "vested interests which resent any intrusion that seems likely to expose their antiquated and wasteful practices...." The editorial writer prescribed doggedness as the only cure for this – "even if they evade the first attempt at reform, sooner or later they will give up protecting those practices when they lean that the systems man does not give up easily and will attempt to improve the operation even if it should take years." [125]

## Generalists, Specialists, and Professionals

The systems men often referred to themselves as members of a profession. Despite this, the SPA never paid much attention to explicit matters of professionalization. It did eventually sponsor a textbook, but otherwise did relatively little in terms of education until the late 1960s.

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[124] The first quote is from Gill, "Managing a Systems Group in Defense Industries", 271 Systems men frequently addressed each other on the nature of the line-staff relationship - see Charles D. Boyle, "How to Integrate Line and Staff", Systems & Procedures Journal 16, no. 1 (January-February 1965):8-23 for an example. On pragmatic steps to increase communication skills see Richard P. Essey, "How to Increase a Systems Man's Ability to Sell His Ideas to Management", Systems & Procedures Journal 13, no. 4 (July-August 1962):16-20, Ralph E. Steere, "How to Win Management's Approval", Systems & Procedures Journal 13, no. 2 (March-April 1962):14-16.

[125] The first quote is from H. D. Kenney, "Systems from the Management Viewpoint", Systems & Procedures Journal 13, no. 3 (May-June 1962):10-13, 11. The editorial is Anonymous, "The Persevering Systems Man", Systems and Procedures Quarterly 2, no. 4 (1952):3

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Unlike the tabulating staff discussed later, its members rarely debated the merits of certification, pondered the perils and pleasures of state licensing or enumerated the attributes shared by more established professions such as accountants and doctors. Instead, they used "professional" as a rough synonym for "skilled, full-time specialist" – the professional systems man was assumed to be well trained, respected and unencumbered by extraneous duties.

For this reason, they never acknowledged that sometimes professional loyalties to the public interest and the betterment of one's profession and more narrow managerial loyalties to one's employer might come into conflict. By 1951 they had already adopted a code of ethics, but this was a singularly toothless document. A member pledged to advise his employer "honestly and wisely" and to cooperate with his fellows in "the advancement of systems and procedures." He or she was forbidden to accept commissions from suppliers on items sold to his employer or client (a prohibition that would actually weaken autonomy), to use the SPA's name to promote his or her services or to improperly use knowledge attained through the association of the condition of a fellow member's business. The code made no mention of any social responsibility beyond that to one's employer and fellow member. Neither was there any mechanism for enforcement of its modest strictures.[126]

An important but implicit contribution of professionalism to the thinking of the systems men was their assumption that systems was a universal kind of activity, one that should be carried out in pretty much the same way in every kind of company. Because of this concept that professional knowledge was generally applicable, they did not organize themselves primarily by industry sector. Although their conference program sometimes included sections on the problems of systems work in particular sectors, by and large their pronouncements on the proper

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[126] Systems and Procedures Association of America, "Code of Ethics", Systems and Procedures Quarterly 2, no. 2 (June 1951):10

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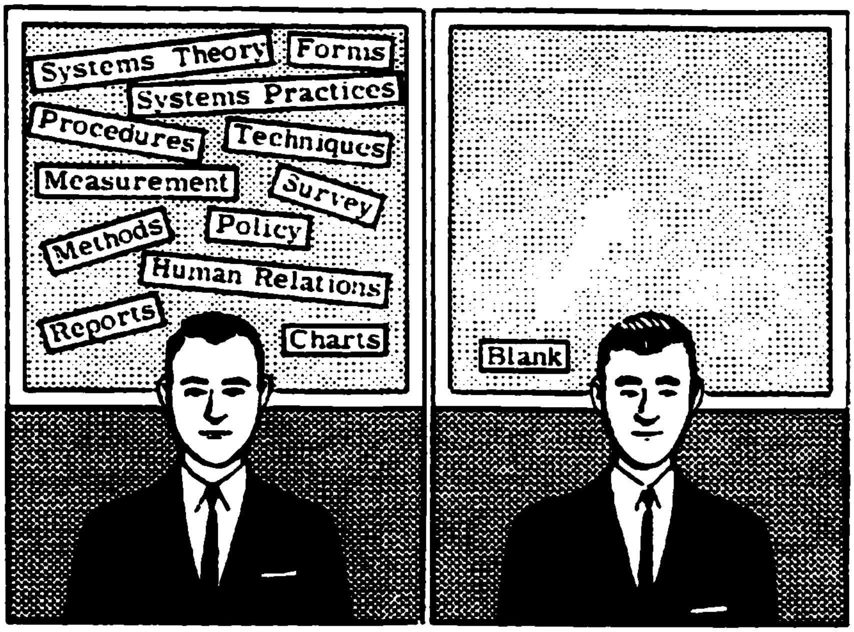
background, activities, and position of the systems man did not pause to differentiate between railroads, manufacturing firms or insurance companies.




To be effective, a man needs a rich systems/administrative background.

**Figure 8: Despite attempts to craft a coherent identity, the "systems" field remained a mish-mash of specialist techniques and ideas from other fields.** [127]

Still more importantly, the professional systems man was someone who had mastered the full range of systems techniques. In 1953, the manager of the Methods Department of the General Electric Illuminating Company addressed his colleagues in the SPA Cleveland chapter. He complained that, "eighteen years after the creation of the methods job as a staff function; methods men, management and educators are still groping for a concept of the job." As a result, systems work was still a collection of trades, rather than a unified profession:

> Some practitioners of the trade say methods work is simply the application of the principles of work simplification. Others say it's forms control.

[127] Matthies, Personal Effectiveness for the System Man: From the Systemation Letter, 13. Though this cartoon was from 1968, except for the addition of "systems theory" the list of techniques pinned on the board had changed little from the 1950s.

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> Still others hold it's procedures writing. Then there are those who maintain it's clerical work measurement, or organizational analysis, or procedures manual preparation, or something else. It is pretty clear that methods men have failed to establish a designation of their work, its scope, and the stature that it should have in the business organization plan.[128]

The answer, he contended, was professionalism. "[I]t is time for methods men to stop practicing a trade. The time has come for us to start building a profession...." He identified a three-point plan to accomplish this. "First, we must adopt a high-level, executive management approach to methods work. Second, we must develop ourselves, our capacity to do the job. And third, we must convince management that our approach is sound, and necessary..."

The identification of the systems man as a generalist was crucial to Haslett, Neuschel and the other leaders of the systems movement. A central theme in Neuschel's 1950 book was the need to make a collection of specialized techniques into a much broader kind of explicitly managerial expertise. His position at McKinsey gave him a particular stake in this. His firm was, after all, in the business of <u>management</u> consulting. A open-ended procedures program carried out directly for the chief executive for the purpose of improved corporate coordination would fit much better with McKinsey's carefully cultivated image than would a less exalted focus on technical efficiency. They presented generalism as something higher and more managerially relevant than any form of specialism. The generalist systems man was held up as a role model for older and narrower specialists, such as forms experts or work measurement specialists, to evolve themselves into. The systems man provided a more attractive collective identity for these disparate administrative specialists than did the more traditional role of office manager.

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[128] Ornsby, "Are Methods Men Selling Themselves Short?".

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Frequently mentioned specialties within systems work included:

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|---|---|
| Forms Control | Work Simplification |
| Reports Control | Office Equipment Standardization |
| Records Management | Punched Card Analysis |
| Documentation of Procedures and preparation of Company Manuals | Office Automation (from the mid-1950s onward) |
| Work Measurement and Sampling | Operations Research (ditto)[129] |

**Table 2: Frequently mentioned systems specialties of the 1950s.**

Not all these specialists were happy to subordinate themselves to the broader systems identity. Neither was it clear whether a small staff of consulting experts could hope to tackle massive and on-going tasks of this nature. Forms control provides an interesting example. Forms control was the name given to a central, staff effort to reduce the number of forms used in the corporation, limit the creation of new forms and ensure that all forms were easy to complete and included only necessary information. Forms control, and the closely related activity of reports control, represented a difficult area for the systems men. For it to work effectively, they had to be willing to thwart the will of departmental managers in the name of the overall good of the company.

In 1951 Frank Knox, wartime Director of Publications in the Executive Office of the Secretary of the Navy and one of America's leading authorities on forms control wrote that, "Forms control is a first cousin to systems and procedures but it is not the same thing. They rub shoulders, but still remain different things." Knox's argument rested on more than mere

[129] The list is based on a general reading of systems literature and textbooks from the 1950s and early 1960s. See particularly a series of articles adapted from an MBA thesis that surveyed the systems and procedures department as a corporate institution. A. Richard De Luca, "Placing the Systems and Procedures Function in the Organization", Systems & Procedures 12, no. 3 (May-June 1961):14-23, A. Richard De Luca, "Organizing the Systems and Procedures Department", Systems & Procedures 12, no. 2 (March-April 1961):4-18, A. Richard De Luca, "Functions of a Systems & Procedures Department", Systems & Procedures 12, no. 2 (March-April 1961):2-7, A. Richard De Luca, "Introduction to Systems & Procedures", Systems & Procedures Magazine 12, no. 1 (January-February 1961):2-7, A. Richard De Luca, "Operating the Systems and Procedures Department", Systems & Procedures 12, no. 5 (September-October 1961):17-29.

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defensiveness. He argued that a systems and procedures group should naturally concern itself with improvement of the firm's most vital administrative and control systems, during the course of which it would inevitably need to redesign many of its most important forms. But while this might eventually take care of the high volume "50,000 a year forms," a dedicated forms control staff would still be needed to manage the vastly greater number of "500 a year forms." These specialists would oversee all aspects of forms: their authorship, design, specification, purchase, manufacture, storage and distribution. They would index and number all forms, monitor their use and improve their designs.

Knox and his colleagues made their argument for forms control on the basis of cost. Not primarily the cost of designing and printing forms, but the cost of time wasted filling in badly designed and unnecessary forms. Forms control advocates quoted a rule of thumb by which one could multiply the cost of producing a form by a factor of ten to estimate the total cost of using it. Left unchecked, operating personnel were liable to run amuck, creating and administering a sea of forms without regard for economy or their continued utility. An anonymous 1953 editorial in Systems and Procedures Quarterly claimed that the only way to control these " bootleg" forms was to forbid the purchase of "captive" duplicating machines (i.e. those out of the control of the staff experts) by departments. The need was urgent – the same editorial estimated that only eleven illicit forms had to be introduced before the extra workload demanded the employment of another clerk just to deal with them.[130]

While this argument made sense from the viewpoint of minimizing administrative overhead costs, for divisional management groups it represented an unwelcome intrusion into their ability to run their own operations. The editorialist had little patience for this resistance ("It forces operating personnel to think and as a result, many of them regard it as an obstacle.") Even

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[130] Anonymous, "'Bootleg' Forms", Systems and Procedures Quarterly 4, no. 2 (May 1953):3.

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systems men sometimes could see the absurdity in rigid forms control – in a humorous short story an innocent manager attempts to have a form produced for use in his own meetings. He finds that to have in produced he will need approval from the forms control office, an official number and forms signed by his own manager. ""Fred learns that it will cost about $3,000 to get a one page form designed, approved, authorized, controlled, printed, stocked and issued for six people to use at a monthly meeting and that the hassle will certainly involve at least three Department Managers and a Division Director. Moreover, it is strongly probable that the meetings will no longer be held by the time the form is ready for use." By the end of the story the poor man had given up on his original tasks and resolves to seek a new career in the Forms Section.[131]

## Drawing the Boundaries – What Systems Work Wasn't

In 1956, Gill tackled the perennial question of "What is a Systems Man?" He took a novel but revealing tack: "determine what a systems man is *not*—and see what we have left over." The list was long, and included efficiency experts, industrial engineers, auditors, accountants, executives and salesmen. (Had the it been prepared just a year or two later, the list would undoubtedly have included operations researchers and data processing managers). Although Gill admitted similarities with each of these groups he insisted that systems work needed its own unique approach and that the successful systems man must give up former allegiances. As he put it, "[i]t is no doubt true that a majority of successful systems people today are former accountants--this is natural and healthy. But they are former accountants: they left accounting, and entered systems..."[132]

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[131] The humorous story is Robert Osborne, "'I Don't Like Your Form, Miss Eagar'", Business Automation 8, no. 4 (October 1962):44-46.

[132] William C. Gill, "What is a Systems Man?" Systems and Procedures Quarterly 7, no. 1 (February 1956):21-23, page 22. Haslett's remark is from J. W. Haslett, "We All Need an 'AI'", Journal of

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The systems men were particularly keen to distance themselves from two groups that had previously failed in similar attempts to create a specialist profession based on expertise in the techniques of efficient administration. One was the "efficiency expert." Haslett conjured up this specter on several occasions, writing of "the now abhorrent 'efficiency expert' who lopped off clerical heads to the cadence of a stopwatch" and whose poisoned legacy still blighted the reputation of his modern and truly scientific successors. The term implied not only a pedantic obsession with ends over means but also an adversarial relationship with the department being reviewed. Gill was no less kind. "Anyone who calls himself an efficiency expert is, of course, not only twenty years or so behind the times but will also meet only sneers and ridicule with such a claim."[133]

The other, of course, was the office manager. Like Leffingwell and his contemporaries, the systems men promised to make the office more like the factory. As John Haslett, a founder of the SPA, wrote in 1950, "a paperwork revolution is inevitable in office management during the next decade, for technology applies to the office no less than to the plant." They largely shared Leffingwell's admiration for the pioneering work of Frederick Taylor, indeed a 1963 article by Leslie Matthies went so far as to call Taylor, "the first systems man". The similarities ran deeper. Leffingwell had pioneered many of the techniques they adopted, including the documentation and simplification of clerical procedures, the flowcharting of paperwork and the simplification and elimination of forms. Yet a reasonably thorough investigation does not uncover a single explicit

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Systems Management 22, no. 5 (May 1971):46, though the efficiency expert was an idea he invoked throughout his career – see John W. Haslett, "A New Role for the Systems Man", Management and Business Automation 3, no. 2 (February 1960):20-22, 40-41, John W. Haslett, "Is Analysis Yielding to Synthesis", Business Automation 12, no. 4 (April 1965):34-40. Matthies also used the efficiency expert as a foil – see Matthies, "Systems: Functions, Relations, Pitfalls", page 48. For a treatment of Bedaux, the quintessential efficiency expert of the interwar years, see Steven Kreis, "The Diffusion of Scientific Management: The Bedaux Company in America and Britain, 1926-1945", in A Mental Revolution: Scientific Management Since Taylor, ed. Daniel Nelson (Columbus: Ohio State University Press, 1992).

[133] Gill, "What is a Systems Man?" page 21.

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reference to Leffingwell in the journals, conference proceedings and textbooks of the systems men.[134]

Unlike Leffingwell himself, the National Office Management Association (NOMA) remained very much alive. Only a few of its members seem to have crossed over into the new systems movement. Irene Place, an academic and herself the author of a major office management textbook, reported that the relationship of the two groups was "discussed both among office managers and systems analysts" but suggested that, "while systems analysis is part of the broad function of office management as traditionally conceived, it has developed its own body of literature and its own professional association." Leaving little doubt as to her own new loyalties, she concluded "It is not new for a son to be more purposeful and resourceful than the father."[135]

Matthies was even keener to distance systems work from office management. While it was administrative, it was not clerical. Drawing upon the idea of staff work, he urged his fellows to "[s]top thinking of the office as a mere clerical function. Remember that the office is, in its true light, an extension of the boss himself." Systems was, or should be, a science of management. "Systems engineers should stop trying to steer systems to a science of better clerking. They should steer systems toward its really great potential as a science that can assist management to cope with the complexities of today's organizations." The very vehemence of his calls may indicate that most of those he addressed remained uncomfortable close to office management. As

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[134] On the use of Frederick Taylor by the systems men, see Anonymous, "With the Masters: Frederick W. Taylor", Systems & Procedures Journal 14, no. 2 (March-April 1963):24-30.
[135] Irene Place, Charles B. Hicks, and Robin L. Wilkinson, Office Management (San Francisco: Canfield Press, 1971), 72.

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he noted, "the average boss regards a systems section as a sort of glorified manual distribution center, and/or maybe he thinks of the men as a group of writers." [136]

As the line supervisors of clerical workers the office managers had little chance to set overall corporate systems and commanded low status in executive circles.[137] The routine and personnel oriented responsibilities seem to have crowded out hopes for executive responsibility, making its holder more of a head clerk than a senior manager. The most fundamental difference between systems men and office managers of the 1950s was therefore the insistence of the former that their work must be undertaken from a staff position. Their job was to coordinate programs to improve arrangements for things like the creation of forms or the handling of files, but not to claim direct control over such activities once new procedures were functioning. Place warned that, "If he retains them and adds people to his staff to supervise them -- sometimes referred to as 'empire building' -- he will eventually have essentially an office management department and will not have fulfilled the new goals that have been identified for him." [138]

As one might expect from their choice of moniker, the systems men were, almost without exception, male. During the 1950s, masculine pronouns were still assumed to encompass both sexes, and "man" was widely used make general pronouncements about the human species. But the systems men seemed to have another motive as well: their universal adoption of the term during the early 1950s to define their community (after previous occasional uses of "methods man" or "systems people"), perhaps reflected an attempt to build a specifically masculine

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[136] Leslie Matthies, ed., Systems As A Channel of Communications (Cleveland, Ohio: Modern Office Procedures, 1957), 34, 36 & 38.

[137] The quote comes from Haslett, "We All Need an 'Al'", page 3, though Haslett expressed very similar views in the 1950s and 1960s.

[138] Mettler, "An "Old Shoe" Concept of Systems".

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identity, and in particular to separate themselves from the appreciable number of women working in the lower-status job of office manager.[139]

Most systems men were less keen to separate themselves from industrial engineers. The industrial engineer was essentially the heir to Frederick Taylor on the factory floor – the figure who investigated and optimized systems of production. Industrial Engineering had a longer history as a staff specialty than clerical systems and procedures work, and because managers tended to view the factory as the heart of their business and the office as unproductive overhead it was also a higher status and more secure one. Some systems men had industrial engineering backgrounds, and many more looked up to industrial engineering as a model for their own profession. Neuschel himself urged them to take industrial engineering departments as a model and a source of recruits, rather than fixating on accountancy. Gill argued that the frequently heard definition of systems work as "industrial engineering for the office" was misleading because systems men worked beyond the office and were not industrial engineers. When "pure industrial engineers" were set to work in a systems department then they would either find inter-relationships between problems of such unfamiliar magnitude that, "these men either become frustrated and scamper quickly back to the factory, or else they come around; they become real systems and procedures men."[140]

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[139] For a discussion of masculinity, work, and technology, see Ruth Oldenzeil, Making Technology Masculine: Men, Women, and Modern Machines in America, 1870-1945 (Amsterdam: Amsterdam University Press, 1999), and many of the papers in Ava Baron, Work Engendered: Towards a New History of American Labor (Ithaca, NY: Cornell University Press, 1991).

[140] Gill, "What is a Systems Man?". Neuschel, "Development of Competent Systems Personnel". While historians have not paid an enormous amount of attention to industrial engineers, the literature is well developed in comparison with that on the systems men themselves. See Daniel Nelson, "Industrial Engineering and the Industrial Enterprise", in Coordination and Information: Historical Perspectives on the Organizational Enterprise, ed. Naomi R Lamoreaux and Daniel M G Raff (Chicago: University of Chicago Press, , Lindy Biggs, "The Engineered Factory", Technology and Culture 36, no. 2 supplement (April 1995):S174-S88 and John C. Rumm, "Scientific Management and Industrial Engineering at Du Pont", in A Mental Revolution: Scientific Management Since Taylor, ed. Daniel Nelson (Columbus: Ohio State University Press, 1992).

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But while systems men saw themselves as expanding the traditional concerns of industrial engineering beyond the plant and into the broader arena of business systems, they were more likely to be lumped together with clerical and accounting operations. As one systems man succinctly put it, "[t]hey're plant, we're office." He said that topics on the margin were negotiated carefully, with occasional joint projects. Another systems man reported that in his company systems and procedures was treated as part of the broader industrial engineering effort. This broader department was divided not by office vs. plant but following the product-oriented division structure of the company itself. This unorthodox arrangement brought forward a warning from another systems man, who said "I'd say there's a danger in trying to run all the phases of the business. I was with such a group several years ago. One Monday morning they wiped out the whole industrial engineering section. I think it's a powder keg myself." The arrangement remained the exception rather than the rule. A decade later, the Systems and Procedures Journal advice column suggested that this arrangement occurred with surprising infrequency given the fundamental similarity between the two activities. The author claimed that if united, the two disciplines would produce a true management expert, oriented toward the whole company, crossing all organizational barriers and capable of rising into the ranks of high management.[141]

## Systems Work In Practice

During the 1950s the SPA boomed as thousands of firms initiated or expanded their efforts in this area. By the end of the decade the "systems men" had found a niche in the institutional form of the corporation. But while tenable, it granted them neither the authority nor

[141] The first quotation is from Courtland W. Piehler, "Systems and Related Disciplines", in Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, ed. Gibbs Myers (Detroit: The Systems and Procedures Association of America, 1958). Ornsby, "Are Methods Men Selling Themselves Short?" suggests that the systems men should work like industrial engineers and see the whole business as a production line indeed of improvement. The second quotation is from Richard W. Pomeroy, "The ? Box", Systems & Procedures Journal 19, no. 1 (January-February 1968):27.

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the security to which many aspired. When defining the "natural" duties of their profession, its members followed Neuschel and placed emphasis on glamorous activities such as operations research and the "management audit" in which staff probe the controls, plans, policies, utilization of personnel and management capabilities of a department. Their core activities, however, remained more mundane. A 1959 survey by the SPA of its members in 1,100 companies found that their bread and butter work remained within well-bounded activities first espoused by the office management reformers since 1910s. While around 80 percent of these firms trusted their systems groups with procedures manuals, forms control and clerical work simplification, only a small proportion claimed to practice operations research or to perform management audits. Less than one third of them supervised five or more people. Most systems men were college educated (primarily accounting and business degrees) and in their thirties or forties. They worked predominantly for manufacturing firms in the northeast or mid-west, although about one fourth were employed by financial or professional services firms. [142]

In 1957, Irene Place of the University of Michigan performed a survey of fifty-eight leading systems men. Her findings generally supported those of the SPA's own survey. According to Place, the SPA's membership was "composed largely of young business employees, mostly trained in collegiate schools of business administration." Many of their positions had been created in the past three years, and none had existed prior to 1943. While she followed Neuschel by strongly promoting the idea of systems as the coordinating mechanism for the whole business, she was nevertheless forced to admit that even among her carefully chosen group of elite

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[142] On the management audit, see Victor Lazzaro, "The Management Audit", Systems & Procedures 11, no. 2 (May 1960):2-6 and A. Richard De Luca, "Functions of a Systems & Procedures Department", Systems & Procedures 12, no. 2 (March-April 1961):2-7. The SPA's survey is discussed in A. Richard De Luca, "Placing the Systems and Procedures Function in the Organization", Systems & Procedures 12, no. 3 (May-June 1961):14-23, page 15.Figures from earlier surveys are reprinted in Association for Systems Management, Profile of a Systems Man (Cleveland, OH: Association for Systems Management, 1970).

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practitioners, "the emphasis is still primarily operational problem solving and not management consulting." She found office equipment studies to be the most common activity (conducted by forty-nine of the fifty-seven firms), followed by methods improvement surveys, forms control and the production of procedures manuals. Management analysis (defined as the coordination of organizational planning) was the least common activity, claimed by less than one in ten of these systems departments. Both surveys agreed that systems men were unlikely to report directly to the chief executive. Despite occasional pleas for unity with their colleagues in engineering, their work was concerned only with administrative procedures and was under (sometimes several levels under) the authority of the corporate controller, the executive most clearly identified with paperwork.[143]

Place found that the systems men had come to their work from a number of different sources, and that the character of a systems department varied greatly from one firm to another. Of the fifty-eight systems experts, seventeen had previous systems and procedures or management analysis experience (many in the armed forces), sixteen had backgrounds in accounting work (including auditing, tabulating and timekeeping), seven had previously worked as office managers, five in forms control and four as management consultants. She concluded that, "we see the analysts converging from three or four main sources: accounting, finance, office management and engineering." She also found that systems departments continued to differ greatly in their cultures, mandates and organizational position. Some were still concerned primarily with clerical standards and office services. In contrast "those groups that reported to a controller and that were staffed mostly by personnel from the accounting department tended to see the job of the systems analyst as primarily an extension of accounting control and standard

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[143] Irene Place, Administrative Systems Analysis - Michigan Business Reports, Number 57 (Ann Arbor: University of Michigan, 1957), 65. On the sources of analysts see page 44. On the different kinds of systems department and the outstanding nature of MBA graduates see page 17. The 1959 SPA survey confirmed that most of its membership reported to a financial executive or assistant.

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operating procedures." She most admired those systems groups that had succeeded in winning the right to report directly to a senior, non-financial executive. These systems men "saw the job of the systems analyst as a management planning, top-level policy and procedure review. Particularly outstanding among these were young graduates of the better schools of business..."[144]

One might suggest many reasons for the general failure of the systems men of the mid-1950s to attain the managerial authority they sought. But the systems men's most fundamental weakness was the fuzziness of all-round expertise in management methods as a claim to professional expertise. As the cartoon below shows, they worried that the intangible nature of the products generated by systems work left them at a disadvantage.

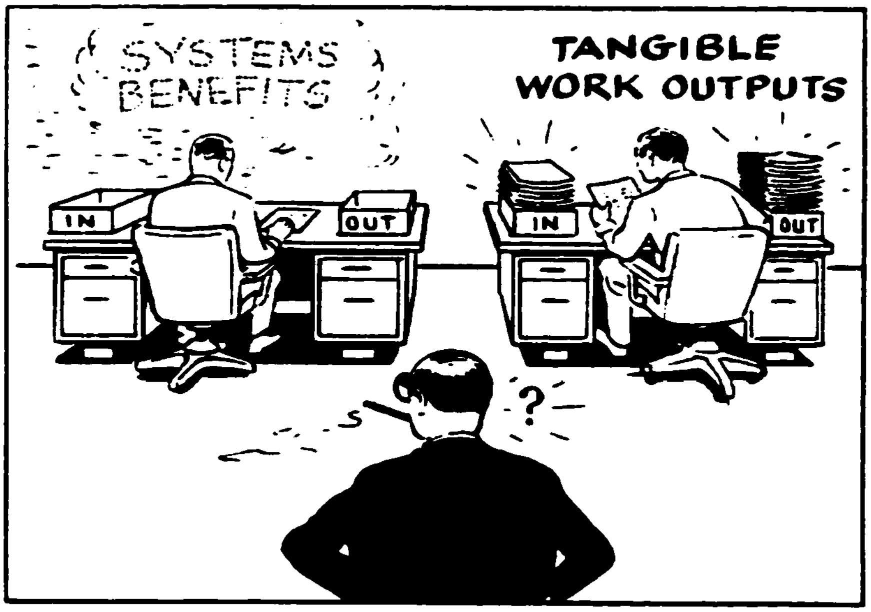


**Figure 9: One of the biggest problems faced by the systems men was the intangible nature of their output.**[145]

A 1959 warning given by a leading British practitioner was to prove prophetic:

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[144] Ibid.
[145] Matthies, Personal Effectiveness for the System Man: From the Systemation Letter, 7.

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> he claims to be an expert in a subject which most other business people claim to be equally expert. What does the system man know that the office manager, or indeed, any other manager does not know? .... There are already growing up in the office field a number of other techniques which do not suffer from these disadvantages. There is the computer programmer who has learned a secret language. There is the operations research man who, as a mathematician, employs unassailable mathematical techniques.... Each has his esoteric techniques to sell. But what has the systems man which is not the everyday currency of everyone else in business?[146]

By the second half of the 1950s, the computer had already become too important for the systems men to ignore. It presented both a challenge and an opportunity. As we shall see in the following chapters, many individual systems men began to specialize in computer related work and became systems analysts within corporate data processing departments. The issue was to split their community, as others warned that by becoming technical specialists in computing they were forever abandoning the dream of collective social mobility into the managerial class. To deal with this problem, systems men were at the forefront of the 1960s effort to redefine the computer as an explicitly managerial tool, rather than a simple mechanism for clerical automation. The vital part they were to play in corporate computing is thus best understood as an attempt to reconcile the long standing tensions between their high aspirations and limited success. It was an attempt to enlist the computer itself as an ally in their quest for class mobility through the dissemination of a new concept of management.

## Operations Research in the 1950s

Meanwhile the application of mathematical techniques to selected military operations gave great credibility to the new discipline of Operations Research (OR). Operations Research experts, the second group considered here, were also attempting to attain collective mobility into executive ranks through the propagation of a new professional identity and a new concept of

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[146] Geoffrey J. Mills, "An Appraisal of British and European Business Systems", in Ideas for Management: Papers and Case Histories Presented at the Eleventh International Systems Meeting, ed. Colver Gordon (Detroit: The Systems and Procedures Association, 1959).

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management. But unlike the systems men, they had little respect for engineering (industrial or otherwise) and did not look to corporate accountants as a model. Their tactic was rather to assert managerial authority on the basis of scientific training, and so their vision of professional authority was along the lines of a scientific society. They favored academic distinction over the standardized, certificate oriented culture of accountants and other established professionals.

The aim in this discussion is to sketch the development of OR and to reconstruct the kind of impression that systems men and executives were able to form of it. No overall history of OR in the corporate world has been written. Where historians have approached the topic they have sometimes failed to differentiate between systems men and OR practitioners. During the 1950s and 1960s, Operations Research was a high profile field, seen by many as one with considerable potential. Its modeling techniques were associated very early on with the power of the computer, and so the allure of operations research was to prove a powerful sales tool to persuade executives to order large and expensive computers. Operations Research groups were proposed as part of several early computer departments, and during the 1960s OR groups and systems men worked closer together in an attempt to build "management information systems" which combined mathematical models with constantly updated operational data. As discussed later, OR concepts from the RAND Corporation were particularly influential during the early 1960s in shaping the idea of "total systems". Despite this, the direct contribution of Operations Research to the direction of corporate computing practice (as opposed to its rhetoric) was quite small.

OR was a success story of the Second World War, having been born as "Operational Research" during the pre-war British push to construct a serviceable radar network. The term itself has little meaning. Historian Eric Rau has argued that the first operational research was largely engineering and that, "the name itself had been coined strictly for bureaucratic convenience." However the name stuck as a label for various British projects, eventually

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involving hundreds of scientists, in which scientists left their labs and contributed creatively to broader aspects of the war effort. The phrase crossed the Atlantic and came to describe the application of the scientific method in general, and mathematics in particular, to wartime logistical problems such as the hunting of German submarines. Although scientists involved never quite achieved the independent authority, or the exemption from traditional military approaches, that they felt they deserved, they finished the war having considerably burnished their reputation as practical problem solvers.[147]

Following the war, many of the American pioneers of operations research sought to replicate their military success by bringing the techniques of science to bear on the problems of corporate management. The first OR textbook, Methods of Operations Research, was published in 1951 by Philip Morse and George E. Kimball, wartime leaders of the ASWORG anti-submarine effort. The next year they helped to form the Operations Research Society of America (ORSA). A separate group, the Institute of Management Science (TIMS), was also founded in 1952 and pursued a very similar agenda.[148]

A 1951 article in Fortune magazine first brought operations research to the attention of a large audience of executives. During this period the field was defined more by the presence of scientists in unfamiliar roles than by any single subject or method. Like other such articles of the 1950s its enthusiasm about the potential of OR was matched only by its vagueness about what civilian OR might actually be. This first article had strikingly few tangible demonstrations of the success of OR in a civilian context, though it did relate the success, some decades earlier, of a Horace C. Levinson – astronomer turned department store executive. Like other early proponents,

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[147] Erik Peter Rau, "Combat Scientists: The Emergence of Operations Research in the United States During World War II" (Ph.D., University of Pennsylvania, 1999). The quotation is on page 40.

[148] ORSA was inclined a little more to mathematics, TIMS a little more toward management, but as one ORSA president remarked, 90 percent of the papers published in the journal of either society could just as well have been sent to the other one. See Robert B. Forest, "The Operations Research Society of America: Interview with ORSA's President", Datamation 9, no. 10 (October 1963):32-34, 37, 39, page 37.

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the author fell back on the idea that what made OR into OR, and stopped other things from being OR, was that it was performed by scientists who followed something called the "scientific method." Because the scientific method was universal, so was OR. Unlike traditional management consultants, the article suggested, the OR practitioner would stick to the provision of empirical data and leave both hunches and actual decisions to managers themselves.

A spate of similar articles over the next few years garnered considerable managerial attention for the new activity. A 1953 piece in the Harvard Business Review is typical. While continuing to stress the scientific method as the defining feature of OR, it made some slightly more specific claims. It would single out for managers those "critical issues which require extensive appraisal and analysis" as well as "providing factual bases" and so free the time and effort of executives to "intensify the potential of their decision making role." It would do this through statistics and, in what the authors claimed as a defining characteristic, the extensive use of models – so that, "operations are considered as an entity". But while the authors were a little unclear about what OR was, they were very clear about what it was not, and who was not doing it. Unlike every other professional activity in business, OR was science, not merely expertise, methodology or engineering. Accountants, for example, did not even come close – their methods were limited and their figures skewed. "Accounting data... require careful interpretation and organization before they can be used safely and efficiently."[149]

They saved their most stinging dismissals for the industrial engineers – close cousins of the systems men who worked in the factory rather than the office. These people, they complained, applied methods -- not science. "[I]ndustrial engineering is not commonly characterized by the mental discipline and techniques of analysis that are commonly associated with the physical

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[149] Cyril C. Herrmann and John F. Magee, ""Operations Research" for Management", Harvard Business Review 31, no. 4 (July-August 1953):100-12. See page 107 on accountants and page 100 on the use of models as a defining characteristic of operations research.

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scientist; operations research is. ...Operations research people are scientists, not experts. It is indicative of the influence which the physical sciences have exerted on the people in operations research that they have a self-conscious concern with concepts and first principles and show a desire to generalize from specific examples to all-encompassing theories."[150]

This statement is striking, but by no means unrepresentative, in its arrogant disdain for the unfortunate non-scientists already working in the world of business. During the early 1950s the assertion of science in general, and physics in particular, as a source of universal authority would get one surprisingly far. The wartime triumphs of science, chief among them radar and the Manhattan project, were still fresh in the public mind. Even the tendency to generalize to all encompassing theories could seem uniformly praiseworthy. Yet even within the OR community some were skeptical about how far this attitude would carry the new profession.

In a review of the Morse and Kimball textbook, A.M. Mood, then chief of Mathematics at the RAND Corporation and a future president of ORSA, quoted the book's definition of operations research as, "a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control." He then observed acidly that, "just among ourselves we will certainly have done a fine day's work when we sell that definition to the chairmen of the boards." Mood complained that the OR techniques discussed in the book appeared to amount to little more than the fitting of simple models to overly simplified problems. Each problem was still solved on a unique basis, guided by human intuition. "Judging from the contents of the book, operations analysis is an art, not a science." As the claims of OR to novelty hinged on its uniquely scientific nature, having dismissed this, Mood found little new in it. Industrial practitioners had long been performing cost accounting, analyzing materials flow and the like and were now rather good at it. "The book suggests that perhaps operations analysis

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[150] Ibid The quotation is from page 108.

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will be useful in business and industry. Well I should say. It has been going on in business for at least a couple of generations with no sign of diminishing--quite the contrary. Does the book draw on any of this vast experience? Not a whit." [151]

Although the missionaries of operations research were eager to bring their gospel to the savages of industrial practice, the process sometimes resulted in mutual incomprehension. A seminar sponsored by the Railways Systems and Procedures Association and the Operations Research Office to explore the potential of OR experienced "a great deal of difficulty of communication between the OR and the [rail road] people." The primary cause of the difficulty seems to have been the lack of clear separation of OR from industrial engineering, exacerbated by the fact that in railway terminology the term "operations" had long referred to the movement of trains. OR pioneers, including Russell Ackoff, later a leading figure in management theory, made a long series of presentations. The experience inspired Ackoff to propose some "ground rules" for future events, a careful examination of which reveals their inspiration by an unfortunate mixture bemusement and hostility created by the seminar. One of these rules was, "design the presentation to fit the audience." He continued, "[d]o not attempt to reach an audience unfamiliar with OR by putting the OR label on 'simple cases.' It often turns out that similar cases have been handled quite competently, and sometimes more expeditiously, by Industrial Engineers, Management Consultants, and others." As a result, he was compelled to remind his fellows that, "[r]elatively few people are delighted by the elegance of analytical methodology. Most people go to sleep." The apparent stupor of the formal presentations had in this case been followed by an "atmosphere of frank discussion".[152]

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[151] A. M. Mood, "Review of Methods of Operations Research by Philip M. Morse and George E. Kimball", Operations Research Society of American Journal 1, no. 5 (November 1953):306-08.

[152] Harold O Davidson, "Railroad Executives' Seminar on Operations Research", Journal of the Operations Research Society of America 2(May 1954):210-11.

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In 1954 a report in ORSA's journal listed a total of eighteen known operations research groups in American corporations, and seven other firms "doing opsearch under other names." The lists were dominated by aircraft and oil companies, and also included such stalwarts of scientific management as the Curtis Publishing Company. At this point ORSA listed a total of 646 individual members of whom 168 worked in industry, for a total of 100 companies. This suggests that interest in OR among the employees of a firm often preceded rather than followed the introduction of a formal OR group. Of the 478 individual members who did not work in industry, 91 were in universities, 62 worked as consultants, 40 in research labs, 20 were at the RAND Corporation and most of the rest worked for various government offices. Thus OR remained far more a group of people on the outside of industrial management trying to use their scientific credentials to get in than an indigenous industrial movement.

As the association's president remarked that year in his outgoing address, its efforts to communicate with industry "have thus far not been impressive," something he blamed on the lack of a coherent definition of what OR actually was. He cited definitions such as the bold "OR is the science of decision," and the honest yet somehow unsatisfactory "OR is what operations-research workers do" and "OR is at present undefined, but in time will become defined by the subject matter appearing in JORSA," as causes of justifiable reluctance on the part of businessmen to hand over keys to executive washroom. Sanford Beer, a leading British OR pioneer, was still more critical of the suggestion that OR could be defined as merely as "a sort of high level activity; it involves studying things scientifically." "Management," he continued, "has no idea of what we are trying to do and is getting tired finding out... This outlook is simply cowardice masquerading as wisdom."[153]

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[153] Stafford Beer, Operations Research Quarterly (March, 1959):1-21. Robert F. Rinehart, "Threats to the Growth and Development of Operations Research in Industry", Journal of the Operations Research Society of America 2, no. 3 (August 1954):229-33.

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Established consulting firms were keen to appropriate the cultural authority of science by hiring scientists and referring to their activities as "operations research." In a 1952 address to an OR seminar at Johns Hopkins University, J.W. Pocock of consulting firm Booz, Allen and Hamilton presented OR as a way for management consulting to return to its roots in the scientific methods of Taylor and his contemporaries. Yet while the examples he gave involved some use of statistics or the application of scientific analogies, they seemed to differ little from more traditional industrial engineering work. Booz, Allen was soon joined in its espousal of OR by other established consulting firms such as Price Waterhouse and Touche, Niven, Bailey and Ross as well as the scientific consulting veteran Arthur D. Little and the upstart "systems" firm Ramo-Wooldridge.

The lack of clear definitions make it hard to say how much OR work was really performed within companies during the 1950s or exactly who performed it. During the early 1950s, corporate systems men seem to have been as ignorant of the existence of OR as most OR enthusiasts were of established systems and procedures efforts. Consulting firms with a foot in administrative systems work and operations research projects played a role in spreading the word – the first discussion of OR in Systems & Procedures Quarterly was published only in 1954 and was based on a talk delivered to the Boston and Bay State chapters of the SPA by an Arthur D. Little consultant. From the mid-1950s onward the systems men devoted increasing attention to operations research techniques. During the same period, discussion of operations research also spread into accounting journals. Some suggested that use of OR techniques could help improve managerial accounting by providing more meaningful reports to management.[154]

In 1958, Bruce Carlson, a statistics specialist at an electrical company, summed up the state of relations between the two fields:

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[154] The first article on OR to be published by the SPA was Frank T. Hulswit, "Let's Talk About Operations Research", Systems and Procedures Quarterly 5, no. 4 (November 1954):3-5.

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> Neither operations research nor systems people seem to be very well-informed about what the other group is trying to do. In operations research, in fact, there has been, until recently, little recognition that a systems profession is evolving apart from industrial engineering. Systems men, on the other hand, tend to look upon operations research as an interloper which in some way is threatening the sound growth of systems work.[155]

But according to Carlson, "a close partnership developed can be advantageous for both." He called on systems men to acknowledge a role for the new techniques of OR, to subscribe to its journals and to attend its meetings. In his opinion, systems men were less methodologically sophisticated than operations research experts, but far more attuned to organizational realities. Operations researchers, he charged, were focused more on improving their mathematical models than improving the company and had a naive faith in the attainability of optimal solutions. "They are beginning to recognize that their tendency to lose interest in a problem once it has been solved on paper is one reason why many of their solutions are either never being put into use or yield disappointing results."[156]

His response illustrated a more general reaction. Most systems men dealt with OR by insisting that operations research was another technical specialty which should fall under the hegemony of the systems generalist, as had older activities such as forms control or punched card accounting. By the start of the 1960s, operations research was a standard part of any discussion of the scope of systems and procedures or list of systems specialties. As Emerson F. Cooley, a long-serving "methods" expert with Prudential Insurance, put it, "In many companies the term 'operations research' has already become a watchword, perhaps a new fad. The operations research boys are often working in a mysterious way to accomplish their results.... using common sense with quite a bit of technique... We can learn quite a bit about this without learning advanced mathematics...." But the feeling was not mutual. Many operations research practitioners

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[155] Bruce Carlson, "Operations Research -- Friend or Foe of Systems?" Systems and Procedures 9, no. 3 (August 1958):11-15.
[156] Ibid, page 14.

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continued to hold themselves aloof from the less scientific methodologies of the systems men, and the intellectual center of gravity of the field remained primarily in university departments, the emerging cold-war complex of government funded institutes, defense contractors, think-tanks such as the RAND Corporation.[157]

Systems men discussed their experiences with operations research departments during a seminar at the 1958 SPA meeting. They found discussion difficult because of different definitions of OR current in different firms. Several speakers saw OR as tied very closely to computer operations, while to another OR was "done by our development planning organization - no connection whatsoever with systems and procedures." One story of OR was especially revealing:

> In our company O/R was whatever the operations V.P. set apart to study from a mathematical standpoint. It lasted about one year, for lack of projects and for lack of coordination. They delved into systems problems and ran afoul of us along the way.... They operated from the top down. This was a reverse. We operate from the bottom up. As you might expect, it blew sky high. This is not a success story.[158]

By the mid-1950s, the question of what OR involved was becoming somewhat clearer in practice if not in theory. While profiles of the field aimed at a managerial audience still stressed the universality and inherently scientific nature of the undertaking, they came to rely more and more on the discussion of a specific and rather limited handful of tools and case studies. These tools included linear programming, game theory, queuing theory, feedback models (otherwise known as "servo theory" or lumped under the rubric of cybernetics). General Electric, Pillsbury and various oil companies were frequently named as pioneers of the technology. The uses included mathematical models of production and distribution to improve warehouse location,

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[157] Dennis Phillips, "Workshop Seminar on Thinking Ahead in Education", in Data Processing: 1958 Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1958) See Luca, "Functions of a Systems & Procedures Department", Richard F. Neuschel, Management by System (New York: McGraw-Hill, 1960).

[158] Piehler, "Systems and Related Disciplines".

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improved inventory procedures to optimize stockpile levels and order sizes, and the adjustment of distillation processes to give the most valuable blending of different petroleum products.[159]

Although techniques such as linear programming were potentially very useful in the situations to which they could be applied, these situations represented quite a small proportion of the questions that faced management. They could only represent situations where a small number of variables, the relationships between which could be specified in unambiguous and quantitative terms, interacted to determine the value of an overall quantity. Yet many OR advocates hoped that with sufficient perseverance they could produce useful models of entire firms (with profit as the output variable) or even of the entire economy using nothing more than linear programming. This feeling lasted well into the 1960s. As Mood claimed in 1963 (by now President of ORSA and a vice-president of the huge scientific computer services firm C-E-I-R,) even a simple linear model of the US economy, with only ten variables, would be a valuable aid. While hundreds of thousands of variables might be needed for some purposes, he felt "the largest machines now available could handle a very fine model of the economy," that the Soviet Union already had such a model, and that if the US did not construct one its politicians and businessmen would be at a huge disadvantage.[160]

As OR staff focused increasingly on a set of specific techniques, their relationship to the systems men began to settle down. Yet this same focus on mathematical model building was soon to steer them toward the computer as a fundamental tool. As increasing publicity was given to the automation of administrative and managerial processes, the next decade was to see a wave of

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[159] For examples of this type of article, see Herbert Solow, "Operations Research is Business", Fortune 53, no. 2 (February 1956):128-29, 48, 51-52, 54-55, 58 and Roger R. Crane, "Operations Research in Industry", The Controller 25, no. 3 (March 1957):118-21.

[160] Forest, "The Operations Research Society of America: Interview with ORSA's President". See Neuschel, Management by System for a claim that the practical scope of application of OR techniques was quite limited.

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interest in the possibility of integrating routine administrative systems with sophisticated models and then computerizing the whole package. As we shall see, this led to the increasing entanglement of systems and OR staff.

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# 4. SORTING PUNCHED CARDS AND SHIFTING IDENTITIES: THE "MACHINE MEN" BETTER THEMSELVES

Another group of aspiring managers, the punched card supervisors of the 1950s, provide an interesting contrast with the systems men and operations researches of the previous chapter. In some ways these were the best established of the three groups during the late 1940s – punched card technology having been available since the 1890s. Yet despite this, they made their first serious efforts to forge a professional association during the years around 1950, as did the systems men and the operations researchers. Their continued presence on the corporate organizational chart was more secure than that of operations researchers or systems men – companies were unlikely to abandon the use of their punched card machines once they were installed, and administrative tasks were transferred onto the machinery far more often than they removed from it. Their close association with these machines guaranteed employment, and as technicians they were less threatening to existing managerial interests than were the systems men or operations researchers. But theirs was also the position farthest from managerial authority or executive respect.

Many of the more ambitious punched card staff felt that their status within corporate America failed to match the new and increasing importance of their work. During the decade after World War II, corporations turned to punched card machines as never before, transferring ever more substantial portions of their routine administrative tasks onto the new technology. But punched card specialists remained mechanics, or at best technicians. Unlike the accountants and controllers to whom their supervisor usually reported, punched card staff members were not recognized as either professional or managerial. Few had college degrees, and almost none had specialist qualifications in the field. Punched card supervisors wanted to be taken seriously in management circles, and so they set out to improve both themselves and their reputation.

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Their mission was thus to raise themselves from humble punched card technicians and supervisors into a new role at once managerial and professional: the "machine accountant". They did so through a new society, the National Machine Accountants Association (NMAA). Like the systems men, their identity was closely tied to a particular corporate department – although their connection to punched card machinery gave it a much clearer mandate and character than the hodge-podge alliance of specialists that was systems and procedures. They shared a concern with the elevation their department on the organizational chart, the broadening of its responsibilities and the improvement of its prestige. Compared to the other groups, they placed a much greater stress on professionalism as a means to achieve this. Their dominant concept of professionalism came directly from corporate staff accountants, meaning that they saw increased professionalism more as a means of acquiring managerial status than of asserting the kind of autonomy and self-employment associated with the classic professions of law and medicine.

The punched card staff are particularly important from an historical perspective because they and their departments became the nucleus around which most corporate computing operations of the late-1950s and early 1960s formed. Both technology and practices evolved gradually from punched cards to computers over many years. The identities and aspirations of the punched card staff, and indeed their professional association, shifted only very slowly as they moved into computer operations. Yet these all played a vital role in determining the shape of business computer work during the 1960s and 1970s. In this chapter, I examine their story up to 1955, the point at which they became seriously engaged with computer technology. By presenting the punched card world of the early 1950s in something closer to its own terms, rather than as a mere preamble to the inevitable triumph of the computer, I hope to show the extent to which the computer departments and occupations that eventually emerged were continuations and hybrids of earlier departments and occupations.

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## From Hollerith to Machine Accounting

The "tabulating" or "punched card" machine enjoyed a long history in American business. Because it was the most important single ancestor of general purpose commercial computer of the 1950s it has also attracted considerable attention from historians looking for the roots of modern computing. The companies that were to prove the most successful in the early computer hardware industry (namely IBM and Univac) built this success on their previous leadership in the supply of mechanical punched card systems.

Yet the glorious destiny of the punched card was far from obvious a century ago. For much of its history it was regarded as a specialized tool for the generation of statistics. While many historians have examined the business history of tabulating machine industry, and a good deal of attention has been paid to the evolution of the machines themselves, relatively little has been written about the actual use of punched card machines. Little historical data has been gathered on the main tasks for which the machines were used, or how these changed over time. We do not know exactly when the dominant use of the machines passed from statistics to accounting, how important cost accounting was, or how rapidly the machines were taken up for related applications such as billing and payroll. Still less attention has been paid to the identity, practices and background of the punched card staff themselves, or of their place within the organization. While this study can begin to answer these questions for the 1950s, much work remains to be done on the first half of the century.

Herman Hollerith applied for the first patent on his punched card technology in 1884. His machines became famous when they were used to tabulate information from the 1890 census. His key invention was not a particular machine but a system of storing facts through a pattern of holes punched into a card. Each card in the census return represented a single person, with the particular pattern of holes punched encoding data such as nationality, occupation and age. Once the design of the cards had been set, any number of different machines could be constructed to

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process them. The essentials of a usable system were a machine to encode information on the cards by punching holes (hole punch), a machine to select from a stack of cards only those with a certain characteristic (a sorter) and a machine to count the number of cards in a deck with each given characteristic (a tabulator). Once data were recorded on the cards it was a relatively easy job to sort them in a new way and run them back through the tabulating machine to obtain a new set of totals. They were thus suited for jobs in which one set of data needed to be tabulated in many different ways. [161]

After the census was complete Hollerith needed a new use for his machines. The system was developed steadily over the next few decades, although customers were never plentiful. A key development of the early 1890s was the adding tabulator, which could total values stored on cards rather than merely count cards which matched the sort criteria. Prudential Insurance adopted their own version of punched card technology to produce mortality statistics, and Hollerith eventually managed to find a cost accounting customer in the New York Central Railroad.[162]

During the 1900s Hollerith gradually accumulated more customers, until in 1911 the company had reached the limit of his one-person management and sales style. He sold it to the Computing-Tabulating-Recording Company (CTR), soon to become IBM. The other major supplier of punched card equipment was Powers. Established in 1911 by a veteran of the Census Bureau, it struggled with no sustained success to compete with IBM during the 1920s. IBM put great stress on the excellence of its sales force and in forging links with customers. Once a firm had invested in their system it was hard to return to manual methods, and so revenues flowed in

[161] At least on early machines, sorting was actually performed by the tabulator after it counted each card, according to a preliminary paper by Lars Heide of Odense University. Hollerith introduced mechanical sorters only for the 1900 census, at which time it was his first piece of equipment to automatically feed cards through.

[162] For the story of punched card technology at Prudential, see Yates, "Co-evolution of Information-processing Technology".

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from upgrades to machinery and from the sale of cards. Machines were usually rented rather than purchased, another good source of long term income.

Technological advance was slow but steady through the 1910s and 1920s. Simple punch machines were largely replaced by key punch machines which worked more like typewriters. New tabulating machines could automatically print out totals and simple reports, as machines which could only add were joined by those capable of more demanding analysis. High speed electric duplicating machines could copy a whole deck of cards. 80 column cards, which allowed storage of more complex records, were introduced and machines devised which encoded alphabetical data (like name and address) as well as numbers and 'yes/no' answers. These improvements helped to make the machines more versatile, and hence more suitable for a wide range of statistical, billing and accounting functions.[163]

Despite this, the machines remained at the margins of office management during the 1920s. This was in part a result of the largely unsuccessful efforts of office management reformers to present themselves as experts on systems and management techniques, distancing themselves from the salesmen of specific machines and patent standardized systems. Galloway devoted only twenty-four pages of his 596 page book Office Management to what he termed "labor saving devices in the office." Between them calculating, adding, bookkeeping, and tabulating machines receive only three pages -- in the bulk of this chapter he discussed the general principle of division of labor and resulting increased speed of specialist workers. Leffingwell paid much more attention to machinery in general than Galloway, but his major textbooks also neglect tabulating machinery and its operation.[164]

Punched card machines received very little advertising in the business press compared to desks, files or bookkeeping machines. They were considered impressive but a little mysterious,

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[163] On the development of punched card technology, see Cortada, Before the Computer.
[164] Galloway, Office Management.

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well outside the experience of a typical office. Even when Leffingwell edited the Office Appliance Manual, a massive encyclopedic tome sponsored and largely written by the office machine industry itself, tabulating technology received little discussion. The book included more than 800 pages of painstakingly detailed descriptions of every kind of machine to be found in the office. It was intended for use as a college textbook, a guide for business men "in planning the betterment of their office work" and a sales and reference tool for the office machine industry itself. Yet the chapter on punched card machines filled just fifteen pages – far less than the forty-six pages on addressing machines, the thirty seven pages on coin handling and changing devices (not including cash registers) or the thirty six pages on conventional bookkeeping machines. Even time clocks – IBM's other main product line – received thirty one pages.[165]

An exhaustive survey of office work and technology performed by the US Women's Bureau in and around 1931 confirms that at this point the punched card machine remained primarily a specialized piece of equipment used in the production of actuarial statistics for insurance companies. Eighteen of the twenty-seven insurance firms surveyed by the Bureau used the machines. For large and medium sized insurance companies it was an essential piece of business equipment – all but one of the seventeen with more that 150 clerical workers had adopted punched cards. However important this technology may have been to their business, it did not need particularly large numbers of keypunch operators -- these typist-like jobs accounted for just 3.6 percent of the female clerical workforce at tabulating-using insurance firms. Despite having a virtual monopoly on the supply of punched card machines, IBM's revenues were then much smaller than those than those of the leading business equipment companies: Remington

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[165] Leffingwell, ed., The Office Appliance Manual.

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Rand, Burroughs, and National Cash Register. They were roughly equal to that of Underwood-Elliot-Fisher, a manufacturer of calculating machines and typewriters.[166]

Only ten of the other sixty-three firms surveyed (those in the investment, insurance, publishing and utility businesses) made any use of tabulating machinery. Neither did the technology seem to be making any rapid strides into other industries – most of these companies had introduced their equipment before 1920. Several had recently updated parts of their systems, introducing machines with electrical feeds, new and more advanced tabulators and additional punched cards. Only one of the entire sample of ninety firms mentioned that it was using its equipment to conduct cost accounting, another was considering this but had yet to put the idea into practice.

The punched card machine's big break came, ironically enough, during the Depression. IBM was in a fortunate position from the beginning, because its revenues came largely from the sale of blank cards and the leasing of machines, and so held up relatively well during the bleak early years of the 1930s. By the end of 1935, IBM had installed 4,303 tabulating machines in the United States. But it was the newly created Social Security Administration (SSA) that helped IBM become the dominant office equipment firm. The new program required the storage and processing of information on the contributions made and benefits received by each worker. The original social security card, symbol of the new role of the government, was itself a punched card encoded with the bearer's number. In 1936 the SSA took delivery of its first major set of IBM

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[166] These figures are based on the original source data for the Bureau's investigations of New York and Philadelphia. Records of the Women's Bureau, Box 211 (Compartment 2, Row 44, Stack Area 530), RG 86 (National Archives II, College Park, Maryland). The Bureau's data included 27 insurance firms, making this the single best represented industry. The sample is quite mixed, including firms specializing in fire, home and commercial insurance as well as the (usually much larger) life insurance providers. Between them they employed 11,301 clerical workers - an average of 419 per firm. A few of the offices were branches of bigger firms, and several more were part of larger franchises. Five of the firms employed more than 500 clerical workers, but only New York Life (2205) and Mutual Life Insurance (1338) employed more than 1000. Notable by their absence were Metropolitan Life and Equitable. For figures on IBM revenue see Cortada, Before the Computer.

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equipment, dramatically boosting the use of the machines for general administrative work. During the 1930s IBM doubled its revenues and substantially improved its profits. By the end of that decade it was still not the largest office machine company, but it was easily the most profitable.[167]

Even the less advanced punched card machines could be used in diverse flexible ways because they did not have to be used as the only tool for the whole of a job. Their simple method of data encoding made it easy for people to read and update them. Not only were the positions of the holes easily visible to the naked eye, but users routinely mixed encoded data encoded in holes with additional items or comments written on in pen or pencil. Systems were eventually devised to use part of the card to store a picture or even a microfilm cell, while the rest of the card was used to index it. In a similar vein, address information from an "Addressograph" plate could be mixed with numerical results printed from a punch-card machine. This let people use punched cards for the part of a job they were most suited to, while working around their many limitations.

At the end of 1943, IBM was receiving monthly rental payments for more than 10,000 tabulators, about two thirds of which were of the newer, alphabetical type.[168] Each tabulator was supported by a number of auxiliary machines – about as many sorters were in use nationally as tabulators, while almost 25,000 key punch units were on lease. During this expansion, the machines had moved decisively beyond their statistical niches and into more general accounting and record keeping tasks such as payroll and billing. Exactly how and when the shift occurred is unclear. By the 1930s IBM had begun to refer to them as "accounting machines," signifying an attempt to reorient the machines toward the kind of work carried out by conventional bookkeeping machines and away from purely statistical tasks. Sales literature from the same period highlights the potential uses of the machines in elaborate systems to store inventory levels

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[167] Ibid.

[168] The figure on tabulator installations is taken from Bashe et al., IBM's Early Computers, 21.

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or bill utility customers. Case studies of pioneering firms such as the Prudential demonstrate that at least some companies were pushing forward with the technology. But no historian has yet supplied clear evidence as to exactly what kinds of jobs (payroll, statistics, cost accounting, stock control, billing and so on) the machines were most commonly used for in the pre-World War II years or how this mix changed over time.[169]

A 1940 article in the Journal of Accounting berated accountants for clinging to the "bromide" that, "punched cards are fine for statistics but no good for accounting" and challenged them to recognize the machines as a vital tool for accounting and auditing on a large scale. At the same time, it warned that users of punched card technology sometimes failed to heed good accounting principles, such as the need to number cards so that their original source documents could be traced.[170]

Most professional accountants maintained an ambivalent relationship with the machines. The dominant culture of accountancy placed little premium on innovation and viewed machinery with some disdain. Operation and configuration of the machines were the task of "tab supervisors" and "tab operators," rather than professional accountants, even after their primary use began to shift from statistics to accounts. These men toiled far down the organizational ladder, little noticed by executives. Their group might find itself reporting to a head of accounting methods, who would report in turn to a head of accounting. The head of accounting was responsible to the controller.

Nevertheless, when tabulating machine staff sought to improve their professional standing they did so by aspiring to the status of "machine accountant". In 1949 the punched card men of Chicago came together under the banner of the Machine Accounting Association. It

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[169] For the Prudential, see Yates, "Co-evolution of Information-processing Technology".
[170] Leon E. Vannais, "Punched Card Accounting from the Audit Viewpoint", Journal of Accounting 70, no. 3 (September 1940):200-17, page 200 & 02.

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defined its membership as "those directly connected with the operation and supervision of punched card accounting machines in a supervisory capacity." As such they were really technicians rather than professional accountants - the choice of name was a statement of aspiration. All references to punched card machine staff by those outside the group tend to call them "tab supervisors" or "machine men".[171]

The new association grew explosively, having tapped into an enormous and neglected market. Within two short years Chicago's Machine Accountants Association had become the nucleus of the new National Machine Accountants Association. The national association was chartered in Illinois on December 26, 1951. Its first national conference was held the next summer, in Minneapolis. By the summer of 1953, the second national conference drew more than 1,000 attendees, attracted in part by the commercial exhibitions supplied by manufacturers. The main functions of the national association were the publication of The Hopper and the selection of a local committee to host the annual national conference. The conferences remained a crucial part of the association's work for several decades. The attraction was as much social as technical, a chance to mingle with colleagues and catch up on old friends. The meeting programs included professional entertainers as well as technical speakers, while a Ladies Committee organized a full program of trips, luncheons and cultural attractions for members' wives while their husbands buried themselves with matters of business.[172]

## Life in the Tab Room

What was life like in a tabulating department of the early-1950s? We know almost nothing about the people who directed the use of punched card machinery. Even the purposes for

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[171] Anonymous, "Questions and Answers", The Hopper 1, no. 1 (September 1950):2.

[172] For the origins of the national association, see Sonya Lee Anderson, "The Data Processing Management Association: A Vital Force in the Development of Data Processing Management and Professionalism" (Ph.D. Dissertation, The Claremont Graduate University, 1987), 19-25.

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which the machines were used remain obscure. The general lack of memoirs, oral histories or easily accessible records concerning the use of punched card machines in business makes this a difficult topic to reconstruct. The main source of empirical data on the tabulating machine work comes from an unpublished 1959 doctoral dissertation by Melvin Lloyd Edwards. Edwards surveyed 42 of the 78 punched card installations in Oklahoma City (at that point a medium sized city of around 425,000 people). His fieldwork took place during early 1958, around the peak of the punched card era. At this point several companies in Oklahoma City were considering the use of electronic computers, but only one had so far been installed.[173]

Punched card work neither demanded nor rewarded a specialist higher education. Edwards found that less than 5 percent of the punched card staff in Oklahoma City had graduated from college – most of them department heads. Even these men and women would have received little or no instruction in punched card methods during their university education. What formal training there was came primarily from the machine supplier companies such as IBM and Remington Rand – about a quarter of the staff surveyed by Edwards had attended their courses. Although a handful of colleges were beginning to offer punched card instruction, this was invariably through vocational or extension courses. Less than 1 percent of the punched card staff in Oklahoma City had taken such a course, while another 2 percent or so had taken a vocational course from a private institute. The similar obscurity of punched card machines in high school education meant that few students of any kind were likely to be exposed to tabulating technology, still less seek out a career based around it.

Punched card work was thus a field into which one stumbled. The most evocate single description of life as a punched card worker is the unpublished memoir of John J. McCaffrey, deposited at the Charles Babbage Institute of the University of Minnesota. Born in 1917,

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[173] Melvin Lloyd Edwards, "The Effect of Automation on Accounting Jobs" (Doctor of Education, University of Oklahoma, 1959).

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McCaffrey worked in his mother's grocery store until the age of twenty-three. Striking out into the labor force, he then crammed jobs as a car dealer, an insurance salesman, a biscuit warehouse worker and a factory laborer into a single busy year. It was during his next job, as a timekeeper in the Wright Aeronautical works of Cincinnati, that he first encountered the punched card machine. The time cards for each week were pre-punched with identifying information for each employee by the tabulating department. Each card included the social security number, clock number, hourly rate, and name of the employee. After he was promoted to senior timekeeper, he was charged with the job of collating these cards and taking them to the tabulating department where they were used in the payroll process to print checks.[174]

These machines were all quite expensive to rent, so a large and well run department would try to schedule its jobs so that most of them were in use at any given time. Their use was quite labor intensive. First, each machine had to have its control board wired for the task at hand (printing a report, copying certain parts of a card, sorting by a certain field).Second, operators had to feed batches of cards in and out of each machine, deal with jams and other problems and transfer cards between machines. Getting the pay checks printed in time was a weekly challenge for the tabulating department, so after he showed an interest McCaffrey soon found himself helping out with its labors. Each time card had to be matched with the same person's master card where permanent information such as address was kept. The punched card machines were too slow to allow individual calculation of the hours worked by each employee, so the punched card staff grouped together all the cards showing standard hours and punched them all with the same results. The tabulating staff had to manually check the cards they fed in and treat non-routine arrangements separately.[175]

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[174] John J. McCaffrey, From Punched Cards to Personal Computers, 1989, contained in John J. McCaffrey Memoirs (CBI 47), Charles Babbage Institute, University of Minnesota, Minneapolis.

[175] Ibid, ch. 1.

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These scenes were duplicated every week in thousands of other firms. By the 1940s, payroll was well established as one of the most common application of punched card machines. The technological foundations of this were laid in the 1920s, as tabulators machines gained the ability to output letters as well as numbers, and in the 1930s as multiplying punches became a common item in the biggest and best equipped installations.[176] Edward's 1958 survey found payroll to be the third most common application, then performed by fifteen of the forty-two firms. It was behind only billing and invoicing (a total of twenty-two firms) and accounts receivable (sixteen firms) but ahead of inventory control (thirteen firms). By this point, statistical analysis was a relatively uncommon application – just nine of the firms were using their machines for this purpose. The firms relied upon their punched card installations to carry out an average 3.4 regularly scheduled tasks. [177]

Punched card machines were specialized to particular tasks. The tabulator was the central and most complex of these machines, but it could do very little on its own. When appropriately wired, the tabulator could print reports based on the cards fed through it. These reports included totals, sub-totals, headings and textual information (such as names and addresses) from the cards. To get output based on only some of the cards (say those for a particular department or job code) required that the cards be run first through a different machine, known as a collator. The machine

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[176] The introduction of the multiplying punch in 1932 broadened considerably the range of possible applications of punched card technology, something that was immediate apparent to existing users. According to a 1932 address to a meeting of the Philadelphia chapter of the National Office Manager's association, "For some years, we [of the Provident Mutual] have given consideration to the installation of a mechanical calculation of dividends using tabulating equipment as a basis. On account of the multiplicity of forms of policies in force it has never been considered practical. However, in 1932 with the introduction of the automatic multiplying key punch, the last obstacle was overcome..." C E West, "Training Equipment in the Provident Mutual", NOMA Forum 9, no. 1 (December 1933):7-10, page 10.

[177] For the discussion of applications, see Edwards, "The Effect of Automation", 122-25 Payroll's importance may be understated here, because Edwards explicitly excluded from his sample all installations not performing accounting work on their machines. Exactly when payroll established itself as a leading use of punched card machines is unclear. It is mentioned as an accepted application in Vannais, "Punched Card Accounting from the Audit Viewpoint", page 200 By 1953 it could be noted that, "The preparation of payroll is usually the first job selected for punched card accounting." R. V. Hopkins, "Machine Accounting's Contribution to Management Control", The Hopper 4, no. 1 (January 1953):7-9, page 8

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operator would then pick up the appropriate cards and carry them over to the tabulator. The order of the cards was also very important. To get a listing of salaries broken down by department and then by job classification required an operator to collate the cards into a separate pile for each department and then sort each of these piles by job classification. Only when the cards were thus ordered could a tabulator insert the appropriate totals and headings when it sensed the department or job classification code changing.[178]

Even running a simple salary report would therefore require at least three machines. Each one would need to be separately wired for the task, and a set of procedures developed to split the job into several steps and move the cards between the machines. Getting information onto the cards in the first place required a key punch (similar to a typewriter, but putting holes into cards rather than letters onto paper). This operation was often repeated using another machine, a verifier, to ensure the initial input was correct. A functional installation required at least one keypunch machine, a tabulating machine and a sorter. On average, two keypunch machines were installed to keep up with the work handled by one tabulator, though this ratio varied according to the type of work.[179]

Any operation that involved performing calculations or updating information stored on cards involved further steps and additional machines. Another kind of machine, a reproducing punch (or duplicator), could copy selected information from one card and onto another. For example, in the payroll procedure permanent information on an employee was stored on one card and this was combined with the person's hours for the week. These working cards would be discarded after completion of the payroll run. An operation such as payroll might also require

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[178] A clear and well illustrated introduction to the configuration of punched card machines, and the purpose of each type, is given in Joseph Levy, Punched Card Data Processing (New York: McGraw-Hill Book Company, 1967). The late date of this book indicates the extent to which traditional punched card technology remained viable long after the introduction of electronic computers.

[179] Edwards, "The Effect of Automation" lists the machines in use.

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intermediate calculations. This involved a final kind of machine – a calculating punch (exemplified by the versatile IBM electronic model 604, introduced in 1948). The calculating punch read information from the card, performed calculations in accordance with the wiring on its front panel and punched back the results into an unused part of the card. Edwards' data suggests that most installations obtained reproducing punches and collators to accompany the mandatory sorter, key punch and tabulator. Even in 1958, calculating punches were relatively rare (23 machines between 42 installations).

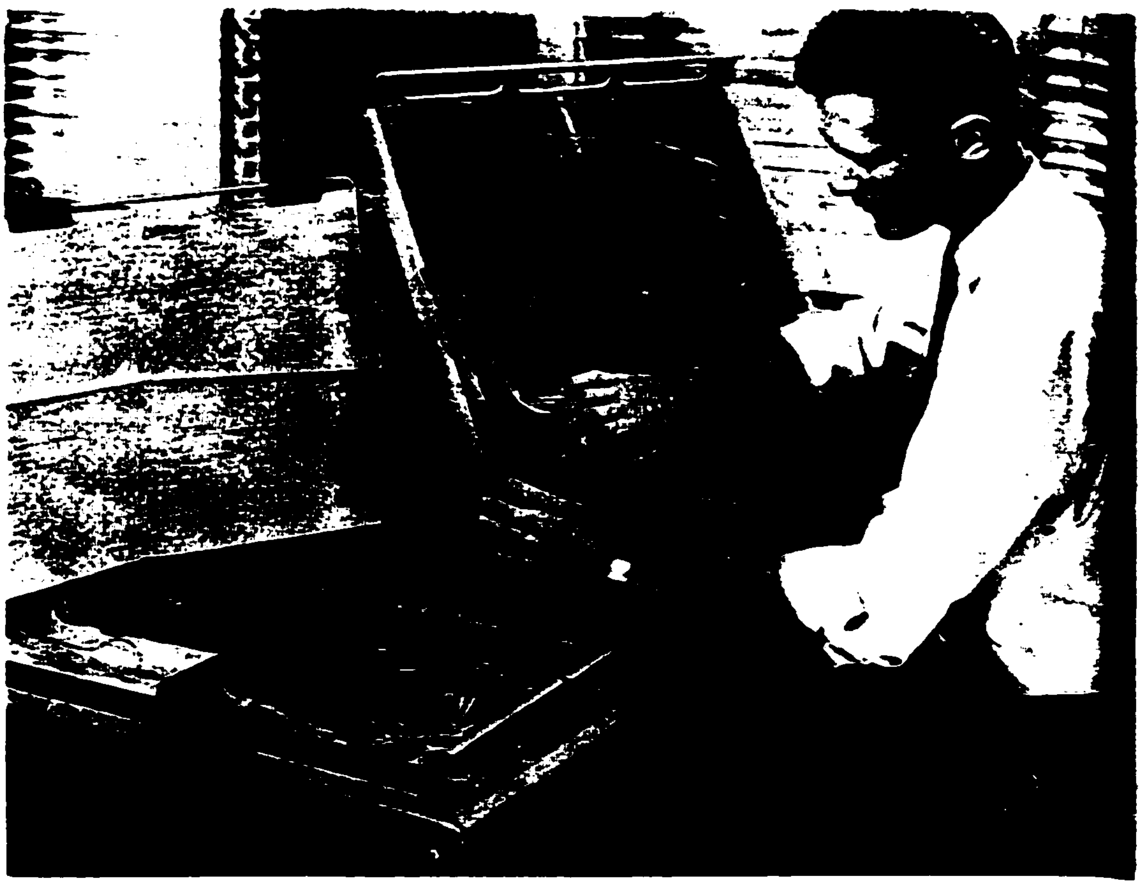

**Figure 10: Wiring a punched card machine panel for a complex job. This picture showcases good practice - note the written instructions, the detachable plug board and the neat wire tray. Once wired for a regular report, a board could be stored and reused.**[180]

[180] The picture is from Anonymous, "Market Managing by Data Processing", Management and Business Automation 3, no. 2 (February 1960):24-26, 33, page 26.

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The task of operating a tabulator or sorter was a quite distinct job from that of using a key-punch machine to punch data onto cards. The former was viewed as technical and was usually performed by a man; the latter was viewed as a clerical job akin to typing and was usually performed by a woman. Every single one of the 136 key-punch operators in the firms examined by Edwards was a woman. On the other hand, women were not completely excluded from work as machine operators – just under a quarter of whom were female. Anecdotal evidence suggests that these women were disproportionately employed in smaller installations, where punched card machine operation was less well separated from general office work. A 1955 presentation by the president of the San Francisco chapter of the SPA suggests that larger installations had turned this division into a matter of policy. For key punch work, he suggested that typing experience was good preparation, and that, "if the girl is not too old and wishes to learn key punching and has indicated she will remain with the company, I think you can afford to train her." On the other hand, when recruiting the operators of tabulators and other punched card machines "I would prefer to hire a *man* with some machine experience and teach him the work. I do not think women generally make good machine operators."[181]

In 1946 McCaffrey landed a job working directly with punched cards. IBM supplied the Wright Aeronautic factory with time clocks as well as its punched card machines. McCaffrey had therefore worked closely with Dick Irwin, the local IBM time clock repairman. Irwin was able to refer him to an IBM representative who ran an informal employment agency for local firms seeking punched card staff. McCaffrey found himself employed by the Bureau of Public Debt, which at that time was seeking to build up a tabulating department very rapidly to cope with an expected flood of war bond redemptions. Edwards' data suggests that referrals by IBM representatives remained the single most important source of punched card staff. More than half

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[181] John C. Peters, "Punched Cards and the Systems Man", Systems and Procedures Quarterly 6, no. 2 (May 1955):8-13.

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the firms he examined used this practice. Private and state employment agencies were the second and third most used methods. Less than a quarter of the firms used classified advertisements and almost none exploited referrals by other workers or educational placement services.[182]

It seems likely that many young people found their first jobs in tabulating in similar circumstances. The Social Security program of the late 1930s accounted for an appreciable fraction of all tabulating machines then in use, and having proven themselves here the machines were pressed into services by many agencies looking to process huge volumes of clerical transactions without hiring similarly gargantuan clerical staffs. These programs required the creation of many new tabulating departments, each of which had to be staffed it its entirety. The Cincinnati tabulating department was being created from scratch, albeit with procedures and wiring diagrams provided by the longer established Chicago operation. The machines arrived seven weeks after McCaffrey – twenty sorters, six collators, six 405 tabulators (or "accounting machines" in the official IBM term) and one duplicator. The department processed a million cards a week. The absence of experienced staff gave McCaffrey a chance to shine, and he rose from clerk to Assistant Floor Manager overseeing day-to-day operations within a few months.

The rapid spread of punched card installations continued unabated through much of the 1950s. Even as the largest punched card users began to turn to computers, the continuing adoption of punched card technology by smaller businesses drove a rapid expansion in the number of installations and held up IBM's income from punched card rentals. Even in 1956, shipments of new punched card machines to American business were worth substantially more than those of new electronic computers. In 1958, Edwards found only one installation in Oklahoma City dating from before 1943. Nine of the forty-two installations were created between

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[182] Ibid, page 141.

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1948 and 1950 – reflecting the postwar boom. Most (twenty-three) had been created between 1952 and 1957. The true average age of a department was probably even less, because Edwards deliberately excluded from his study most departments in operation for less than a year.[183]

The tabulating department was a noisy, often uncomfortable place. The machines clanked and rat-tat-tatted as cards poured through them at a rate of hundreds per minute. Even those that did not punch new holes in them, such as sorters, made a racket as they read the cards and dropped them into different chutes. Duplicators and punches thrust rods in and out of the cards, and tabulators printed columns of results. It was also likely to be a hot place for much of the year – punched card machines were quite resilient and so neither they nor their operators were likely to command the comforts of air conditioning. As Edwards noted, punched card machine installations were very crowded places. Most installations were crammed into the "left-over space" of existing buildings, so that, "The space is often overcrowded by the machine and operators have almost no room in which to maneuver."[184] This was not an altogether white-collar environment. McCaffrey recalled, "When the weather got too hot (and after the women secretaries, control clerks left), we men would strip down to our shorts." On one occasion a

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[183] Edwards, "The Effect of Automation", circa 114. The claim on relative volumes of punched card and computer shipments is based on Cortada, Before the Computer and is obtained by taking the shipment value data for punched cards and cash registers presented on page 260 and subtracting the estimated dollar value of cash register shipments presented on page 259. Only in 1962 did the share of IBM's revenue from punched card machines fall behind that derived from computer products.

[184] Edwards, "The Effect of Automation", 165. There was nothing new about this. Back in 1933, a representative of RCA Victor had complained to an audience of office managers that, "We have a very compact layout. In fact many firms would feel that the space was inadequate for the work turned out. However, there is good light and ventilation and a proper flow of work. The noise of the operation, on the contrary, has not been eliminated." The firm crammed a department of twenty seven machines and twenty seven people into a mere 1,900 square feet. R W Wythes, "Machine Accounting Methods as Applied to Accounts Payable", NOMA Forum 9, no. 1 (December 1933):10-12.

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sudden thunderstorm left many cards damp, after which they had to be ironed carefully before they could be read.[185]

Despite this promising start, McCaffrey's ties to tabulating work were sufficiently loose that he took a hiatus – working first as a salesman for Nestle, and then as the proprietor of a family grocery store. After realizing that in the changing world of post-War retailing his little store was headed for failure, in 1948 he again contacted IBM to find a position. This time he found himself working on a system to support the GI Bill by recording each course taken by a veteran under its provisions. He soon moved on, when IBM recruited him directly away from this job to help them by taking a job with the Terre Haute Brewing company. The company had been using punched card machines for a year, but due to poor planning and cumbersome procedures they had been little impressed by the results and were about to send them back. Thus McCaffrey found himself promoted to department head. This was not quite as grand as it sounds, since the department held only him, a female assistant, and the key-punch operators.[186]

This department represented the small end of the spectrum, but was by no means exceptional. A decade later, Edwards found that most of the Oklahoma City departments were rather small, with a median size of seven people. Of course, as each large department employed more people, most of the punched card employees actually worked in the 20 percent of departments with more than thirteen employees each. McCaffrey's move from a more junior post in a large, government installation to head a small, newly established department in a local firm fitted an enduring pattern. Edwards noted that many people left government installations after getting a few years experience, because pay and opportunities were better elsewhere.[187]

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[185] McCaffrey, From Punched Cards, ch.2 p.9.
[186] Ibid, ch. 3-4.
[187] Edwards, "The Effect of Automation", 116 on department size, 165 on flow from government service.

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By contrast with these Lilliputian endeavors, in 1951 the Prudential Insurance company had thirteen separate punched card installations. Though the smallest of these had only a dozen pieces of equipment, the largest boasted more than one hundred. Between them they employed more than six hundred people and a thousand machines. 700,000 of the 4 million dollars spent annually were for the collection, keypunching and verification of data. The largest single expense was the salaries of the other tabulating staff, a cool 1.6 million dollars. Another 1.4 million dollars went on machine rental to IBM. The final expense illustrates one of the often-overlooked sources of IBM's spectacular financial success: 330,000 dollars for the cards themselves. Prudential's punched card operations accounted for almost 0.7 percent of IBM's entire income during 1951, and the firm was one of IBM's ten biggest customers. While these levels of spending were surpassed by few corporate punched card operations the proportions expended on each item were more broadly representative. A survey of one hundred users found that about ten percent of budget was used to buy cards, 42 percent on machine rental and 48 percent on wages (including keypunch expenses).[188]

Most punched card departments were headed by staff with low organizational status. While Edwards found that most (thirty three of the forty-two) installations were headed by punched card specialists such as McCaffrey, he also found that few had true managerial status. Twenty-five of these specialists were given a "supervisor" title, four were called either "head" or "chief," while only four were accorded the dignity of a managerial title. Neither did their departments themselves sound particularly impressive. Even in 1958, only five were accorded the grand name of "Machine Accounting Department." Both "IBM Department," and "Tabulating

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[188] For the Prudential figures, see F. M. Johnson, "Control of Machine Accounting Equipment", Systems and Procedures Quarterly 4, no. 2 (May 1953):18-22, 26. The more general survey is reported in Herbert A. Fraenkel, "Installing the Punched Card Procedure", Systems and Procedures Quarterly 4, no. 4 (November 1953):8-11, 21-22. For IBM revenues during the 1950s see Cortada, Before the Computer, 233. For the importance of Prudential to IBM, see Thomas Watson, Jr. and Peter Petre, Father, Son & Co: My Life at IBM and Beyond (New York: Bantam, 1990), 192.

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Department/Section" were both more frequently reported, and even the grim "Machine Room" was used by three firms. There was, however, little standardization. Twenty-one different names for the punched card department were reported, fifteen of them used by only one of the forty-two firms surveyed. This is a quite extraordinary range of different titles for the same activity, suggesting that no stable institutional identity for punched card work had yet been established. [189]

McCaffrey's path from general clerical work to machine operation to machine supervision was not uncommon during the 1940s and 1950s. Edwards found that, of the fifty-three supervisors he surveyed, twenty-three had entered work with their current employers as general clerks and a further nine as machine operators. The rapid spread of punched card machine installations made experienced supervisors hard to find. Tellingly, no supervisor had worked as a key-punch operator, preserving a rigid segregation between the feminized clerical work of data entry and the technical, mechanical and largely masculine realm of punched card machinery.[190]

His new job as a supervisor proved McCaffrey's springboard to greater things, including active participation in the embryonic NMAA. He was a delegate to its first conference, held in Chicago's Morrison Hotel during 1951. He became president of the Terre Haute chapter. (Like many of the first NMAA chapters, the Terre Haute branch had previously been an independent "Tabulating Department Club"). His involvement with the NMAA continued after he moved to a larger department in Louisville, Kentucky – where he hosted its Mid-Year Board of Directors meeting in 1953. McCaffrey stayed in touch with his friend Dick Irwin, and recalls the two men having designed the NMAA's second logo together on his kitchen table (it depicted the letters NMAA superimposed on the map of the USA).

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[189] Ibid, 117-121.
[190] Edwards, "The Effect of Automation".

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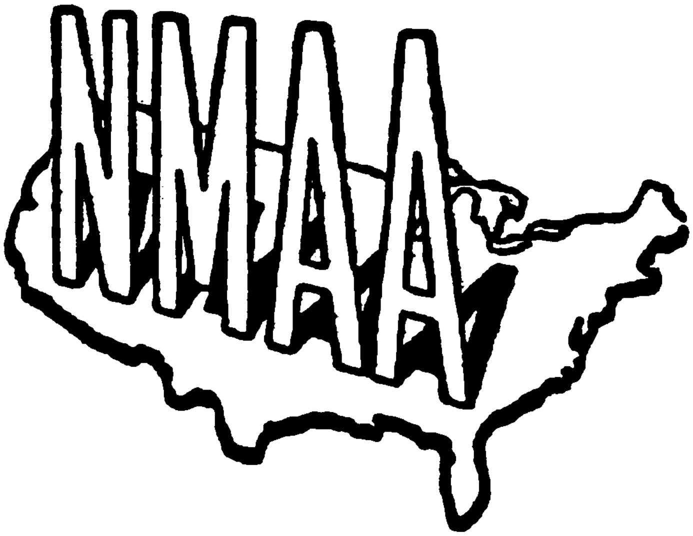


**Figure 11: The NMAA logo used during the mid-1950s.**

McCaffrey's ties to IBM illustrate the extent to which punched card supervisors were as much IBM representatives within their own companies as they were the representatives of their own companies in dealing with IBM. Like McCaffrey, the tab supervisor might owe his very job to the kind words and placement services of an IBM salesman. His main source of training and machine knowledge came from regular IBM seminars. Should he be struggling with how to make a case for the purchase of new machinery or its application to new tasks, he could count on the assistance of well-trained IBM staff with a "cookbook" of proven approaches. Their relationship was symbiotic. Both had an interest in increasing a company's reliance on IBM equipment, in growing the tabulating department and in replacing older machines with the newest and most capable models. Indeed, the prestige accruing to a punched card supervisor among his peers was in large part a function of the size of his installation measured in "points" – where each point was a dollar of IBM rental per month.[191]

[191] On the tendency of punched card supervisors to "satisfy their ennui by a simple discussion of points" see Paul A . May, "Machine Accounting -- An Important Adjunct to the Controller", Journal of Machine Accounting 6, no. 6 (June 1955):17-23. Points retained their importance in computer installations,

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## Becoming Machine Accountants

What was a "machine accountant?" This question more than any other was to occupy the National Machine Accounting Association's members during the 1950s. They knew what a "tab supervisor" was, and they knew that this wasn't all that they wanted to be in the future. But they weren't quite sure what they could be instead, or how to get there. Their closest association was undoubtedly with their machines, yet they knew that to improve their status within the corporation they needed to gain recognition as more than the operators and guardians of machinery. The very term "machine accountant" a simple derivative of "accounting machine," symbolized this tension – on the one hand, it strived for the higher status professional field of accountancy, yet on the other it tied its adherents forever to their machinery.

Boosters within the NMAA promoted the machine accountant as an altogether different animal from the tab supervisor of old. Lester E. Hill, the Chief of Tabulating for Ryan Aeronautical and one of the leaders of the national association was not afraid of hyperbole. "The machine accountant in the punched card field," he told his members in 1957, "is a combination of an industrial management engineer, an industrial accountant, and industrial engineer, general accountant, cost accountant, office manager, and executive administrator, as well as being a first rate technician. Believe me, this is some man!"[192]

By examining the speeches given to NMAA chapter meetings and the articles published in The Hopper we can trace the concerns of the machine accountants. They reveal a strange but illuminating mix of formulaic exhortations to professional betterment and wiring diagrams demonstrating new techniques. Most of the former are the text of addresses given to their meetings, or are reprinted from accounting publications. During the first two volumes of The

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and are mentioned in Herbert R. J. Grosch, Computer: Bit Slices from a Life (Novato, California: Third Millennium Books, 1991).

[192] Lester E. Hill, "The Machine Accountant and his "Electronic" Opportunity", Journal of Machine Accounting 8, no. 1 (January 1957):12-14, 23-25.

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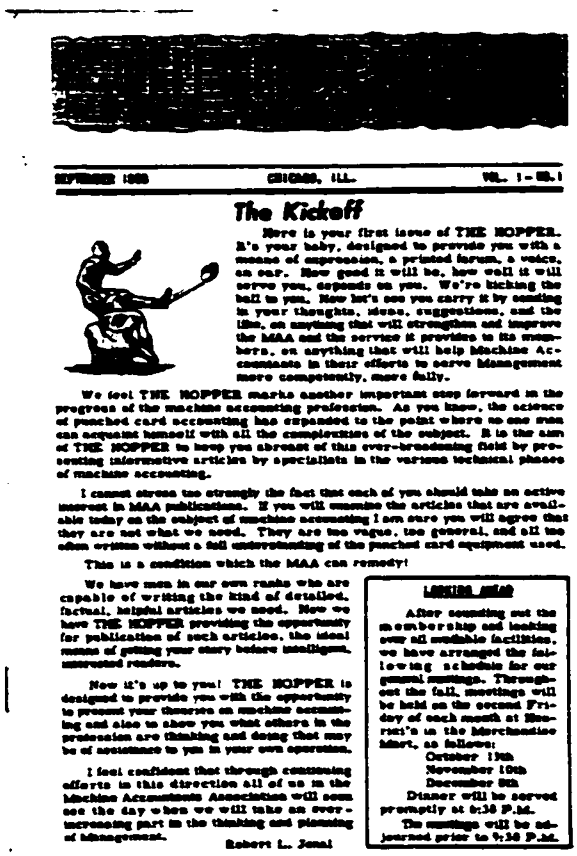
Hopper, the monotony is broken periodically by stock images of bikini-clad minor starlets taken from the studios' publicity materials. These presumably served to emphasize the human side of machine accounting, in much the same way other journals published a picture of the author.



[illegible] CHICAGO, ILL. VOL. 1 - NO. 1

## The Kickoff

Here is your first issue of THE HOPPER. It's your baby, designed to provide you with a means of expression, a printed forum, a voice, an ear. How good it will be, how well it will serve you, depends on you. We're kicking the ball to you. Now let's see you carry it by sending in your thoughts, ideas, suggestions, and the like, on anything that will strengthen and improve the MAA and the service it provides to its members, on anything that will help Machine Accountants in their efforts to serve Management more competently, more fully.

We feel THE HOPPER marks another important step forward in the progress of the machine accounting profession. As you know, the science of punched card accounting has expanded to the point where no one man can acquaint himself with all the complexities of the subject. It is the aim of THE HOPPER to keep you abreast of this ever-broadening field by presenting informative articles by specialists in the various technical phases of machine accounting.

I cannot stress too strongly the fact that each of you should take an active interest in MAA publications. If you will examine the articles that are available today on the subject of machine accounting I am sure you will agree that they are not what we need. They are too vague, too general, and all too often written without a full understanding of the punched card equipment used.

This is a condition which the MAA can remedy!

We have men in our own ranks who are capable of writing the kind of detailed, factual, helpful articles we need. Now we have THE HOPPER providing the opportunity for publication of such articles, the ideal means of getting your story before intelligent, interested readers.

Now it's up to you! THE HOPPER is designed to provide you with the opportunity to present your theories on machine accounting and also to show you what others in the profession are thinking and doing that may be of assistance to you in your own operation.

I feel confident that through continuing efforts in this direction all of us in the Machine Accountants Association will soon see the day when we will take an ever-increasing part in the thinking and planning of Management.

Robert L. Jonal

**LOOKING AHEAD**

After counting out the membership and looking over all available facilities, we have arranged the following schedule for our general meetings. Throughout the fall, meetings will be held on the second Friday of each month at [illegible]'s in the Merchandise Mart, as follows:

October 13th
November 10th
December 8th

Dinner will be served promptly at 6:30 P.M.

The meetings will be adjourned prior to 9:30 P.M.

**Figure 12: The first issue of The Hopper, the newsletter of the (National) Machine Accounting Association.**

These articles and speeches returned again and again to a handful of topics. One of these was the enormous opportunity confronting the ambitious machine accountant. In a 1951 Hopper article, one long-time tabulating supervisor with International Harvester assured his colleagues, "Listen, Mr. Supervisor, wide open to you is the exciting opportunity to follow a growing trend toward mechanization of office effort in your company -- in the whole business world in general! And this trend is seething with possibilities. It's important! You as a tabulating supervisor are in

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on the ground floor of this trend. You can tie in with it... ride it to success... if you prepare yourself for the opportunities that will present themselves!" As here, they emphasized that these new rewards would accrue only to the worthy and the prepared.[193]

How to prove one's worth and prepare one's self for this brave new world? In their speeches, meetings and articles they invoked two terms again and again. One was "professional," the other "management." Indeed, collective action to improve their status, assert professional status and join the managerial class was the explicit purpose of the (N)MAA itself. After laying out a self-conscious program to attain the trappings of professionalism, the message from President Robert L. Jenal, in the first issue of The Hopper, concluded that, "through continuing efforts in this direction all of us in the Machine Accountants Association will soon see the day when we take an ever-increasing part in the thinking and planning of Management." A few years later, another president credited the establishment of the association to the realization "that machine accountants had a great potential future if they were banded together." [194]

Yet even as they laid claim to the status of accountancy, everything about them screamed membership of a very junior technical class. In these first years management was often a capitalized term in their reports – an exotic and distant landscape seen through veils of mist. They conceived professionalism in the most prosaic terms – a series of procedures by which they could join the higher status groups all around them. Elsewhere in that first issue an article asked, "Why Be Different? Look around your company and you will find that the Credit Manager, Traffic Manager and practically all department heads belong to associations designed to further them in their professions.... Certainly, as a forward looking Machine Accountant, you should follow a

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[193] D. G. Hoffman, "Opportunity", The Hopper 2, no. 1 (January 1951):6, 8.

[194] Gordon C. Couch, "The President's Column: Service--The Key to Advancement", The Hopper 5, no. 2 (February 1954):1-2.

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similar pattern to show that you too are interested in being of greater service to your management."

As these exhortations suggest, the line between serving management and joining management was often blurred during the first half of the 1950s. Articles on the improvement of managerial skills tended to reiterate the basics – show leadership, get staff to work effectively, find out what motivated them. The desired status of manager was juxtaposed with the current realities of "supervisor" and "technician."[195]

What specific action could be taken? Some authors and speakers recommended self-help. "So, You Want to Be a Manager?" a memorable screed from 1956, urged ambitious machine accountants to pursue the following: read books, take courses, join Toastmasters to practice speaking skills, take part in Church activities, and participate in the local PTA. The author, a training consultant for the Prudential Life Insurance Company, concluded with the observation that, "One of the most important aids in this transition from technician to manager is **to have faith**.... 1. Accentuate the positive! 2. Reject negative ideas! 3. Believe, first of all, in yourself. 4. Believe in your company. 5. Believe in your country. 6. Believe in the future, and 7. Believe in God."[196]

Others pursued the task of collective uplift on a more practical basis. Some of their activities were social – chapters organized dinners and dances to bring their members together. Both national and local organizations included women's committees so that the wives of the members could entertain themselves and each other with talks and social activities while their men-folk pursued their professional agenda. Members passed on their experiences with different

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[195] One of the earliest articles on the personnel aspects of management for machine accountants was L. J. Hale, "Never Underestimate the Importance of People", The Hopper 3, no. 6 (November-December 1952):8-12. See also Joseph P. Yoder, "The Machine Accountant: Supervisor or Manager?" Journal of Machine Accounting 7, no. 9 (September 1956):6-8.

[196] Wilkinson, "So, You Want to Be a Manager".

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kinds of equipment and shared their techniques for wiring more effective control boards. More formal presentations allowed experienced machine accountants to share their experience as supervisors. A number of chapters began to work with local universities and private training companies to develop courses in machine accounting techniques.

During the 1950s this blending of civic involvement, religious patriotism, professional bonding and social activity was by no means unusual. Groups such as the Rotarians and the Shriners maintained a distinctively American tradition of associational and grassroots capitalism – blending social service with fraternal self interest. The local chapters of professional and trade groups continued these traditions, affirming the social prestige of their members and the civic importance of their occupations. The machine accountants sometimes discussed their efforts as part of a more general "association movement," that bound specialist societies to the broader commercial success of America and helped small businesses to benefit from the knowledgeable specialists of larger ones. On a practical level, the functional similarities between local chapters of fraternal associations, secret societies, craft unions and professional associations are more striking than their differences. The main difference is perhaps that newer professional groups were concerned as much with their status within the social hierarchy of the corporation as within the broader community.[197]

Aware of their marginal positions, NMAA chapters frequently invited corporate controllers and public accountants to address their meetings and explain how they were perceived. Some of these men were former machine accountants now moved on to greater things. In 1952 the Boston chapter held a "Bring the Boss" night to which it invited Robert H. Kroeger, the comptroller of Combined Jewish Appeal and an executive of Stop and Shop Food Stores. His

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[197] On machine accounting as part of a broader associationalist movement, see W. H. Evans, "External Support for Data Processing", in Data Processing Volume VI: Proceedings of the 1963 International Data Processing Conference (Chicago: Data Processing Management Association,, 1963), 116-7.

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advice was typical of that given by sympathetic observers. "[I]n the machine account department, the department head is usually a very fine technician, who knows the machines, what they can and will do, and generally knows how to get the answers out of cards. But all too often, there he stops." He suggested that as a result the machine accounting department head was unlikely to understand "true accounting," or how the reports produced by the machines were used and why they might be needed. They were thus unable to understand the concerns of other departments, or bring real efficiency to their operations by pruning unnecessary jobs and combining others. He suggested that their very closeness to the machinery made managers unwilling to turn to them for advice -- "because our new machines are automatic or semi-automatic, for some unknown reason, many times we of top management think of our machine accountants as being automatic."[198]

One solution that Kroger and many others advocated was the "education" of management on the potential of their machinery. "[W]hy trust one of your most treasured possessions, your business, to the operation of a set of machines without at least knowing what those machines will do..." This differed little from the calls of the systems men to educate executives about the new methods of management. In both cases, the task was easier said than done. Whenever executives and technicians found themselves with a difference of opinion resulting from fundamentally different conceptions of what was important, it was rarely going to be the executive who felt obliged to seek reeducation.

Another staple complaint of the modernizers was that many machine accounting departments failed to practice efficient internal operations. These speakers suggested that before machine accountants could hope to improve the efficiency of other departments they first had to achieve a basic level of efficiency in their own operations. The elementary nature of these

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[198] Robert H. Kroeger, "Management Looks at Machine Accounting", The Hopper 3, no. 2 (March 1952):16-22.

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prescriptions reveal the prevalence of a surprisingly traditional and craft-based culture in the machine room itself. For example, many authors penned articles on the need to move toward the written documentation of all procedures, so that a job could be run even if the person responsible for it were sick or had been promoted. As a punched card instructor put it, "anything that's not written is hearsay and the second time it's repeated it becomes fable." Equally novel was the idea of having a formal system for scheduling work or for costing the amount of human and machine time involved in running a job so that its efficiency could be determined.[199]

The most managerially minded of these men realized that such a change would bring about a fundamental shift in the organization of the tab room, away from a craft-based apprentice system and toward something a little more like an assembly line. In 1953, a punched card manager from the Southern California Edison Company boasted of his company's success in using formalized flowcharts, written procedures and a neat color-coding system to manage its more than 500 control boards. It had standardized the "only one way that is the best and most efficient way," and in doing so increased production while lowering operation and training costs. But for tab supervisors to become more like industrial managers appeared to require tab operators to become more like assembly line workers. As he put it, "With the aid of machines and the procedures being prepared, a development… which in manufacturing circles has been called 'transfer of skill' is about to be introduced. How else can an operator with only a couple of years training -- or less -- be in a position to produce millions of dollars worth of dividend checks..." There is, however, little evidence that such a goal was widely achieved. Even here, you will note, the shift was "about to be introduced". Despite such occasional public flourishing of Taylorism,

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[199] E. Philip Daro, "Workshop Seminar on Selection and Training of Personnel", in Data Processing: 1958 Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1958).

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the tab room of the 1950s had more in common with the artisanal workshops of the first luxury automobile pioneers than the automatic assembly lines created for the Model-T. [200]

## How To Better Oneself – Machine Accounting and Systems

From its very foundation, the NMAA had hoped to attract systems men into its fold. As the first issue of The Hopper had reported, membership was not available to machine operators but should do "a great deal" for a "systems or methods man." Its success here was limited – systems men were attempting to burnish their managerial credentials by getting further away from the details of machinery. As the association's leaders charted a similar objective for their own members, it is unsurprising that they sometimes tried to broaden their authority into the systems area. During the late 1950s the more ambitious and managerially minded among the NMAA were promoting a broader role for the punched card supervisor, in which he would be charged with judging how best to apply tabulating machines to business as well as with tackling the jobs passed to him by others. Edwin Wolf, host of a 1958 NMAA workshop on "planning new applications" suggested hopefully that the tabulating supervisor was "always going where other people don't think he belongs… looking for things to do and asking questions." It was his job to investigate business, and particularly accounting operations, to find things that could be done better by machine. During this process he would have to create new procedures for efficient clerical work, and might even find out that machines were not the most appropriate tool for some jobs. But the responses from other speakers (who unfortunately remain nameless) reveal just how far from everyday reality these bold aspirations were. According to one, bad things would result "when the tab supervisor starts out on his own on…. getting into other departments, taking work

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[200] Alfred Whitney, "How to Prepare Machine Procedures", The Hopper 4, no. 2 (1953):1-5

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away from them. I'm afraid he would not only be unpopular, but he wouldn't be permitted in the building after a few weeks." [201]

This raised the question of where the tab department stopped and the systems and procedures operation started. As another speaker put it, "Tab service is usually set up as a service, reporting usually to the comptroller. The people who have the authority to report to top management and have costs (which they analyze) and work very closely with the tab personnel, are systems and procedures personnel." But Wolf insisted that many firms, particularly smaller ones, did not have separate systems functions and so, "Very often the tab man is the systems and procedures man." This would allow the tab personnel to take on systems duties by default, and so become more managerial and less technical. When a cynic asked, "What do you suggest this company to do get this tab man to get out of his chair and do some of this work?" and proceeded to answer his own question with "Compensation, I assume that's the only reason there could be," Wolf disagreed heartily. "The primary reason is to better himself, naturally," he replied. There is something in this notion of "bettering oneself" at once innocently ambitious, and profoundly conscious of class relationships and one's current place within them. It is more evocative of striving workmen or assiduous clerks than of a self-confident profession.

During the early 1950s the systems men paid considerable attention to punched card operations. They had two main perspectives on punched card work. The first was on the use of tabulating machines as part of efforts to improve administrative efficiency and implement new systems and procedures. Working out business procedures for use with tab machines required a

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[201] The workshop proceedings were transcribed as Edwin Deforest Wolf, "Workshop Seminar on Planning New Applications", in Data Processing: 1958 Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1958). On the original membership criteria of the MAA see Anonymous, "Questions and Answers".

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certain amount of familiarity with their operation and limitations. Thus punched card work was often mentioned as a tool or specialization in the repertoire of the systems man.[202]

The other perspective they had on the tabulating operation was as a sometimes chaotic and disorganized place in need of their systematizing skills. F.M. Johnson was a methods analyst with the Prudential Insurance company, a well-known pioneer of punched card operations. As we have seen, Prudential employed over six hundred people to operate more than a thousand pieces of IBM equipment. Operations on this scale justified the application of the methods of clerical efficiency pioneered by office managers, including careful measurement of machine output and efficiency. He estimated that only 45 percent of all the machine time available was actually used for production work. 21 percent was spent on setup, card handling, delays, testing and errors and the remainder was left unscheduled.[203]

Some systems men were quite skeptical about the managerial qualifications of tabulating machine supervisors. In 1953 a systems man working as an assistant to the Comptroller of the Continental Grain Company reported on his company's experiences with tabulating machines since their introduction in 1950. He credited careful planning and systems work with the success of the machines in halving the number of staff required and reducing costs overall. This success, he implied, would have been impossible to achieve had the department not been removed from the hands of a "technician" who viewed the department itself as a "complicated and intricate machine." Instead,

> the head man should have managerial ability, including the tact and patience to deal continually with his supervisors who may not understand the simplest fundamentals of punched card work. He must be able to talk two languages and be a true liaison between two different fields of work. He should be part salesman, part executive and part skeptic. He should never become lost in the

[202] For an early discussion of tabulating work within the systems community see C.G. Bishop and J. R. Woodward, "Two Tabulating Case Studies", Systems and Procedures Quarterly 1, no. 2 (June 1950):12-15.

[203] Johnson, "Control of Machine Accounting Equipment".

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> maze of wiring diagrams which make the electrical equipment function. In fact, it is best if he does not know how to run a machine. The technical aspects of wiring control boards and setting up the intricate details of machine operations are better left to a skilled technician.[204]

This discussion anticipates one of the most important discussions of the computer era – whether knowledge of computers is a qualification or a handicap for the head of the computer department. It demonstrates the enduring tensions between technical and managerial identities.

Wolf's discussion also reveals the ongoing conflict between the machine oriented, craft based culture of tabulating machine work and the efforts of modernizers within the NMAA leadership to promote a new, more professional and more systematic approach. Wolf took it as a given that all control boards should be accurately diagrammed and that the procedures needed to run a job should be written down and kept up to date. But his audience of tabulating supervisors was less certain. "A diagram of the wiring of the board? I found that to be a complete waste of time," said one. Another said "What do we do, do we go to the diagram or do we go to the board? I think that most of us go to the board." According to a third, "Most of us fellows in here probably got most of our procedures in our heads instead of on paper." To Wolf it was these attitudes, and a refusal to train assistants or formalize their work scheduling, that doomed his colleagues to a lifetime of technical work. "Well," he retorted, "it is very nice while you are in the tab department, and it also tends to keep you in the tab department."[205]

## Blue Piping, White Collars

Despite all the striving of the machine accountants to join the managerial class, existing members of that class were not keen to welcome them. In 1958, just as computers were beginning to raise the profile of punched card staff, the leaders of the NMAA invited James P. Moore, the comptroller of the Mutual Life Benefit Company of New Jersey, to address their conference and

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[204] Fraenkel, "Installing the Punched Card Procedure".
[205] Wolf, "Workshop Seminar on Planning New Applications".

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supply a truly managerial viewpoint. Unfortunately, his opinion of the managerial potential of the machine accountants, or as he insisted on calling them "the machine men", was not high. According to Moore,

> Management's point of view about Machine Men is, I think, undergoing a radical change. In the recent past such men were regarded by management in very much the same way as management regarded factory workers or automobile mechanics. In other words, they have been thought of in large part, and to the extent they may have been given any thought at all, as blue collar workers, or at the very least as having blue piping on their white collars. More recently, and I personally think that the electronics boom has been largely responsible, management has been taking a new look at the Machine Men.... It sees the same people, but somehow they look different. They seem to have a new hairdo, and some mighty attractive clothes which virtually obliterate any of the blue hues earlier much more discernable.[206]

While he perceived "a strong implication that Machine Men would like to join the ranks of management," he offered them little encouragement. He observed that, "Not everybody is either fitted for or belongs in the management ranks" and that their current attitudes were decidedly unmanagerial. In his view they were currently technicians, victims to an "obsession with machinery, any machinery as long as it is machinery." They had little sensitivity to "management's objective, namely, the making of profits." Their only hope was to pay more attention to methods and procedures, rather than to the latest equipment. As he put it, their instinct was to "put a lot of unnecessary frosting on a cake which was only half baked to start with."[207]

Thus from the outside the punched card people retained at least a hint of blue on their collars, had no discernable professional status and might, at best, be accorded respect as skilled technicians. A question must be asked of the punched card people that is less applicable to the systems men or the operations researchers: why did they seek their group mobility through

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[206] James P. Moore, Jr., "Management Viewpoints on Men, Machines and Methods", in Data Processing: 1958 Proceedings, ed. Charles H. Johnson (Atlantic City, New Jersey: National Machine Accountants Association, 1958).

[207] Ibid.

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managerial professionalism? Why not a union? In the eyes of executives their collars held at least a tinge of blue. They had a traditional craft culture and an identity constructed around their expert relationship with their machines. Knowledge of their techniques and procedures was usually passed down from person to person – almost none of them received college training and few even wrote down their procedures or documented their board diagrams. The path to seniority in the punched card world was from an informal apprenticeship under close supervision, through journeyman status as a wirer of boards and overseer of particular jobs to a final mastery of the craft as a tabulating machine supervisor. Their mysteries were little understood by outsiders. One might easily equate them with such skilled craft workers as printers in the pre-Linotype era. Might they not defend their trade on its own terms, through a craft union, rather than through a quixotic attempt to become either accountants or managers?

There are some important counter arguments. One is the (relatively) short-lived nature and (relatively) fast changing nature of punched card technology. Although punched card technology was introduced in the 1880s, it found truly widespread use across a wide range of administrative tasks only during the 1930s and 1940s. This deprived punched card workers of the chance to build strong traditions over generations, and of the nineteenth century heritage preserved in established craft unions. Another is the fact that punched card departments grew up from the first within large corporations – unlike more traditional crafts, in which unionization was an attempt to preserve the autonomy lost as artisanal independence was eroded in the new industrial order. A third powerful factor is the close linkage of the punched card staff with IBM and the other equipment manufacturers. When a punched card worker had been placed in his current job by an IBM representative, had received his only formal training in machine operation, supervision or job planning through complimentary IBM sales events, and depended on the IBM rep for assistance with the analysis of new tasks, it was less likely for him to identify corporate

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management as the enemy. The other easily available role model for the punched card staff was the corporate accounting profession – not exactly a hotbed of union activity.

Two other considerations were probably of even greater importance: the advantageous labor market for punched card staff and the general attractiveness of unions during the 1950s. Workers in general turned toward unionization only after their loss of pay, autonomy, dignity, social status and predicable employment forced them to abandon an earlier republican sense of participation in the world of business as individuals. This never happened to the punched card staff. Although they started from rather a low base, their progression in terms of wages, respect, status and job opportunity was one of gradual improvement rather than erosion. Punched card machinery spread rapidly from the 1930s to the 1950s, and computers spread still more rapidly afterwards. This rate of growth gave punched card staff a reasonable hope of rising to a supervisory or senior position and enjoying an improved standard of living. It also made it easy for them to move between companies, strengthening their identification with their trade but weakening any feelings of comradeship they might feel for less privileged workers around them. Neither did new technology ever really deskill or routinize punched card work.

By the early 1950s, as McCaffrey moved more deeply into punched card work, the union movement might not have been such a tempting thing to join. On one hand, following the shocks of the 1930s and the political battles of the 1940s the union movement had reached its zenith in terms of numbers, and achieved a new respectability and stability. On the other, by doing so it had abandoned claims to exert a real say in the way that companies were managed or structured, settling instead for the improvement of pay and conditions. Although it was not apparent to most contemporary observers, it had also been contained within established, blue-collar occupations and industries. Professionals, supervisors and clerical workers were never broadly unionized. If the "white collar proletariat" of badly paid and regimented typists, stenographers and file clerks with dead-end jobs could not be organized then what hope was there for the punched card staff?

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This is a counter-factual question. Not only did punched card workers or their successors as computer operators and programmers never unionize but no serious and widespread attempt to organize them has ever been documented. But given the subsequent restructuring of the economy, it does not seem unreasonable to suggest that a union movement without appeal to the new skilled craft occupations such as punched card workers, and their successors, was one unlikely to thrive in the long term. When highly skilled, technically oriented employees like printers were replaced with computer-based technologies, developed and overseen by other highly skilled, technically oriented employees, the people who lost their jobs identified themselves as workers whereas the people who kept their jobs identified themselves as managerially-oriented professionals. Neither identity was determined primarily by the nature of their skill, or by their relationship to their technologies.

### Inside The NMAA

The campaign for "betterment" was conducted on several levels. On one hand the battles were fought within the operations of individual firms. But as the association grew in strength many chapters tried to shape the uplift of their membership through programs of education and training. Much of this took place through the mechanisms of chapter meetings, personal contacts and addressees. Some of the more ambitious chapters supplemented this with more formal seminars, in some cases working with local universities to offer extension courses for their members.

For example, in 1954 the Kansas City chapter was planning to work with the University of Kansas City to provide courses for its membership. While some chapters arranged vocational courses in the use of specific machines and techniques, the education committee of Kansas City planned a more ambitious program to boost the professional caliber of its membership: "We must encourage a sincere desire on the part of the member to broaden his personal outlook toward his

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chosen profession. Our educational obligation is to create a desire within that member to want to better himself as the opportunity arises." They proposed a series of courses to cover accounting, supervision (basic personnel management), applications (how to apply the machines to new problem, including systems and procedures techniques, work simplification) and office management ("to equip the machine accountant to accept broader responsibilities and to enter into the broader sphere of influence"). The emphasis on accounting was necessary to justify the "machine accountant" title and to assure "our future progress. To which end, "We must bring them up to date in accounting principles and somewhat away from the positive and negative narrowness imposed by 'punchies' in a card." But this increased knowledge of accountancy was seen not as a way of becoming accountants, but as a stepping stone on the way to executive management. Knowledge of accounting would lend a broader managerial perspective, and ultimately "fulfill a need to give even further knowledge in the broad sphere of executive management... give the individual all he needs to move into higher positions within his company."[208]

James A. Hunt, the author of the report, recognized that this was an ambitious agenda to pursue. "Upon first appraisal of the above, it may appear that our goal is seemingly impossible. However, we must realize that if there is going to be any substance to the organization itself, we must offer something useful, worthwhile and concrete for the betterment of all the members." This problem of substantial betterment was to hang over the association for the next twenty years. During the late 1950s, Hunt pursued similar objectives as the national association's Vice President for Education. They were ultimately central to its education and certification programs of the 1960s. But progress on the national level was slow. In 1957, Hunt told the NMAA conference that despite progress by several chapters, and a number of partnerships with local

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[208] James A. Hunt, Progress Report: College sub-committee, Educational Committee, Kansas City Chapter, NMAA, 1954, contained in Data Processing Management Association.

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universities, there was still little national support or overall structure. "Action has come as a result of integration of the local need or the local pressure."

During the first few years of its existence the national organization seems to have had little authority other than as an assemblage of individual chapters. Its committees achieved little and it had no staff of its own. Chapters submitted little material to The Hopper, meaning that it was filled in large part with the reprints of article published elsewhere. The main contribution of the national association appears to have been as a clearing-house of useful materials developed by the chapters and as a sponsor for the national convention. In 1953 then president Gordon G. Crouch reported that following the successful completion of the second national conference (attended by more than a thousand people) the association planned for the first time to hire a secretarial assistant for its volunteer national secretary. To pay for this and other improvements, "annual dues have been raised from one dollar to three dollars which, in the opinion of your board of directors, is still a bargain."[209]

During 1955 the national association also investigated the production items bearing its insignia, including Zippo lighters, tie-pins, name badges and membership certificates. It provided a small number of awards, including one to the chapter supplying the most material for The Hopper. It also lent the NMAA banner to chapters when they wished to use as a backdrop for important occasions. Apart from sponsoring the national meeting and producing The Hopper, this appears to have been the limit of its activity.

Explosive growth in the number of chapters (103 chapters with 7,500 members by 1955) made it hard for the association's volunteer national leadership to keep up, and left the relationship of chapters to national headquarters a highly charged issue. This rapid growth was to leave it with a rickety structure, because its charter legally established its board of directors as

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[209] Gordon G. Couch, "New Horizons for NMAA", The Hopper 4, no. 6 (June 1953):1.

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including at least one representative from each of its constituent chapters – leading to board meetings with several hundred so-called directors present. This sometimes led the executive staff at national headquarters to view the chapters as an ignorant and unruly rabble, while the chapters were inclined to resent the resources committed to the national organization and the control they gave up to it.

The leaders of the national association saw The Hopper itself as something that its members should be able to show to their superiors "in order to impress top management on the importance of the NMAA." As early as 1952 the association's Board of Directors was seeking ways to make the publication more credible in this respect and to change its name to something more managerially-oriented. By 1954 dissatisfaction with The Hopper was rife and the directors has lost patience with the team of brothers who produced the journal in their spare time. "They just don't do nothing. They just sit and wait.... We are trying to get a professional publication out of an amateur staff."[210]

They did, at least, succeed in changing the publication's title. In 1954 the results of a questionnaire delivered to the Executive Committee had shown that the members considered "The Machine Accountant" and "Journal of Machine Accountants" to be preferable titles. The committee added the third and ultimately victorious title of Journal of Machine Accounting – Systems and Management before sending the choices to the Board of Directors for a vote. The series of name changes reflect an effort by the leadership of the association to affirm its managerial credentials and move it away from a focus on machinery. Discussion of the possibility of hiring a professional editor or transferring the journal to a real publisher continued through the

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[210] National Machine Accountants Association, Board of Directors Minutes, 18 June, 1952, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 5. National Machine Accountants Association, Board of Directors Minutes, 18-19 Feb., 1954, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 157-58.

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1955 and was the subject of an entire session of the Executive Committee in 1957. In 1958 the committee voted to change its name again, to the Journal of Machine Accounting, Data Processing and Management.[211]

Punched card staff identified so closely with their machines that the difference between IBM and Remington Rand users assumed the status of a schism, constantly threatening to break apart the unity of the association. In at least one chapter, these tensions lead to a board evenly divided between the two camps and to its ultimate disintegration. The national association refused to recognize attempts to set up chapters that included only one kind of machine, or those, like a proposed Washington chapter limited to non-governmental users, that specialized in particular kinds of user.[212]

The appointment in 1955 of Dick Irwin as Executive Secretary, who on a salary of $7,500 became the first full time staff member, began to strengthen the national association. Irwin, the former IBM time-clock man from Cleveland, had been active as a volunteer in the association and served as its president. The association had previously been run by a volunteer Executive Secretary. Irwin's shift from elected officer to salaried staff person, and indeed before that from time-clock repairman to NMAA president, reflected the rather small world of punched

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[211] See National Machine Accountants Association, Executive Committee Minutes, 17 Feb., 1954, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis for discussion of new names for The Hopper, National Machine Accountants Association, Executive Committee Minutes, 10-15 June, 1958, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis for the vote to change its name again, National Machine Accountants Association, Executive Committee Minutes, 9-10 Sept., 1955, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis for discussion of a new publisher, and National Machine Accountants Association, Executive Committee Minutes, 23-28 June, 1957, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis for the special session on the future of the journal.

[212] National Machine Accountants Association, Executive Committee Minutes, 14 June, 1955, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 12.

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card practice during the 1950s. The association was still a rather ad-hoc, part-time operation dominated by a fairly small leadership who tended to swap offices with each other.

During the 1950s the most ambitious of the NMAA leaders promoted three crucial transitions in the identity of their members: from technician to professional, from supervisor to manager and from a machine focus to business system focus. These three transitions were soon to be joined by, embodied in, and in many ways subsumed to, a fourth: the transition from mechanical punched card equipment to electronic computers. From the mid-1950s onwards, discussion of electronics began to dominate discussion of the future of machine accounting. This culminated in the redefinition of the association itself – from machine accounting to data processing.

## Three Visions of Management

The machine accountants, the systems men and the operations researchers were all outsiders of one kind or another, seeking to legitimate themselves as managers. Each had, in some way, to redefine accepted notions of what was, or was not, managerial. Each of them was represented by one or more professional associations founded within a year of two of 1950, and each of them was closely tied to the emergence of a particular corporate function. Their identities developed, and their fortune waxed or waned along with the position and size of a little box on the corporate organization chart. Each had to build a new identity among its members, one that was at once coherent, managerially-oriented and demarcated by a distinct zone of professional authority separate from that of other groups.

Despite these similarities, their origins and cultures were quite different. The operations researchers clearly came from outside the corporate world, and as they saw it, from above. They believed themselves to practice a scientific, and therefore higher and more universal, way of knowing, and so sometimes approached the world of management with an unappealing mixture of

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condescension, ignorance and arrogance. They did not want to join management as it was, but to create a new kind of management in their own image. The machine accountants came just as clearly from below. They were technicians and supervisors, machine men and artisans. They wished to "better themselves" along every axis available – to become at once managerial and professional. They worked the hardest of the three groups on achieving the tangible trappings of corporate professionalism enjoyed by groups like accountants.

The systems men are less easily categorized. Their backgrounds were diverse, and for practical purposes the new systems and procedures identity was a narrow wrapper placed around a mass of different and more technical specialties. Like the machine accountants they were trying to upgrade themselves from technical to managerial status. Unlike the machine accountants they had at least some realistic connection to the concerns of executives. Of the three groups they clearly had the best understanding of management and the clearest idea of where they should fit within it. Their problem was that most general managers did not share the particular ideology of systems they had adopted to unify their different specialties and demarcate a broad authority for their staff authority. However much "selling" or "education" they directed toward executives, they were largely unable to escape the control of the financial function or to gain the freedom to plan a comprehensive re-engineering of business procedures rather than being dispatched to fix one local problem after another.

None of these groups came from the traditional ranks of management. All of them sought group mobility through different combinations of professional identity building, promotion of the importance of their work to executives and the retraining of their fellows. This is why the concept of managerial class formation discussed in the introduction remains salient. They did not aim to become managers one at a time, working their way into the management ranks and climbing the pyramid from supervisor to middle manager. Instead they sought collective entry to the managerial class, by strengthening rather than abandoning their more specific identities as

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systems men, operations researchers and machine accountants. The nature of the managerial class formed by their struggles was subjective, unstable and constantly shifting. Like the working classes explored by recent labor historians, it arched above the more stable and more specific identities associated with particular crafts and occupations. Like those class identities, it evolved with material shifts in the nature of work and broader social transformations, but cannot be reduced to a deterministic product of material transformation or a simple reaction to externally imposed and impersonal forces.

The categories of "management," "system" and "technician" were as provocative and as intellectually malleable during the emergence of the modern managerial classes as ideas like "republicanism" and "artisan" were in the formation of the working class a century before. Like so many other social groups, the three examined here were involved in making claims about the inherent nature of things and by doing so establishing a perceived world in which the value of their expertise would appear to be self-evident. In corporate society, just as in larger society, ideas do not float disembodied in a dispassionate intellectual sea. Ideas like "systems" were shaped by the existing cultures of the groups that adopted and promoted them, and once established these ideas in turn played a vital part in shaping the world in which we all live and work. They are deeply embedded in specific social and cultural traditions. Like the republican rhetoric of democracy and personal autonomy, each idea was claimed and redefined by a number of different groups, giving rise to discussions in which different parties would seize upon the same rhetoric to support opposing points of view.

Nor were these the only three visions of aspired-to managerial identity being promoted during the 1950s. Specialist groups of all kinds, from records managers (the supervisors of file clerks) to purchasing managers were joining their own associations. Business schools were creating the modern MBA curriculum, and putting a new emphasis on quantitative and financial methods. Executives and scholars discussed whether management could or should be a

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profession, and whether managers should heed a noble responsibility to social well-being. Should management be a science? A profession? Neither? Everyone wanted to be managerial, but no-one was really sure what it meant.

Nevertheless, by the mid-1950s, the three groups were already moving towards a shared destiny and a new mission. Over the course of the next decade, each was transformed by its relationship with the new technology of the electronic computer and each was largely absorbed into a new corporate institution: the data processing department. Their separate reactions to the new technology were profoundly conditioned by their earlier aspirations and the struggles of their members to forge coherent and managerially relevant identities. Each of the three groups played an important role in shaping the cultures and institutions of corporate computing, eventually becoming semi-autonomous strata within larger, hybrid departments.

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# SECTION II: CREATING DATA PROCESSING 1954-1958

## 5. BUYING AND SELLING AN ELECTRONIC REVOLUTION

The history of the computer is littered with firsts. Historians have identified a host of seminal machines, each adding another important characteristic of the modern computer and so deserving the some much-hyphenated version of the title. Dismissing the un-built mechanical devices of Charles Babbage still leaves the seeker of seminality a progression from the 1944 Harvard Mark I (first programmable, digital, general purpose, automatic computer) to the 1948 EDSAC (first stored-program, digital, general purpose, electronic, full-scale computer in regular use). This in large part because of the many inconclusive battles (some legal, some personal) to establish the first computer, and therefore to name its inventor and patent holder.[213]

But despite the fact that the electronic digital computer had been well and truly invented by 1948, the public paid very little attention to it. Newspapers, magazines and newsreels did contain reports on the "giant brains" that filled rooms and performed calculations with inhuman speed and accuracy. This was not, however, a media barrage – the computer was much less well known than other novel wartime technologies such as radar, the atomic bomb and the jet engine. Early managerial discussion of the computer presented it as an electronic marvel about to transform the world of business. Although experimental computers such as the ENIAC received a reasonable amount of publicity during the 1940s, businessmen would read little about them on the

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[213] The invention of the computer was a topic of enormous controversy at one point, prompted in part by a lawsuit filed by Honeywell against Sperry Rand in an attempt to invalidate the patent issued to the ENIAC's inventors by showing that the computer had been invented by John V. Atanasoff several years earlier. The question thus assumed considerable financial importance, and also motivated a good deal of historical debate, the outcome of which has been general acceptance of this series of hyphenated titles. Historians have now lost interest, though partisans continue to debate fiercely – for a recent example see Scott McCartney, <u>ENIAC: The Triumphs and Tragedies of the World's First Computer</u> (New York: Walker & Co, 1999).

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pages of Fortune, Forbes or Business Week. These giant electronic brains were scientific curiosities.

It takes the modern reader a certain degree of mental effort to appreciate the indifference with which most of the business world greeted the advent of the electronic computer. Pioneering machines such as the ENIAC are more widely known today – enshrined as they are by popular museums and books as the seed of the information age – than they were during their own operational lifetimes. It was far from clear that this expensive, exotic and experimental behemoth of calculators had any role to play in the administration of business. It seemed as remote from industrial management as the battleship or V2 rocket. If one were to look for an epoch defining technology so fundamental that it would change the operations of every business then nuclear power would have been the likely choice, with its promise of energy too cheap to meter.

This obscurity was, in large part, well deserved. At the end of 1950 the world boasted less than a dozen operational general purpose electronic computers, all of them one-of-a-kind models built for experimentation and technical calculation.[214] Their creators accomplished astonishing feats, inventing not only individual machines but also the wealth of electronic devices such as memory tubes and ideas such as the programming tools necessary to make them function.

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[214] Putting precise numbers on such a claim is always hard, in part because of the questions of which machines to include, and how to treat experimental computers being tested. However, a list as of December 30, 1950 would reasonably include the US Army's ENIAC and (installed but not yet working) EDVAC, Harvard's Mark III (under testing by the Navy), IBM's showpiece SSEC, Cambridge University's EDSAC, MIT's WHIRLWIND, the National Bureau of Standards SEAC, Manchester's Mark I, the National Physical Laboratory's ACE, the German Z4, and the one-off BINAC produced by Univac for Northrop. If one counts the most advanced punched card systems (the CPC and 607), analog computers, or programmable electro-mechanical machines (a series of Bell Labs machines, two earlier Harvard models), the list becomes far longer. If one excludes machines which did not follow the stored program model, such as the ENIAC and the Harvard Mark III, then the list is even shorter. On the Harvard machines see I Bernard Cohen, Howard Aiken: Portrait of a Computer Pioneer (Cambridge, MA: MIT Press, 1999) for the Mark I and J A N Lee, "Howard Aiken's Third Machine: The Harvard Mark III Calculator or Aitken-Dahlgren Electronic Calculator", IEEE Annals of the History of Computing 22, no. 1 (January-March 2000):62-81 for the Mark III. On the Bell machines, see Paul E Ceruzzi, Reckoners: The Prehistory of the Digital Computer, from Relays to the Stored Program Concept, 1935-1945 (Westport, CT: Greenwood Press, 1983).

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They were motivated more by the thrill of the machine itself than by any particular task that the machine was likely to perform (admittedly, this was not generally what they told their sponsors). When the computers did undertake useful work, this was primarily in the solution of scientific problems and the printing of mathematical tables, something reinforced by the academic environment in which they were constructed.[215] Funding for early computer development in the US came overwhelmingly from the Federal government and its various military offshoots.[216] In the brave new world of the atomic era, association with big science promised considerable prestige to the computer and its creators. The first machines had limited capacity for internal storage, tended to fail after very brief periods of sustained work, and did not possess many peripheral devices with which to store and retrieve a large amount of data.

The startling thing is not the businessman's ignorance of the computer, but the rush to commercialize this obscure technology. At the close of 1950, the prototype of the Univac I (the first commercially marketed computer model) was nearing completion, Ferranti was working on its own computer product, the British LEO was just a few weeks from tackling the first computerized payroll run, and Thomas Watson Jr. had already committed IBM to enter the computer business.

Business leaders learned of these first, experimental, computers the same way as the rest of the public – through newspaper reports, magazine articles and some popular books. A few managers did not even wait for computers to become commercially available before throwing themselves into the new field – but these men were very much the exception rather than the rule.

[215] The first histories of the computer clearly reflect the concerns of this era. These accounts present the computer as revolutionary tool wielded in the service of a well established goal. The computer is revealed as the direct descent of the abacus, Napier's "bones", Pascal's calculator and the slide rule – all devices that scientists and engineers have relied on for their mathematical work. Although the computer possessed remarkable speed, and the new attribute of programmability, its reassuring position as the final branching in a long family tree served to make it seem less risky and alien.

[216] For a thorough exploration of the role of the state in funding early developments in computer technology, see Kenneth Flamm, Creating the Computer : Government, Industry, and High Technology (Washington, D.C.: Brookings Institution, 1988).

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The best known is Edmund Berkeley. Although Berkeley is sometimes characterized merely as an "insurance executive" who saw potential in the computer, his background is actually more interesting than this. An actuary by professional training, he first became interested in mechanical calculation while working in the Prudential Insurance methods department – exposing him to punched card technology and to the nascent culture of the systems men. After discussing the potential of electronic calculating technology for the insurance industry with GE and Bell Labs as early as 1941, Berkeley spent much of the War assisting Howard Aiken with his enormous mechanical calculators at Harvard. On his return to the Prudential he actively involved himself with the groups trying to commercialize computer technology, and persuaded his company to place the first order for a Univac computer. [217]

Berkeley left the Prudential shortly afterwards, but his interest in computing did not abate. Instead he wrote a book on the topic, Giant Brains: Or Machines That Think. On its publication in 1949 this book became the definitive popular guide to the new field of electronic computing. Through its attempts to demystify the computer and present it as one of a long series of information processing machines, Berkeley created a template that authors would follow for decades to come. He was also the founder of the first American academic society for the computing field: the Association for Computing Machinery (ACM). But the same passionate commitments that drove Berkeley into computing also drove him out of the insurance industry. His strident opposition to nuclear weapons and steadfast advocacy of world peace cost him his job at Prudential, and caused many within the computer field to view him as a crank. For better or worse, most managers did not share his nature. Few followed him into computing, and few were

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[217] Berkeley is discussed at length in Yates, "Early Interactions Between the Life Insurance and Computer Industries: The Prudential's Edmund C. Berkeley" and in Atsushi Akera, "Calculating a Natural World: Scientists, Engineers, and Computers in the United State, 1937-1968" (Ph.D., University of Pennsylvania, 1998), 567-86. Both rely on his archival papers -- Edmund C. Berkeley Papers (CBI 50), Charles Babbage Institute, University of Minnesota, Minneapolis.

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as eager to order experimental technology. After his departure, his colleagues rescinded the Univac order.[218]

The arrival of commercially available computers from Univac and IBM made the computer into an object of professional concern for less unusual managers. Since 1946, Eckert and Mauchly, the creators of ENIAC, had been attempting to design and sell a large commercial computer for administrative work. For the next few years they had this market to themselves, but even so their progress was slow. It was 1951 before they delivered their first computer, by which point their company had become the Univac division of Remington Rand. Like the first punched card technology, it was put into use by the US Census Bureau. The successful installation of a computer brought much needed credibility to Univac and proved the existence of a market for their product, but it was the use of a Univac by CBS television to issue early predictions of the 1952 Presidential election that first gained the company widespread publicity. The success of the Univac prompted IBM into the development of its own large computer, the IBM 701, first installed in 1953. At the same time, the computer manufacturers began a concerted push to "educate" management as to the value of their wares.[219]

The first computers purchased by American corporations were used for calculation, rather than administration. Thus, for a brief historical moment, the majority of corporate electronic computer installations and trained programmers were engaged in scientific and engineering computational work, rather than administrative processing. This community came late to the use of punched card machines, and was never more than a minor sideshow in the punched card world.

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[218] Edmund C. Berkeley, Giant Brains or Machines That Think (New York: John Wiley & Sons, 1949). Berkley's role within the ACM is discussed by Akera, in Franz L Alt, "Fifteen Years ACM", Communications of the ACM 5, no. 6 (1962):300-07 and in Lee Revens, "The First 25 Years: ACM 1947-1962 (sic.)", Communications of the ACM 30, no. 10 (October 1987):860-65.

[219] A good summary of the development of the Univac and its relationship to IBM is given in Campbell-Kelly and Aspray, Computer, 105-30. For a longer treatment, see David E Lundstrom, A Few Good Men from Univac (Cambridge, MA: MIT Press, 1988).

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Its culture and interests were at odds with those of mainstream punched card staff. By virtue of the rise of big science and the military-industrial complex during the early 1950s, technical computation was suddenly a viable market for IBM's million dollar 701, driven by users like Boeing, Douglas Aerospace and Lawrence Livermore, Lockheed, Los Alamos and the National Security Agency. This group formed a small part of IBM's total business, but a very substantial part of its early computer business.

We saw earlier that punched card supervisors gained status among their peers largely according the value of their equipment, expressed in "points" or monthly rental dollars. A similar culture had sprung up among groups established to perform scientific and engineering calculations. As a member of Boeing's group recalled, prior to the 701, "A computing facility's status was determined among peer personnel in industry by the number of CPCs and by the number of 16-register external storage units each contained." The arrival of the 701 gave a whole new dimension to this competition. Early users boasted of their success in winning good positions on IBM waiting lists, or in persuading the firm to supply them with hard-to-obtain luxuries such as video outputs and expanded memories. Heads of IBM 701 installations formed a small and prestigious club, literally and metaphorically. The literal version of the club was called SHARE, and was established formally in 1954 to coordinated regular meetings between representatives of the 19 701installations. SHARE was limited to users of the scientifically oriented 701 (and its successors), ensuring that scientific and administrative computing user groups retained their separate identities.[220]

But by the mid-1950s the balance was swinging back toward machines intended for routine administration, as IBM brought its new large-scale electronic technologies to bear on its heartland markets. This push was led by a new "Electronic Data Processing Machines" group set

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[220] Randall E. Porter, "First Encounter with the 701", Annals of the History of Computing 5, no. 2 (April-June 1983):202-04.

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up in 1954 and headed by Vince Learson, a veteran sales executive with considerable internal clout. Its first product was the 702, announced in September 1953 but not delivered until 1955. The cost and capabilities of the 702 were roughly comparable to that of the Univac I, combining a tiny electronic memory with banks of tape drives and a relatively high-speed calculating capability.[221]

The transformation of the computer into a machine optimized for corporate administration was by no means a trivial task. The first commercial computer hardware was relatively close to the experimental laboratory machines of the 1940s, and so was well suited to routine, mechanical calculations such as ballistics tables calculated by ENIAC. Being small, the program taxed neither the input capabilities nor the internal memory of the computer. Because each item of output involved a great deal of calculation the slothful nature of printers and cardpunches was not an undue problem. The machine's overall throughput was constrained more by the speed of its calculating units than by the speed at which data and programs could be fed through it. As an early user of an IBM 701 in the aerospace industry was later to recall, "Computing really was just that: input numbers from cards were transformed into output numbers on the printer". There was no need even to write routines to handle the processing of text.[222]

Accounting problems reversed this ratio, placing much more stress on the machine's internal memory and on the speed at which data could be read into memory. Because scientific and administrative computing involved different sets of trade offs, the 701 and 702 differed fundamentally in their internal representation of data. The 701 worked directly with binary numbers, giving it additional flexibility for scientific calculations but making it convoluted to

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[221] On the origins of the 702 see Bashe et al., IBM's Early Computers, 121-76. For a contemporary description, see C J Bashe, W Bucholz, and N Rochester, "The IBM Type 702: An Electronic Data Processing Machine For Business", Journal of the Association for Computing Machinery 1, no. 1 (October 1954):149-69.

[222] C. L. Baker, "The 701 at Douglas, Santa Monica", Annals of the History of Computing 5, no. 2 (1983):187-94.

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work with text. The 702 hardware broke data down into individual characters and stored numbers as decimals, giving it the edge when working with text and with data split into records of differing length – situations frequently encountered in administrative work. When machines like this were applied to administrative tasks, keeping them fed with data became a particular problem. Punched cards and paper tape were reliable and well-proven technologies, but the machine would spend most of its time waiting for the next card to be read. Magnetic tape could supply data in a flood rather than a trickle, but it was a new technology and early versions proved notoriously unreliable. Despite its specialist design, the 702 suffered for administrative purposes because it was not able to process one record simultaneously loading another from its tape drives – crippling its performance when working with large administrative files. Meanwhile the Univac I was sold for various civilian purposes – though its design was not particularly well suited to either kind of work. [223]

Even after the first administrative-oriented computers were announced and promoted, few general managers had a clear idea of what they were or what they could do. The object of discussion in the early 1950s was often not "the computer" as such, but the more general yet closely related topics of "electronics for the office" or "automation." As consultant John M. Thesis informed an audience of cost accountants in 1954, "The word 'electronic' has become a 'buzz word' joining 'atomic' and 'space flight' in conveying the impression of scientific magic." It was by no means apparent in the early 1950s that the stored program, electronic, digital computer was the key electronic product.[224] It appeared initially as a representative of a much more general

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[223] Bashe et al., IBM's Early Computers is still best source of information on these IBM machines.

[224] A word on analog computers is appropriate here. Historians have devoted considerable attention to the role of analog electronic computers. See, for example, Aristotle Tympas, "From Digital to Analog and Back: The Ideology of Intelligent Machines in the History of the Electrical Analyzer, 1870s-1960s", IEEE Annals of the History of Computing 18, no. 4 (Winter 1996):42-48, Per-Arne Persson, "Transformation of the Analog: The Case of the Saab BT 33 Artillery Fire Control Simulator and the Introduction of the Digital Computer as Control Technology", IEEE Annals of the History of Computing 21, no. 2 (April 1999):52-64 and Analog computers were models, in which numbers were represented by

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class of electronic technologies, which would replace humans in the performance of an ever-wider collection of tasks. Even in the managerial press, considerable credence was given to the imminent arrival of totally automated factories, which were predicted to inflict massive technological unemployment and fundamental social change. Thus the potential of "electronics" in business was frequently claimed to lie in its corresponding potential to automate many of the activities currently conducted by management. As Thesis remarked later in the same article, "Electronic data processing systems are now the highest form of mechanization available for business procedure applications."[225]

Like other corporate managers and specialists, systems men and machine accountants were only exposed to serious discussion of the computer and its potential for administrative management from 1953 onwards. Only from this date does one find appreciable numbers of articles about computing in their journals and magazines, speeches on computing at their chapter meetings and conferences, or reviews of computer related books in their newsletters. They therefore enjoyed no head start with the computer over their counterparts in accounting or general

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continuous variations in the strength of internal signals or position of internal elements. Side rules, orreys and the "Phillips Machine" hydraulic model of the Keynesian economy were all mechanical analog computers. The use of electronic components and amplifiers made it possible to construct more elaborate models. The first such computers were essentially miniature models of electrical power systems, but engineers soon realized that they could be used to solve other systems of differential equations. During the 1950s and 1960s such machines were often efficient and practical alternatives to more complex programmable digital computers. Many hybrid analog/digital designs were also produced. In contrast, digital machines (such as desktop adding or billing machines) represented numbers as a string of digits, each one of which had a discrete value. To perform a calculation, each digit was considered separately. This is another area where the term "computer" proves misleading. While both analog and digital machines could perform many kinds of computation, analog technology had no possible use in the administrative data processing tasks in which the "computer" found its primary calling. Punched card machines were all entirely digital. No analog machine could store a name, print an address or process a payroll file. The only plausible applications of analog machines to administration would have been for operations research tasks such as managerial model building and simulation.

[225] John M. Thesis, "Practical Application of Electronic Equipment", Journal of Machine Accounting 6, no. 3 (March 1955):5, 7-8, 16-17 (the article originally appeared in NACA Bulletin, August 1954). The term "automation" was coined within Ford during the late 1940s, but only became widely known following its tireless promotion by consulting prodigy John Diebold during the early 1950s – see John Diebold, "Automation - The New Technology", Harvard Business Review 31, no. 6 (November-December 1953):63-71.

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management. They also learned about computers in much the same way as other managers – through articles, speeches and seminars from the representatives of computer manufacturers (and later from the handful of consulting firms beginning to involve themselves in the field). But despite its relatively late arrival in their occupational discourse, the computer was rapidly seized on by the systems and machine accounting communities.

## "The Ominous Rumble You Sense is the Future Coming At Us"

The first mention of "electronics" in the Systems and Procedures Association journal Systems & Procedures Quarterly was made by John Haslett of Shell Oil. In its 1950 inaugural editorial, Haslett suggested that future historians would view the "coming revolution in paperwork" as equal in magnitude to the earlier revolution in industrial production. But while he identified "technology" as a driving factor in this revolution, he named no specifics. Haslett continued his argument in a 1951 article, the title of which posed the question "Is the Modern Office Vanishing?" He outlined an evolutionary theory of the office, in which the rise of the systems men was an inevitable and logical step. Beyond this lay an electronic future, in which, "The place of the systems specialist on the management team will become universally secure, providing the profession as a whole has done its job well." New technology would make office production more like factory production, and centralize it to justify the use of powerful but expensive machines. [226]

In this later article, Haslett singled out electronics as the key technology of the paperwork revolution. This culminated in a challenge to his fellow systems men to channel the transformative power of electronics towards their own professional ends. "Paper work may be entirely eliminated. Instead of a piece of paper representing each business transaction, there may

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[226] Haslett, "The Coming Revolution in Paperwork" J. W. Haslett, "Is the Modern Office Vanishing?" Systems and Procedures Quarterly 2, no. 2 (June 1951):11-13.

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be substituted something like an electronic impulse, regardless of the distance between points of origin or reception. The inevitable paperwork revolution is clearly at hand, for technology affects the office no less than the plant. It is up to management to recognize that fact. It is up to the systems man to do something about it."[227]

Bold as this concept of electronics was, it lacked any particular grounding in commercially available technologies. The systems men had no particularly privileged access to information about the computer, indeed Haslett's was the only article on electronics published in SPQ during 1951. The next year it published another, this one attributed to the President of Burroughs Corporation, the leading vendor of adding and bookkeeping machines. Sticking more closely to current technology, he warned that the computer required substantial modification before it would be a practical tool for business.[228]

In 1953 a third article on electronics appeared. The article's author, W. B. Worthington, a systems man working for Hughes Aircraft, shared Haslett's dream. Worthington's technical knowledge of the computing field appears, from his citations, to have gone little further than the reading of an article in Dun's Review. Indeed, Worthington made the bizarre yet revealing claim that Taylor's Principles of Scientific Management remained the best initial guide to the application of computers. His enthusiasm for the new technology was palpable. "We can set a course towards push-button administration, and God willing we can get there... The ominous rumble you sense is the future coming at us..." The article was long on hyperbole and short on specifics – though it did suggest that the business power of electronic technology lay in its ability to work faster than a human.[229]

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[227] Haslett, "Is the Modern Office Vanishing?" page 13.
[228] John S. Coleman, "What Price Business Electronics?" Systems and Procedures Quarterly 2, no. 3 (January 1952):4-7.
[229] W. B. Worthington, "Application of Electronics to Administrative Systems", Systems and Procedures Quarterly 4, no. 1 (February 1953):8-14, 9-10.

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The first actual case study of the use of electronics to be documented in SPQ was not of a general purpose computer (despite its choice of "Electronic Data Processing" as a title) but of a custom-designed toll collection and accounting system for the New York and New Jersey Port Authority. Discussion of a general-purpose computer came a little later, when Milton E. Mengel, a representative of Burroughs, became the first to explain programmability and the differences between scientific computers and the models tailored to business that his company planned to supply.[230]

It was followed in 1955 by an address from electronic data processing and systems consulting firm Haskins and Sells, promising savings from clerical cost reduction so large that they invariably "have sounded almost unrealistic." Knowing his audience, he was careful to explain that the computer would bring them the power and status they sought: "Never before," he told them, "has there been the requirement for such a complete change of methods in such a wide area as is implicit in the electronic approach to data processing. This is a job for imaginative thinkers having the earnest support of top management. Department barriers may disappear and supervisors of long service may find their departments eliminated almost entirely." Insisting that the technology was now ready for general use, he stated that, "There are now very few valid reasons for systems people to shy away from consideration of the use of electronic data processors for accounting applications." [231]

## "The Machine Accountant and His Electronic Opportunity"

The computer seemed at first to creep up on the machine accountants. Given their narrow focus on punched card machines, they paid less attention even than the systems men to vague

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[230] The first of these was J. Henry McCall, "Electronic Data Processing", Systems and Procedures Quarterly 5, no. 4 (November 1954):12-16. The second Milton E. Mengel, "Electronic Business Machines -- Today--Tomorrow", Systems and Procedures Quarterly 5, no. 4 (November 1954):7-11.

[231] Virgil F. Blank, "Electronics -- Possibilities and Limitations", Systems and Procedures Quarterly 6, no. 3 (August 1955):8-15, 13-15.

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predictions of upheavals in the office. The world of giant brains and bomb calculations seemed, for the most part, very distant from the noisy, mechanical labors of the tab room. Even Berkeley's book was only reviewed by The Hopper in 1954, five years after its initial publication. But a trickle of articles on the topic soon became a torrent as "electronics" and its contribution to the office emerged as a topic of primary concern to the association's elite. What turned the computer from a distant and unfamiliar "giant brain" into an everyday reality for much of the association's membership was the arrival of more affordable and immediately useful electronic technologies.

Only in 1953 were "electronics for the office" or electronic computers first mentioned in The Hopper. These early articles were largely similar to those aimed at a more general audience. They presented a technical primer, a description of binary, an outline of the internal structure of a computer, an introduction to the idea of a program and so on. Indeed, such was the lack of computer expertise indigenous to the NMAA that many of the best articles were reprinted from the journals of more scientifically oriented societies. The first articles were by computer vendors and consultants, including one by co-inventor of the ENIAC, and Univac executive, Robert Mauchly. He supplied The Hopper with an introduction to computer technology, focusing particularly on its programmability and its use of magnetic tape to explain how it differed from the punched card machines with which his readers were familiar. [232]

Not until September 1954 did The Hopper feature any comment on the computer by someone not directly employed by the computer industry. This came not from one of its rank and file members, but from Ned Chapin – at this point a lecturer at the Illinois Institute of

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[232] Richard E. Sprague, "Are Punched Card Machines on the Way Out?" The Hopper 4, no. 7 (July 1953):2-7. For an important example of a reprinted series, this one from the Society of Industrial and Applied Mathematics, see R.F. Clippinger, B. Dimsdale, and J. H. Levin, "Automatic Digital Computers in Industrial Research", Journal of Machine Accounting 6, no. 2 (February 1955):7-11, 14-16, R.F. Clippinger, B. Dimsdale, and J. H. Levin, "Automatic Digital Computers in Industrial Research -- Part 2", Journal of Machine Accounting 6, no. 3 (March 1955):9-11, 19.

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Technology. This article, however, did little more than reiterate accepted notions of computer evaluation: that good systems work was crucial, that costs and benefits must be measured carefully, and that a computer "can give a company a strong competitive edge." Valuable as many of these observations were, they had no particular relation to the skills, experience or realistic organizational power of the machine accountants.[233]

The very first computers available for business use were a radical departure from traditional punched card machines. They cost perhaps twenty times more than the biggest tabulators, used magnetic tape instead of punched cards as their primary medium for data storage and were electronic rather than mechanical. They commanded public attention, and the scientific mystique of the "giant brain," in a way that no tabulator could ever do. The big computers from IBM and Univac captured the lion's share of attention in the general business press and more specialist management publications such as the Harvard Business Review.

Despite their growing interest in computers, most machine accountants had neither the managerial clout, the mastery of systems and procedures work or the scientific aura needed to convince managers to put them in charge of these pioneering computer efforts. Managerially-oriented writers who saw the computer as an entirely new technology were sometimes scornful of their relevance to the new era. When a team from Harvard sought to define best practice in computer evaluation, they dismissed the punched card supervisors as too inflexible and tied to old thought patterns. It was their opinion that, "company executives need have no concern if punched-card tabulating equipment men were not available to work on an automatic data processing project."[234]

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[233] Ned Chapin, "Justifying the Use of an Automatic Computer", The Hopper 5, no. 8 (September 1954):9-10, 14, page 9.

[234] Peter B. Laubach, Company Investigations of Automatic Data Processing (Boston: Graduate School of Business Administration, Harvard University, 1957), 147.

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By 1955, however, the mass market for computer systems was emerging elsewhere, through smaller machines that extended punch-card technology into the electronic age. These provided far more continuity from punched card work to computer work than was initially expected by those who, like the Harvard team, focused on the largest computers. Indeed, electronics were already well established in IBM's line of punched card machines when it produced its first computer. The firm's first use of electronics in its regular product line was a very specialized piece of auxiliary punched card equipment, the 603 Electronic Multiplier. By 1948 it had followed this with the 604 Electronic Calculating Punch. Although not a computer in the generally accepted sense, it was a very flexible machine that could be given simple programs by wiring connections on its front panel. Scientific users of punched card machinery went a step further with the Card Programmable Computer (CPC), a two-machine hybrid in which cards placed in a separate machine were used to control the operation of a 604. [235]

These machines were not computers, but fit into the general discussion of electronics, and like computers they demanded careful handling and substantial air conditioning to keep their vacuum tubes running reliably. In 1953, an assistant manager in the Methods Department of Shell Oil told an SPA meeting of his firm's use of a 604 to perform payroll calculations, and to control warehouse inventory levels, in part of the company. Shell was also experimenting with the use of a CPC to perform royalty calculations on oil. Although he also surveyed larger and more experimental electronic machines, the speaker felt that undue sensationalism was obscuring real accomplishments by existing punched card installations. "Few management men today," he complained, "seem to grasp the fact that electronics has already entered the office. It's not too

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[235] On the 603 and 604 see Watson and Petre, Father, Son & Co: My Life at IBM and Beyond. The CPC is discussed in James Cortada, The Computer in the United States: From Laboratory to Market, 1930-1960 (Armonk, New York: M.E. Sharpe, 1993) and its origins are detailed in Akera, "Calculating a Natural World".

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surprising when you consider that most of the electronics articles in popular magazines read like 'space ship' novels."[236]

The first generation of computing equipment entered most firms not in the grand shape of a five thousand-tube monster but in the most modest guise of an IBM 650. Introduced in 1954, this machine continued IBM's strategy of an incremental shift toward electronics. The 650 was a true computer. Designed for inexpensive mass production it contained fewer vacuum tubes and calculated far more slowly than its big brothers in the 700 series. Its memory was housed on a rotating drum rather than a fast electronic device. It did not demand an expensive rush toward unreliable and unfamiliar tape drives, because the earliest and most popular models worked directly with punched cards. The central unit was about the size of a large refrigerator. An entire system needed less than a tenth of the two or three thousand feet of floor space demanded by a large computer, and could work with existing peripheral devices such as sorters and reproducers.[237] As a result it could easily be fitted into existing punched card installations. Acquiring such a machine required much less justification, soul searching, and high level review than the purchase of a 701 or a Univac I. Despite some initial misgivings from established salesmen, it was a machine that the existing IBM punched card sales and service organizations were able to support effectively. Nevertheless it was programmable, giving thousands of companies their first taste of the joys and expenses of running a programming operation. The arrival of the first of these machines, at General Electric and Lockheed, was eagerly reported in the NMAA's journal.[238]

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[236] Matt W. Boz, "Where We Stand Today on Electronics for the Office", The Hopper 5, no. 1 (January 1954):4-6.

[237] For the typical working areas, rents, delivery dates and other useful information on early computers see R Hunt Brown, "Computer Comparison and Census Chart", Management and Business Automation 4, no. 1 (August 1960):34 and its subsequent updates in later volumes.

[238] Anonymous, "General Electric and Lockheed Among First to Get IBM 650's", Journal of Machine Accounting 6, no. 5 (May 1955):18-19

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From this point onward, it became increasingly rare to find an expansive prediction of the glorious future of machine accounting that did not explicitly ground its ambitions in electronic technologies and the forthcoming transformation of the office. Over the next few years, their discussion of such electronics became less and less hypothetical and more and more tied to the specific technologies of the digital computer. In 1954 NMAA president Gordon C. Crouch claimed that, "electronics" were the future of machine accounting, making the machine accountant "the link between the scientist and the business man." Electronics, he insisted, had "raised this field of endeavor to the level of a profession requiring not only mechanical skill but also sound technical knowledge." Couch, however, did not mention the computer per se.

Thomas J. Watson, Jr., President of IBM, appeared as a keynote speaker at the third NMAA annual conference, held that year in Cleveland. While Watson did mention the computer as an example of business electronics, his comments too were addressed much more generally to the marriage of electronics and machine accounting. He warned the assembled punched card supervisors that the "electronic revolution in the office" promised similar changes to the industrial revolution" and promised that, "those with the best background for stepping into the 'electronic office' of the not too distant future, were the managers of today's punched card installations."[239]

The machine accountants and IBM held a common interest in making the introduction of electronics an evolutionary rather than a revolutionary shift. IBM's great advantage over other computer supplies was its stranglehold on the existing base of punched card machine installations. Historians have documented many of the advantages this brought the firm, such as steady revenues, an excellent sales force well versed in business problems and unsurpassed

[239] Anonymous, "Glowing Future for Machine Accountants Described by Convention Speakers", Journal of Machine Accounting, Systems and Management 5, no. 7 (July-August 1954):3, 8.

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engineering capabilities to produce the mechanical peripherals such as tape drives and card readers necessary to make computers useful. The loyalty of the punched card staff working for its customer was another, equally valuable resource. Many who made a career around the machines derived as much or more of their identity from being a "tab man" or "machine accountant" as they did from working for a particular firm. Their department was often called the "IBM Department". On a local level, IBM informally helped to keep punched card men informed of career opportunities in other firms, helping to build a loyalty to IBM greater than their loyalty to their employers. As we saw earlier, McCaffrey landed most of his punched card jobs this way.

Less covertly, they were supplied with training seminars and were helped to prepare proposals for the upgrading of punched card equipment or its application to new jobs. In 1956 Charles C. Smith, an IBM sales representative, addressed the Greater East Bay chapter of the NMAA in Oakland. He informed his audience that IBM now had more than 1,500 model 650 computers on order, and was already making one installation every day. This, he suggested, was an opening for the well prepared machine accountant: "EDP [electronic data processing] is really here, and is upon us so rapidly that we have no trained labor market." He was eager to boast of his own company's role in readying them. He reminded the chapter's membership that it had known little of computers a year ago, when his previous speech to them had alerted them to the urgent relevance of this topic. "The association acted immediately, and within a month a large part of the membership was attending special IBM schools on familiarization and basic programming principles." IBM offered these short courses free of charge, so keen was it to turn its existing corporate constituency into advocates for the use of its new technologies.[240]

In 1956, Gordon Bower, a Machine Applications Manager with Moore Business Forms, addressed a regional conference of the NMAA in Chicago on "The Relationship of the Machine

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[240] Charles C. Smith, "Removing the Mystery from Electronic Data Processing", Journal of Machine Accounting 7, no. 7 (July 1956):12-13, 16-27.

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Accountant." His speech put the case for punched card staff to involve themselves in computing -- "it is your birthright to take on a responsible part of this work". Even before a computer was ordered, he suggested, their intimate relationships with IBM and Univac gave them a special role in the selection process. In addition, "knowledge of punched card routines is an absolute requirement for best application of the new data processing machines available today." Once the order was placed, "you should be an important member, if not the leader, of the systems group assigned to the development of the system." Following the established pattern of the genre, he mixed these glittering vistas of possibility with an urgent call to personal betterment. "Now you are in the big leagues.... if you have gotten a little rusty on system analysis, writing procedures and drawing flow charts--now is the time to get back in the groove."[241]

This message was echoed a few months later, when Ned Chapin returned to The Hopper with another article. "The machine accountant," he promised, "has ready made for him a key role in the development and installation of the new business systems that automatic computers make possible." He observed that computers and punched card machines were generally applied to similar applications, and that most computer processes worked on data that had already been punched onto cards. But while good performance here "can result in advancement for the machine accountant himself", Chapin warned that this would require the study of automatic computers, "office politics" and systems analysis. The latter, he warned, would likely be the hardest. But Chapin reinforced the idea that the sought after status of professional machine accountant now demanded an embrace of both systems analysis and computers. While "many machine accountants do not understand how to do quality systems analysis for an automatic

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[241] Gordon Bower, "The Relationship of the Machine Accountant to Automated Data Processing", Journal of Machine Accounting 7, no. 1 (January 1956):9-10, 15.

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computer," he insisted that, "a machine accountant who never appears to get beyond knowledge of the machines is properly called a 'tab man,' not a machine accountant." [242]

This theme was powerfully adopted in 1957 by Lester E. Hill, soon to be president of the NMAA. Hill entitled his article "The Machine Accountant and his Electronic Opportunity." Hill pointed out that the embryonic technologies of administrative electronics relied on a technology familiar to his members. "All machines have the common language of this unit record, the punched card... the most efficient tool for integrating data." Something of a technological partisan, Hill defended the punched card as superior to both paper tape and magnetic tape for administrative purposes. But with this opportunity came danger. Without a firm commitment to self-education, training and professional betterment, the machine accountant risked being swept away by the rising tide electronics. Instead, he must "pick up the ball and run with it or else he will find himself in the category of the bookkeeper who didn't believe that punched card systems were here to stay." [243]

## "High-Speed Operations Research for High-Speed Business"

Operations Research had a more intimate connection with early scientific computing efforts than did machine accounting or systems work. Even here, however, acknowledgement of the computer was conspicuous by its absence during the early 1950s. The first articles promoting operations research in places like Fortune and the Harvard Business Review made no mention of the computer or other electronic technologies. This was in part because these articles put far more faith in vague evocations of the scientific method than in discussion of specific techniques. By 1954 this was beginning to change. As in other kinds of managerial discussion, the concepts of automation and of electronics gained currency some time before specific awareness of the

[242] Ned Chapin, "The Machine Accountant's Approach to Systems for Automatic Computers", Journal of Machine Accounting 7, no. 8 (August 1956):28-32.

[243] Hill, "The Machine Accountant and his "Electronic" Opportunity".

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computer. After interviewing executives at three hundred American corporations, the authors of a Harvard Business Review article reported that, "the trend toward automation was the phenomenon most frequently mentioned in connection with operations research." The reason for this was simple: "If the human factor in production is reduced through automation, the process becomes more quantifiable..."[244]

As we have seen, early operations research efforts were concentrated in military agencies, universities and defense contractor and non-profits such as the RAND Corporation. These were also the places in which, circa 1955, one was most likely to find an electronic computer. Indeed, RAND was one of the select group of institutions that had constructed its own computer (the JOHNNIAC) rather than wait for one to be available commercially. RAND, and its subsequent spin-off SDC, was a hotbed of innovative computer research for many years to come. Others at RAND performed computer simulations of atomic warfare, and pushed forward with the new field of game theory. Likewise, Jay Forrester, the creator of MIT's path-breaking Whirlwind computer, moved from hardware design into the construction of schematic computerized models of logistics, markets and the earth itself.[245]

There was thus considerable contact between the pioneers of scientific computation and members of the burgeoning operations research community. As OR turned toward model building as the core of its claim to scientific and professional status, its future was tied increasingly closely to the computer. The computer allowed the execution of models and simulations many orders of magnitude more complex than those that would have been feasible by hand. Once people really got to grips with the new technology, their biggest discovery was probably just how intractable most problems remained. During the 1950s, however, machine translation from Russian to

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[244] John J. Caminer and Gerhard R. Andlinger, "Operations Research Roundup", Harvard Business Review 32, no. 6 (November-December 1954):132-36.

[245] For an example of Forrester's research, see Jay W. Forrester, "Industrial Dynamics: A Major Breakthrough for Decision Makers", Harvard Business Review 36, no. 4 (July-August 1958):37-66.

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English, long term weather forecasting and control and perfect models of the economy were widely believed to lie within reach. Furthermore, the power and accuracy of the computer lent considerable cultural authority to any prediction or claim made on the basis of a computer model. A claim attributed to a computer was more compelling than one attributed to a human.[246]

As firms began to install their own computers, operations research enthusiasts rushed to convince them that without OR the potential of their new machine would be wasted. In 1955, Russell L. Ackoff spoke at the Harvard conference on Automatic Data Processing. Using similar language to the systems men, Ackoff argued that OR had to include the application of the scientific methods to the interaction of separate functions within a business, so as to maximize the interest of the organization as a whole. Unsurprisingly, he viewed OR as more important than data processing – suggesting, for example, that statistical sampling would often be a more accurate form of production control than trying to use a computer to count each individual item. But he also argued that the combination of EDP and OR would prove more powerful than either could hope to be in isolation.[247]

In a separate presentation, the three members of the newly formed Information Processing Fellowship of the Mellon Institute of Industrial Research discussed, "The Selection of an Application for Mechanization." They insisted that the real benefit of the computer would come only from its ability to provide better information faster and cheaper through the use of

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[246] For an example of the glowing press given to machine translation, see David O Woodbury, "The Translating Machine", The Atlantic Monthly 204, no. 2 (August 1959):60-64. Many poplar predictions on topics such as weather forecasting, automated psychiatry, and so on can be traced back to Berkeley, Giant Brains or Machines That Think, 180-208. Computerized world models, particularly for weather forecasting, are the subject of a forthcoming book by Paul Edwards, who has presented preliminary work in Paul N Edwards, "The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models", in Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, ed. Agatha C Hughes and Thomas P Hughes (Cambridge, MA: MIT Press, 2000).

[247] Russell L. Ackoff, "Operations Research - Its Relationship to Data Processing", in Automatic Data Processing Conference, ed. Robert N. Anthony (Boston: Graduate School of Business Administration, Harvard University, 1955).

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operations research techniques. As experienced scientific programmers, they welcomed this chance to extend their existing computation work into corporate management. Somewhat ambitiously, they attempted to represent all the functions of the firm, and the information flows between them, using a single small chart. (It was this kind of schematic approach that gave a bad reputation to people with a scientific computing background when they tried to cross over into administrative computing). They suggested that no more than half the computer's time should be scheduled for regular work, "leaving room for the management science, Operations Research studies, and the preparation of special reports and studies. It is in these areas that we feel the real value of our research will lie."[248]

Despite such expressions of interest, most accounts of OR directed at the managerial public continued to suggest that it was the scientific method, rather than electronic technology, that truly defined OR. In a 1956 Harvard Business Review article, Herbert Solow reminded his reader that not only did OR not demand a computer, but that, "O.R., indeed, may sometimes be a rational substitute for gadgeteering."

Such reservations were well and truly put aside in 1957, when the HBR published an article headed "The computer makes possible – High-Speed Operations Research – Which Makes Possible High-Speed Business Planning," by Melvin E. Salveson. Salveson, a member of General Electric's "Operations Research and Synthesis Consulting Services" group and veteran of its Louisville Univac installation, argued that, with the conjunction of OR and the computer, scientists had "broken though the learning barrier to nature's secrets." The resulting "revolution impose[d] severe new demands on managers in industry." While admitting that the computer was currently used mostly for routine tasks, he insisted that its true potential lay in planning of various

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[248] John D. Dillion, Janus O. Dyal, and Jr. Byron O. Marshall, "Selecting an Application for Mechanization", in Automatic Data Processing Conference, ed. Robert N. Anthony (Boston: Graduate School of Business Administration, Harvard University, 1955), 122.

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kinds – forecasting, budgeting, game playing, location selection, personnel selection, plant layout and inventory planning. Under the new "systems approach", he believed that these were all now within the rightful domain of OR. Salveson called for OR to go about "redesigning the business." The corporation was "closer than it might sound" to being a scientific experiment, and, whether they realized it or not, "the executive and the scientist are engaged in the same sort of labor." Indeed, the use of the computer for prediction and modeling made it possible for the first time for managers to really understand what they were doing. "One of the most important uses of OR and large-scale computers is to increase the speed and power of the learning process in a business." [249]

This hyperbole was intended to convince managers that they would be committing a dreadful mistake if they ordered a new computer and failed to charter a strong operations research group to go with it. As such, its success was equivocal. The computer undoubtedly raised interest in OR, and a substantial proportion of OR departments did probably owe their existence to its arrival. But most computer efforts did not include a substantial number of people with an OR background – not least because there were very few OR practitioners available to hire. One also suspects that, even if they were available, the cultural strain of integrating punched card and OR personnel into a single project team would have been considerable. In a composite case study of an industrial firm obtaining its first computer, Richard G. Canning related that the company originally intended to create an OR group as an integral part of its computer effort (along side operations and programming/systems analysis). But despite management's commitment the OR posts proved hard to fill, so its contribution to the analysis of early applications remained quite limited. Even this is probably an overstatement of the involvement of OR personnel in most administrative computer groups of the 1950s. And, as we have already seen, the scope and power

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[249] Melvin E. Salveson, "High-Speed Operations Research", Harvard Business Review 35, no. 4 (July-August 1957):89-99.

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of actual OR techniques turned out to be much more limited than boosters like Salveson had hoped. Most computers spent almost all their time running routine administrative jobs for at least the next decade.[250]

## "A Dream off A Pink Cloud": Selling a Revolution

Early discussion of the computer and other administrative electronics often hinged on the concept of an unfolding "revolution." Systems men and operations researches were already convinced that their professions held the key to a new and better kind of management. When the power of administrative electronics crossed the threshold of managerial awareness, it provided them with a powerful new tool for self promotion. Whether working for computer manufacturers, as consultants, or as corporate employees they were often fast to endorse the concept of a technological revolution to underpin their belief in managerial revolution. A revolution was, pretty much by definition, not something that one could ignore. Two revolutions should have been enough to shake even the most conservative of managers. Worthington, quoted earlier in his discussion of the "ominous rumble," provided a particularly graphic version of this theme.

> [T]he potential effect of electronics is of the order of that wrought by moveable type. The changes ahead appear to be similar in character but far beyond those effected by printing....
>
> It takes about five years for Mr. Management to get his feet on the ground in this field of application of electronics to administrative systems.... The first competitor in each industry to operate in milliseconds, at a fraction of his former overhead, is going to run rings around his competition. There aren't many businesses that can afford to take a chance on giving this fellow a five year lead. Therefore, most of us have to start now, if we haven't started already.[251]

The argument illustrates one of the most remarkable continuities in the discussion of corporate computing. For a half century, enthusiasts have been using the dazzle of microseconds

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[250] Richard G. Canning, Installing Electronic Data Processing Systems (New York: John Wiley & Sons, Inc., 1957)

[251] Worthington, "Application of Electronics to Administrative Systems"

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and megahertz, joined more recently by the exponential curves of Moore's law, to argue that the unprecedented power of the latest revolutionary computer technologies is about to dictate a corresponding and almost effortless revolution in business. The only thing to do is to get out of its way, and maybe to employ the services of the author. Yet on the human level – the level of organizational structure, productivity figures and managerial practices – change has been at best evolutionary and invariably painful. Worthington's claims closely mirrored those used by a more recent cohort of technology pushers to persuade firms to sink vast sums into unproven and immature technologies for electronic business. The new technology will rapidly and fundamentally reshape the competitive position of your firm, it will take years to fully implement, and it will confer insurmountable advantages on the first of your competitors to embrace it. As a result, you have no choice but to invest massively in this "disruptive technology;" if you wait to see how and if it works then you will be swept into the dustbin of business history by the insurgent competitors that really "get it."[252]

[252] Modern consultants call this the "fear factor" – pointing out to executives that their companies have lots of money but little time, and hence it would be wise to part with a lot of the former to gain a little of the latter. As a best selling business book of 2000 claimed, things moved so fast in the Internet age that to adopt the "fast follower" tactic of adopting only proven approaches was enormously irresponsible. In this kind of argument, the lack of demonstrated savings or debugged systems is actually a selling point! See Philip Evans and Thomas S. Wurster, Blown to Bits: How the New Economics of Information Transforms Strategy (Boston: Harvard Business School Press, 2000). For discussion of the mass hysteria whereby investors threw money at loss making startups and established companies threw money into creating loss-making spin-offs to stave off their challenge, see Amy Harmon, "What Have E-Consultants Wrought?" New York Times, 13 May 2001.

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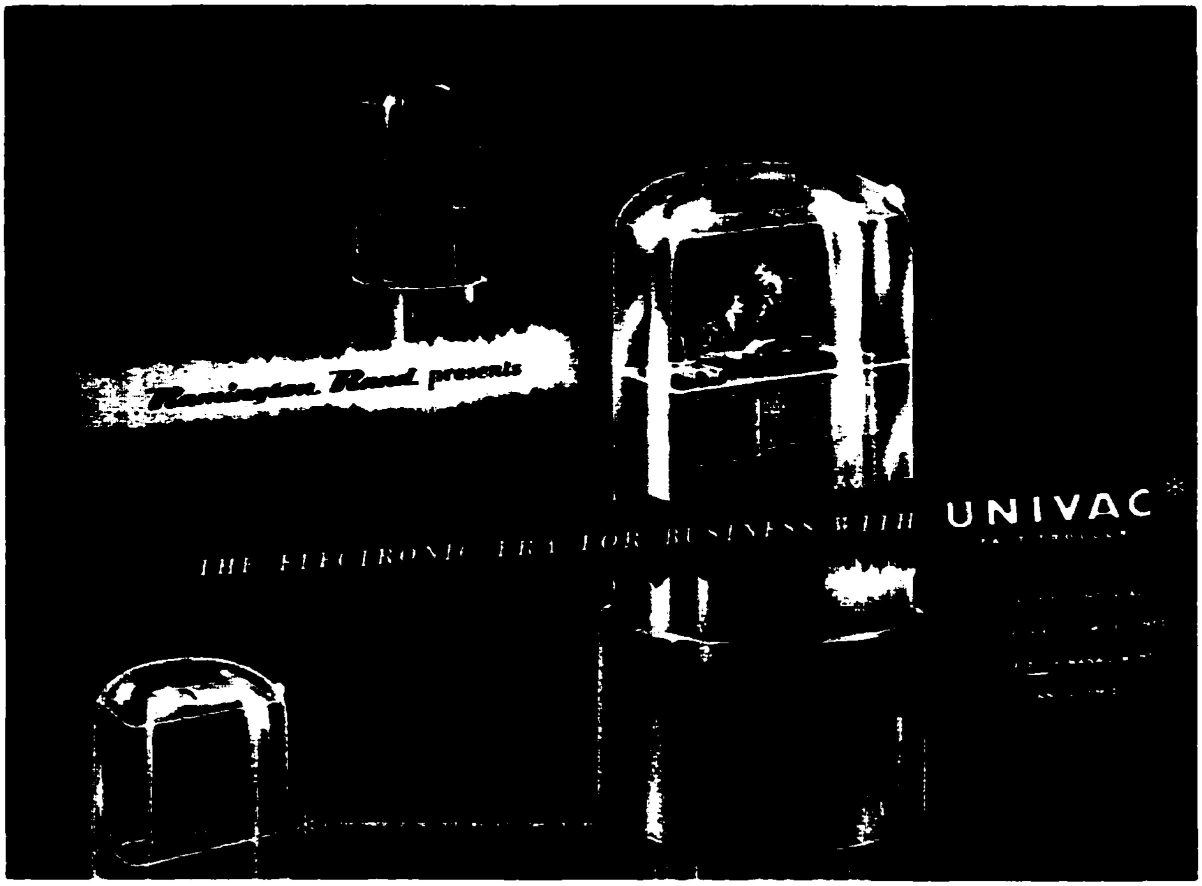


**Figure 13: An early Univac advertisement. Note the business manager inside the vacuum tube.**[253]

The computer moved rapidly from an item of speculation among systems experts into an actual tool of corporate administration – bringing the rhetoric of revolution into the mainstream of managerial discussion along with it. The Harvard Business Review had little time for understatement in 1954, when it published its first detailed article on the application of electronic computers to business. The article, a shameless piece of corporate self-promotion by General Electric, boasted of the firm's success in applying a Univac to automate the production of its payroll – the first Univac purchased by a private corporation and the first computer of any kind to be installed primarily for corporate administration. This move, the editors opined, "may

[253] The source of this image is a 1950 Remington Rand brochure, found in the Computer Product Literature Collection (CBI 12), Charles Babbage Institute, University of Minnesota, Minneapolis.

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eventually be recorded by historians as the foundation of the second industrial revolution..." According to the article, the computer could pay for itself by processing payroll for just five thousand employees and running for two hours a day. Anything accomplished by the computer beyond that would go straight to the bottom line. The following year, another General Electric manager laid down the gauntlet to management in impassioned terms. Urging them to embrace the power of operations research and the computer to automate their decision making, he asked "isn't there a danger that our thought processes will be left in the horse-and-buggy stage while our operations are being run in the age of nucleonics, electronics and jet propulsion?"[254]

As it turned out, selling a revolution was easier said than done. It required different skills from the relatively straightforward task of selling a punched card machine. Both of the two largest computer suppliers of the 1950s struggled to adapt. Univac was a division of Remington Rand. While Remington Rand was the largest office equipment company of the era, decades after its foundation it remained a fractious and chaotic federation. This was not helped by its acquisition of two separate computer companies, each with its own facilities and products. Even in principle it would have been hard for a single Remington Rand account representative to sell forms, typewriters, punched card machines and computers. In practice this was compounded by organizational politics. If a tabulating machine salesman were somehow to sell a computer, then he would not receive any commission, despite losing potential income by foregoing punched card machine sales. The Univac teams were thus effectively working in competition with their own colleagues, and without the benefit of any personal knowledge of business operations.

In contrast, IBM's sales organization was the stuff of legend, beginning with Tom Watson, Sr.'s accomplishments as the star salesman at NCR before being summarily dismissed

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[254] Roddy F. Osborn, "GE and UNIVAC: Harnessing the High-Speed Computer", Harvard Business Review 32, no. 4 (July-August 1954):99-107 Melvin L. Hurni, "Decision Making in the Age of Automation", Harvard Business Review 33, no. 5 (September-October 1955):49-58

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by its mercurial founder John H. Patterson. But well into the 1950s IBM was an informal collection of different factories, chief inventors with their own laboratories, and feuding executives whose power ebbed and flowed on the strength of their relationship with the Watsons. The customer contacts and skills that had served the regular sales force so well in renting well-understood and comparatively modestly priced punched card machines were of little use in selling large computers. Its first large computers, including the 701 (originally called the Defense Calculator), were sold and supported by the Applied Science Division, founded in 1948 and staffed in large part by Ph.D.s with experience in wartime scientific computation and punched card machines. These brash and highly credentialed young men had little in common with the indoctrinated legions of IBM salesmen, who had spent decades learning standard procedures to configure punched card installations to perform well-understood tasks. [255]

At least some of the eager new computer salesmen sought to bypass their traditional contacts in office management, punched card groups, or systems departments. The new world of electronics, they argued, demanded direct contact with top executives. In 1954, Dun's Review and Modern Industry hosted a roundtable discussion between representatives of office machine companies – whose candor was solicited by anonymity. The new technology, they confided, demanded a new approach, one that their existing salesmen could not easily adapt to. Rather than selling individual machines, they asked instead, "Don't you think that the office should be sold to management as a production unit like the machine shop?" To this end, one firm boasted that, "We have stopped our salesmen using the word 'machines'; it's out of the vocabulary entirely.... That's

[255] According to Cortada, himself a longtime IBM employee, "The legendary sales force at IBM, which has been given credit by just about every historian, economist, business leader, professor, and consultant for selling computers better than Remington or anybody else in the 1950s and 1960s, had to be replaced to do the job. In the late 1950s, this legendary sales force was superb at selling punched card equipment, but knew little to almost nothing about how to sell computer systems...." Cortada, Information Technology as Business History: Issues in the History and Management of Computers, 127. For the story of the IBM "Applied Science" team, see Akera, "Calculating a Natural World", 378-96.

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shown last and talked about last, no matter what the application is.... If you sell the idea, then you've got the sale." As well as selling image and ideas more than machines, the salesmen had "to sell above normal channels. We've got to go to the top." [256]

"We just will not talk to anybody below controller," claimed one of the computer company executives. Time spent talking to the systems man, according to the these computer company executives, was very likely time wasted. He was "the guy who stops us when he has no power to purchase." At best, though, the systems man could be a conduit to someone who mattered. "[W]e try to use him as a bridgehead within an organization to get an opportunity to study and make a survey of that particular company's needs. Then we go back and make a proposal and try to see to it that the systems man, either as our ambassador or going with him, presents that proposal to the person who has authority to buy."[257]

Ironically, they leveled the same charge of conservative self-interest at the systems men that the systems men themselves applied to operating management, charging that, "the methods man is trying to protect his job, and if he's got some system in there that's working in a mediocre way, he'd just like to keep on working with it." Office managers, the traditional audience for office machine salesmen, had still less clout. "He... is not his own boss. He has to consult with everyone who uses his equipment, and his decisions fall into a small area--the area that is left after everyone else exercises his. I think he is basically a personnel man who has to meet a production schedule. He is certainly not a manager in the usual sense of that word...." Echoing Leffingwell's lament a generation before, they complained that, "management has gone on the civil service basis that it was a job to which a man was promoted; you don't get a young, ambitious college graduate to go into that field." Furthermore, they claimed, office managers

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[256] Anonymous, "The Office Equipment Industry: They Sell Answers to Problems that Executives Don't Know Exist", Dun's Review and Modern Industry 64, no. 3 (September 1954):101-19.
[257] Ibid, page 117.

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judged their importance by the number of people they supervised – providing little incentive to substitute capital for labor.[258]

One of the executives boasted of his firm's success in convincing the top management of the Aluminum Company of America to fund a major project. This involved "converting several of their systems that reach from one end of their organization to another." The reporter noted with approval that, "It was simply a dream off a pink cloud compared to anything they'd done before, but the company that sold them talked about the things that would accrue to the benefit of the company if this thing were possible." Whether the project was, in fact, possible was not disclosed. The important thing was to keep one's head in the clouds.[259]

The claim of revolution thus came in two conceptually distinct forms. One was the operations research or management science position that the computer would automate, optimize and therefore revolutionize the process of organizational decision making. These arguments received an early and powerful expression at a 1955 Harvard University conference, at which Herbert Simon, Russell Ackoff and others explored the potential of the computer as a scientific tool to fundamentally reshape the practice of management. The title of a 1956 article, "Can You Afford the 'Practical' Approach to Electronics" summed up the claims made for this approach. Its author, a consultant, argued against the apparently low-risk approach of using computers to gradually automate current processes while leaving the overall structure of management intact. Instead, thundered the author, the potential of the "visionary" approach was so great that the true risk lay in evolutionary thinking.[260]

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[258] Ibid, 103-05.
[259] Ibid, page 119.
[260] Ackoff, "Operations Research - Its Relationship to Data Processing" R. R. Ross, "Can you Afford the 'Practical' Approach to Electronics?" Management Methods (November, 1956):36-37, 56. This thinking reached its zenith in the celebrated Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980s", Harvard Business Review 36, no. 6 (November-December 1958):41-48.

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The other claim of revolution was in clerical cost reduction through the direct substitution of capital and electronics for clerks and mechanisms. This was a more conservative idea of revolution, which required its adherents to argue that the cost savings were so huge to make this too an area in which any hesitation would be irresponsible. As one consultant put it, "the estimated savings have sounded almost unrealistic... if your company is not presently engaged in an electronics study program, is your reason good enough?" This view was backed by the influential and generally conservative Controller's Institute in its first evaluation of the economics of computing. Its author, Frank Wallace, a partner with consulting firm Peat, Marwick, Mitchell & Co., explained to his penny-wise fellows that, "unwarranted caution can deny a company a major instrument of competitive and financial leverage."

The two claims of benefits too good to miss sometimes came together in a powerful way. Order a computer, save a million dollars a year on clerical costs and use its spare capacity to revolutionize management. Or, sit out the second industrial revolution and be crushed by your competitors.[261]

## ...Buying a Computer

For many companies this was an easy choice to make. In 1954 the computer was a revolutionary novelty; by 1958 several thousand had been installed. From 1954 to 1959, estimated shipments of computer hardware rose from $10 million to $600 million. Companies, indeed, were ordering the machines faster than IBM could build them. New machines were normally announced a year or two before the first models were delivered. But even in 1958, several years after the first installations, the time between order and delivery for a 700 series computer was approximately eighteen months. Few of these large scale administrative

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[261] Frank Wallace, Appraising the Economics of Electronic Computers: An Approach for a Company to Determine the Feasibility of Acquiring a Computer (New York: Controllership Foundation, 1956) Blank, "Electronics -- Possibilities and Limitations".

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installations had yet proven their economic merit – one Harvard Business Review article of 1957 asserted that, "The number that care paying their way at this point can be counted on one hand, with some fingers left over."[262]

Contemporary estimates valued the hardware in a typical installation centered around a single large computer at $2 million – around $13 million in today's dollars. In 1955, IBM had installed only about twenty-five of its large 700 series computers, most of them the 701 and 704 models intended for scientific and engineering calculations. Although the first of these had been supplied in 1953, the majority of these installations were still in the experimental stages. General Electric's pioneering Univac had garnered a spate of publicity in 1954. Yet, as Peter B. Laubach, part of a Harvard Business School group set up to investigate administrative computing, admitted in a 1955 article in the Harvard Business Review, the "revolution… appears to be off to a faltering start. Too much was promised too fast, with the result that many businessmen have grown skeptical of the entire electronic data-processing field." Of the dozen or fewer computers at work on administration, accounting and statistics for business, he estimated that no more than two or three were in full operation and had any hope of covering their costs.[263]

From our modern vantage point, it is hard to appreciate the prospect offered to managers by the first administrative computers. On the one hand, we have all used computers and we know how the story turns out, if not why or exactly what route the narrative of history followed to get there. Unlike those early managers, we know that the computer is not a fad, that it is capable of

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[262] Ralph F. Lewis, "Never Overestimate the Power of a Computer", Harvard Business Review 35, no. 5 (September-October 1957):76-84. For estimates of the total size of the administrative computer market, see Cortada, The Computer in the United States: From Laboratory to Market, 1930-1960, 117-18. Cortada's figures come from Montgomery Phister, Jr, Data Processing Technology and Economics (Santa Monica: Santa Monica Publishing, 1976). Elsewhere, Cortada quotes another estimate, from the International Data Corporation, giving the value of computer hardware expenditure in 1958 as 250 million dollars Cortada, Information Technology as Business History: Issues in the History and Management of Computers.

[263] Peter B. Laubach and Lawrence E. Thompson, "Electronic Computers: A Progress Report", Harvard Business Review 33, no. 2 (March-April 1955):120-28.

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tackling many administrative operations and that the technology had considerable room for improvements. But from our vantage point, these early models seem quite ludicrously expensive, hard to use and unreliable. They were inconceivably slow and could store no more information internally than one might write by hand in a slim legal notebook. And they would all be obsolete within a few years – before the task of programming the planned applications was even complete. While it might reduce clerical costs, the acquisition of a computer demanded the attentions of a small army of operators, programmers, analysts and technical managers. To understand how and why computers were purchased in the 1950s we must forget every one of these things.

An internal IBM market analysis, produced during February 1955, gives an idea of the company's progress in the introduction of large computers for business administration. As the report's foreword noted, "Industry acceptance has been ever increasing, as evidenced by the many letters of interest received...." The orders, it continued, "seem to indicate a substantial market for machines of this capacity." By this point, IBM had already taken orders for a total of ninety-nine of its large, administratively oriented computers. The situation brought some comfort. But a question mark remained, because so very few of these machines had yet been delivered and almost none were doing useful work. As the report noted "There has been, however, very little actual experience, particularly on commercial accounting applications where the bulk of the potential lies, to substantiate their worth to the eventual user. The success of the entire program will undoubtedly rest on the success of the first few installations."[264]

Without any proven savings, and few functional installations, to order a computer was an act of pure faith in the transformative power of technology. Despite his enthusiasm, even Thesis

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[264] J. W. LaForte, Market Analysis -- Electronic Data Processing Machines Types 702 - 703 - 705, 1955, contained in Cuthbert C. Hurd Papers (CBI 95), Charles Babbage Institute, University of Minnesota, Minneapolis.

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had been obliged to concede that a manager looking for a demonstration would find that, "there are few examples to be seen. You probably cannot see a computer performing an operation similar to your own." Yet 1955 was a banner year for IBM, despite the firm's caution. As well as working way down the fat order book for its large 700 series, it began to deliver its "medium sized" 650 machines. An average 650 system cost about 3,750 dollars a month to rent (equivalent to a purchase price of 200,000 dollars). The 650 proved to be the "Model T of the computer industry" – more than 1,100 were in use for business applications by 1958. Both the 650 and 700 series machines were "first generation" machines, reliant on bulky and unreliable vacuum tubes for their electronic capabilities. Other firms produced large computers (notably RCA and Univac) and small ones (Burroughs and Univac), but these fit the same general pattern as the IBM models and offered the same kinds of capability. Not until the very end of the decade were all these first-generation machines rendered obsolete by a second computer generation of transistorized machines.[265]

How and why did so many companies choose to order such expensive and unproven machines? Clever salesmanship cannot, in itself, explain why executives were willing to talk to computer salesmen, still less why they agreed to order a computer. Were the savings to be gained by replacing clerks and punched card machines with million dollar computers really so compelling as to render the "wait and see" approach more dangerous than the "fools rush in" philosophy? It seems unlikely. There is little evidence that companies that waited until, say, 1960 to install a computer suffered any undue effects. While scholars of the "new institutionalism" in organizational analysis have drawn attention to fads and herd behavior as powerful factors in the

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[265] For the technical and business history of first generation computing see Bashe et al., IBM's Early Computers, Campbell-Kelly and Aspray, Computer, 105-30, Paul E Ceruzzi, A History of Modern Computing (Cambridge, Mass.: MIT Press, 1998), pages 13-64. For contemporary descriptions of the business-oriented 702 see Bashe, Bucholz, and Rochester, "The IBM Type 702: An Electronic Data Processing Machine For Business".

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spread of organizational analysis, this does not in itself explain how such fads are initially established. So how did so many large, well run companies manage to order so many computers before either the costs or the benefits were really known? After all, our impression of 1950s corporate management is more one of conformity, conservatism and inflexibility than of a group willing to gamble millions of dollars on a whim.[266]

The answer lies in a ritual known as the feasibility study, used by businesses from the very early days of administrative computing in order to investigate the potential of the computer. Some of the earliest books and articles on the use of the computer in business devoted themselves to an examination of the way in which such a study should be conducted. This analysis relies primarily on five book-length guides to the study of computing. Two of them were published by the Controllers' Institute and written by consultants (one by Frank Wallace, one by a Price Waterhouse team). Two were written by Richard G. Canning (author, consultant and publisher) and the final one was written by Peter B. Laubach and based on the experience of a Harvard University group set up to study data processing. This latter study was particularly important – for its thorough and frank treatment of the process by which twenty-nine firms evaluated the potential that computers held for their business. The book was intended as a realistic guide to managers as to what they might be getting themselves into and what best practice was believed to be, and so remains our best single guide as to the process by which so many companies committed themselves to computer technology long before its economic value had been demonstrated.[267]

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[266] On the role of fads, see Abrahmson and Fairchild, "Management Fashion: Lifecycles, Triggers, and Collective Learning Processes".

[267] Wallace, Appraising the Economics of Electronic Computers. Richard G. Canning, Electronic Data Processing for Business and Industry (New York: John Wiley & Sons, 1956). Canning, Installing EDP. Laubach, Company Investigations of Automatic Data Processing. B. Conway, J. Gibbons, and D. E. Watts, Business Experience With Electronic Computers: A Synthesis of What Has Been Learned From Electronic Data Processing Installations (New York: Controllers Institute Research Foundation, 1959). The

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These authors all agreed that the feasibility study should be rigorous, and include both the comparison of machines from several manufacturers and the identification of potential areas for application of the computer. In a good study, they suggested, analysis and preliminary programming would proceed far enough to judge accurately how efficient each possible model of computer would be at running the job, and how many hours each month it would take. Armed with this knowledge, a company could calculate how many clerks and punched card machines the computer would save once it was running at full capacity. This would give an estimate of the benefits of the computer. The costs seemed easier to estimate – rental for the computer, the one-time costs of installation, analysis and programming, and the continuing costs of consumables (tapes and cards), and of operators and supervisors in the computer department. If the discounted benefits came out larger than the costs then the machine should be ordered.

On its face, this exercise appeared to place the installation of a computer on the same rational basis as the decision to invest in a new set of lathes or to build a warehouse. In practice, however, it was deeply flawed. Although some of the companies ordering these computers went through the motions of careful study, spending many man-years of effort learning about computer technology, the information needed to judge the economic potential of the computer simply did not exist. Nobody knew what the cost of programming might turn out to be, whether obsolescence would be a serious problem, how to quantify the "intangible" benefits of improved management, or whether the computer would really be able to cope with non-routine activities. Pioneers had already discovered that the studies made by eager representatives of the computer manufacturers could not be taken seriously – these "systems studies" tended to underestimate

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feasibility study has not received much historical attention, though it is treated in Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970", 170-77.

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everything from the floor space required to the complexity of the programs needed to undertake a task to the cost of converting data from manual methods.

Estimates of how much computer time a program would need or how long the program would take to write were sometimes off by a factor of ten. This meant that the computer would be running fewer tasks, and generating fewer benefits. On the other hand, the lack of spare computer capacity made it almost impossible to write and run actual programs before making the commitment to order a computer. On the costs side, the expense of programming was massively underestimated. As late as 1956, it was often viewed as a one-time expense to be amortized over the life of the computer, rather than an ongoing and constantly increasing black hole in the budget.[268]

To painstakingly pick apart the many invalid assumptions made to justify computer cost savings would be to flog a dead horse. Neither would it be fair to ridicule the minority of firms that at least tried to produce a serious economic analysis of their own. But one additional assumption must be dealt with: the useful lifespan of the computer. This determined the period over which the startup costs of programming, conversion, installation and training could be spread. In his well researched 1956 book, Office Work and Automation, Howard S. Levin presented some return on investment figures, using estimates that represented the consensus at that time. Levin showed that while purchase (as opposed to rental) could be justified using accepted cost estimates and a ten-year assumed lifespan, "neither rental nor purchase is supported if we assume a five-year useful life for the computer system." Thus, even the optimistically low estimates of costs and high estimates of benefits current in the mid-1950s could only justify the

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[268] Wallace, Appraising the Economics of Electronic Computers, 47, 65.

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acquisition of a computer if one assumed that it would remain useful for substantially more than five years.[269]

Punched card machinery, after all, was depreciated over sixteen to twenty years according to the IRS guidelines of the period – and no separate guidelines had yet been established for computer equipment. It took some time for many people to grasp that computers would not be like this. Then, as now, any given piece of computer equipment was likely to be obsolete within five years of its purchase. While it may still function perfectly well, the dramatically lower costs, easier maintenance, higher performance and improved programming abilities of newer machines usually justify the retirement of the old computer from its original task.

In 1954, Thesis, the consultant and proponent of computer use, had acknowledged the threat of obsolescence only to dismiss it. "The concern of the user over the matter of equipment obsolescence has been a deterrent to more rapid progress.... I believe the obsolescence question has been overplayed." His firm, of course, had a vested interest in selling others on the potential of computers. In this he would seem to have been successful. In 1955, Robert E. Slater, the Controller of John Hancock Mutual Life Insurance was positively sunny when he addressed the NMAA conference. After the completion of an exhaustive study, he had committed his firm to

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[269] Howard S. Levin, Office Work and Automation (New York: John Wiley & Sons, 1956). His opinions echo those of Thesis, and of Robert E. Slater, "What Management Has "Discovered" About Computers", Journal of Machine Accounting 6, no. 7 (July-August 1955):15, 18, 24-25, 32, page 24. On the depreciation of punched card equipment, see Donald C. Niles, "Purchase versus Rental of Data Processing Equipment", Systems and Procedures 8, no. 1 (February 1957):25-39, page 28 – the topic became much more important around this date, as IBM was forced on anti-trust grounds to offer purchase as well as rental options. Experts continued to discount the importance of obsolescence even after transistorized models had been announced and disc drives were becoming common – see Neal J. Dean, "Computer Installation -- Will It Pay To Wait?" The Management Review 49, no. 3 (March 1960):25-28, 79-83, page 25 and John H. Dillon, Data Processing in Navy Management Information Systems, SecNavInst. P 10462.7 (Washington, D.C.: Department of the Navy, 1959), V-9.

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acquire a smaller IBM 650 computer to supplement its existing punched card machines. He found the risks posed by further technical advancement to be much overblown. [270]

> [W]e have heard a great deal about obsolescence of equipment. I was inclined to accept it as an important factor so important, in fact, as almost to preclude purchase of a machine. Yet, after a great deal of study and discussion with consulting engineers, I have come to the conclusion that obsolescence is not now a factor of primary importance. Certainly there are going to be many improvements over the next decade, but all indications point to the fact that manufacturers will have to update equipment presently in existence when they come out with something new.[271]

This concept proved surprisingly resilient, despite annual announcements of new and improved computers. The prize for wishful thinking must be awarded to Neal J. Dean, a partner with Booz, Allen & Hamilton and one of the leading computer management pundits of the 1960s. In 1960, even as transistorized computers were rendering existing valve based models obsolete, he presented an ingenious analysis of obsolescence. He argued that current machines were unlikely to wear out in less than twenty years, and that managers should try, if possible, to plan their hardware needs a decade ahead and make sure the machines they ordered now could be expanded to meet these demands. His exemplary analysis calculated the potential savings from computer purchase over a ten-year operational life. While he was aware that further improvement was likely, Dean held that, "the very fact that a more 'advanced' device may be available should not of itself render an existing device obsolete in any sense of the word which is significant to management." He insisted that, "'True' technological obsolescence probably occurs only with a major technical breakthrough rather than with gradual improvements," whereas "developments have been more evolutionary than revolutionary." As an example of such a possible revolution, he mentioned a "random access device" but insisted that such capability "seems to be almost ten

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[270] On the depreciation of punched card equipment, see Niles, "Purchase versus Rental of Data Processing Equipment", page 28.

[271] Slater, "What Management Has "Discovered" About Computers", page 24.

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years away, since it requires a technical breakthrough in research, plus development and engineering time."[272]

In fact, obsolescence claimed most first generation machines within a few years of their installation. Despite Dean's reassurances, large, random access devices (or as we would call them today, hard disk drives) were widely available by 1962, and were one of the key characteristics of the "third generation" machines that dominated the product lines of all major manufacturers from 1964 onwards.

The benefit side of the equation was little clearer. Cost savings were expected to follow from the elimination of the clerks who were currently performing the work manually. Concern over clerical costs was not wholly misplaced. The proportion of the American workforce engaged in clerical work had risen rapidly and continually since the 1880s, and in the newly tight labor markets of booming post-War America many were concerned that this would begin to drive up wages.[273] Such worries aside, clerks remained rather cheap when compared with first generation computers.

The Controllers Institute study outlined a reasonable start to estimating clerical cost savings. The firm should chart all of its most important clerical costs and show the amount incurred performing each of these tasks at each of its main locations. Then came the leap of faith. How much of this could the computer save? "It is obvious," wrote Wallace, "that a computer could not replace all clerical costs. Therefore, the clerical costs must be higher than the cost of operating a computer. The art is not sufficiently advanced to give any rule of thumb indications of how much higher present clerical costs must be." Estimates of high cost savings were premised

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[272] Dean, "Computer Installation -- Will It Pay To Wait?" page 25. Similar sentiments are expressed in Dillon, Data Processing in Navy Management Information Systems, SecNavInst. P 10462.7, V-9.

[273] Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970" suggests a feared shortage of suitable female clerical workers was one of the major factors driving the initial adoption of computers.

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on the idea that all or most of the clerks could be eliminated after conversion was complete – what else could automation mean? Later studies found the true potential for elimination to lie somewhere between 25 percent and 0 percent of the existing clerical workforce in the area automated – though many firms claimed to have reduced the rate at which their clerical staff expanded. Much less of the existing clerical work was truly routine than had been assumed by managers and consultants.[274]

The "intangible" benefits stemming from improved management and organizational transformation were often claimed to dwarf the more tangible savings to be had from eliminating clerical positions. Little attempt was made to quantify these – that was why they were called intangible. While, as Wallace wrote, "It goes against the grain of business to approve such an item of capital expenditure on the basis of assumed intangible benefits," their discussion nevertheless gave the impression of a safety margin. If predictions of clerical savings proved to be overstated, this would surely be balanced by the magic of intangible savings elsewhere. The problem was that these savings would not just happen by themselves. As a 1957 article in the Harvard Business Review by Ralph F. Lewis pointed out, while "much talk," and lots of good ideas had been produced over the use of computers to better inform management, there had been far "too little translation of this talk into performance." To remedy this, he called for a company-wide "entire study of management problems" and the production of entirely new systems.[275]

This was, of course, something that the systems men had been proposing for years, but Lewis believed the computer had brought a new urgency to the task. Fortunes were being squandered ordering computers as a means of "Keeping up with the Joneses" which, he believed,

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[274] Wallace, Appraising the Economics of Electronic Computers, 21. The difficulty in achieving projected savings was already apparent – see Laubach and Thompson, "Electronic Computers: A Progress Report", page 125.

[275] Lewis, "Never Overestimate the Power of a Computer". Wallace, Appraising the Economics of Electronic Computers.

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was "the real reason for large numbers of computer installations." Lewis claimed that the "sound and fury generated in the business press" by the simple automation of payroll and other routine operations obscured the fact that the computer could only raise costs when compared to a well-run manual system. The intangible benefits of automated payroll, meanwhile, were negligible. But Lewis saw opportunity for systems men in this mess. He related a case study in which improved systems work had greatly improved efficiency. While he conceded that in theory these savings could have been achieved without the computer, he reported that, "management would never have allowed the necessary sweeping changes in procedures. In this case, the magic word 'computer' opened departmental doors which had been closed to systems people for years."

## Pushing for Status

Before it even arrived, the computer provided office managers and clerical systems and procedures experts with a wedge to pry open the doors of divisional operations and increase their status in the eyes of their superiors. The Harvard team documented several firms in which their role in the study led to a formal upgrading of these groups, before the decision to purchase a computer had even been made. Experts with a strong systems and procedures background were adamant that the study should produce figures on a number of different options, including the improvement of efficiency through better procedures or the improved use of conventional punched card equipment. All agreed, however, that in practice the study team was far more likely to be charged with a "yes" or "no" answer to the single question of computer acquisition than with an open-ended study of all the possible technological, procedural and organizational avenues for administrative improvement. This only raised the odds that the study would turn into an exercise in the rationalization of a decision to place an order.

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The study team acquired a particular kind of bias. Its members were self-selected in the first place, and had then spent months or years immersing themselves in the exciting new world of computing, learning about hardware, writing sample programs, attending conferences, bonding with manufacturers' representatives, and hiring consultants. By the end of this process they had begun to reorient their careers away from accountancy or office management and toward the new field of electronic data processing. In addition, as the firm's computer experts, they could expect to hold considerable power within a new department if they recommended the acquisition of a computer. As John Dearden, a prominent skeptic, was later to observe, "Management should recognize that the recommendation of the feasibility study will almost certainly to be to acquire a computer and that it will be difficult, at that time, to override this recommendation. In fact, in many instances the only decision management really makes is to authorize an initial study. From the moment of authorization, the project develops momentum that is just about impossible to stop."[276]

One of the Harvard team's most important findings was that, "in many of the companies studied, the original impetus came from a person relatively far down in the organization. When such a person sparked the project, an important problem was to obtain the support of top management." They found that the process by which this took place was generally not entirely rational. Even where elaborate projects were undertaken to assess the computer's exact capabilities against the job's requirements, top managers were much more likely to be convinced by an immediate and easy to grasp demonstration of the computer's mathematical virtuosity than by a laborious analysis of the proportion of payroll operations that could be easily automated.[277]

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[276] John Dearden and F. Warren McFarlan, Management Information Systems: Text and Cases (Homewood, IL: Richard D. Irwin, Inc., 1966), 23.

[277] Ibid. quote is from page 30, observations about the power of demonstrations are from page 85.

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These studies suggest that individual enthusiasts within the companies had often been following computer technology for several years before their companies launched a formal investigation of its feasibility. The feasibility study was a chance for such enthusiasts to convince their fellows that the computer was a worthy investment. Insurance companies had a particularly long standing interest, because of their long history with punched card machinery and their reliance on actuarial calculations. The Prudential's Berkeley was the most famous of these men, but the Harvard team found several others. The Franklin Life Insurance company, for example, had been following computer research since Harvard's Mark I mechanical calculator was completed during Word War II, and decided to order its own electronic computer in 1951. Wallace was reluctant to leave conduct of the study in the hands of such enthusiasts. He warned that, "[m]any business men who have investigated computers have become entangled in technical concepts -- binary bits, memory, word length, access time, tape speed, program commands, and such." In some firms, particularly decentralized engineering companies, the impetus could also come from a division manager or a senior manager. Such firms were sometimes motivated to set up a higher level committee on discovering that multiple uncoordinated investigations were taking place in different parts of the company.[278]

The feasibility study was expected to include a great deal of learning. This took place on two different fronts. First, the members of the study group would have to learn about the computer. Presentations from the representatives of computer companies played an important part in this. These ranged from afternoon seminars to more formal two to six week courses. Experts also suggested that the team should read extensively among the burgeoning numbers of journals and news-letters devoted to computing. During the mid-1950s, conferences were a particularly important venue for the team to meet consultants, swap experiences with representatives of other

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[278] Wallace, Appraising the Economics of Electronic Computers, 5.

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companies and view demonstrations of new equipment. These conferences contributed greatly to the formation of a broad community of administrative computing, in which ties between members of these different groups strengthened. As a result, corporate computing staff identified ever more strongly with their new occupation and with the technologies of computing than with their former occupations, or even their current employer. As Wallace wrote in 1956, "The computer field is somewhat of a little world unto itself. It is highly desirable that members of the team be in contact with this new world."[279]

The second kind of learning was the "education" of other members of the firm, from the top executives who could approve the purchase to the clerks who were fearful of losing their jobs. As befit the then-fashionable ideas of the human relations school of management, experts often mentioned the need to communicate carefully with affected workers and to give them the impression that they were involved in the process. It was not, however, assumed that the views of clerks and clerical supervisors would have any bearing on the substance of the plan adopted. Any concerns were diagnosed as evidence of a pathological resistance to change. Consider the advice of Wallace:

> On planning the announcement that a computer is to be acquired, consideration should be given to the desirability of a company-wide computer indoctrination program.... The objective is to eliminate as far as possible any psychological resistance to the introduction of the computer which could hamper or completely defeat a successful conversion. Of course there is nothing new about this problem. Introduction of a labor-saving device is always viewed with suspicion.[280]

The other question, of course, was what model of computer to buy. For companies looking to buy a large, general purpose computer in the mid-1950s the main choice was between Univac and IBM. Both could supply a room-filling machine built with thousands of vacuum tubes together with an assortment of printers, tape drives and card readers. The potential of electronics

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[279] Ibid, 25.
[280] Ibid, 54.

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drew a host of other companies, many selling smaller or more specialized systems. The ideal feasibility study would involve thorough examination of the potential of various models of large and medium sized computers to speed a particular set of jobs. A true comparison would also have to isolate the impact of improved planning and work design from that of the machinery itself. The computer would have to prove its superiority over manual methods and traditional punched card machines as part of an optimally designed system. A variety of consulting firms, including many established accounting practices such as Arthur Andersen, were available to offer assistance in this arduous task. Indeed, the specifics of machine selection were impossible to separate from the important yet often neglected questions of economic viability. Early studies often looked at the theoretical maximum speed of the computer, neglecting the many variations in design, peripheral equipment and programming capabilities that determined the actual rate of throughput. Despite assurances to the contrary, the latter was essentially impossible to measure without actually writing a program very similar to the final one.[281]

Consideration of "special purpose" equipment added an additional complication. A company had to decide whether to purchase a standard, general purpose computer system, a specially modified version or seek to build its own equipment. A few hardy pioneers such as the English catering firm Lyons took the in-house route, but as production machines proved their versatility it soon lost its attractiveness. Customized or special purpose equipment was harder to dismiss. Customers were not always used to using a single machine for many accounting applications. Bookkeeping machines had been produced in many different models for slightly different tasks, and major customers could have these tweaked to add special characters to the

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[281] For one early summary of the comparative evaluation of different computer models, see Ibid, 41-50. Richard G. Canning returned repeatedly to the idea that it should be possible to automate comparison of the cost and performance of different computer configurations when applied to a particular administrative task. Richard G. Canning, "New Light on Error Detection and Control", EDP Analyzer 1, no. 1 (February 1963) and Richard G. Canning and Roger L. Sisson, The Management of Data Processing (New York: John Wiley & Sons, Inc., 1967), 84-85.

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keyboard. More importantly, some experts considered it inherently more efficient to use equipment tailored to a particular job rather than to waste most of the capacities of a less specialized machine. There were also a lot of tasks for which standard computers were poorly adapted. Any company looking to provide instant access to airline reservations or bank account balances was obliged to look beyond the capabilities of a general purpose system.[282]

The best and most methodical practice was clearly to make a trial use of a computer before buying. At least one of the firms studied by the Harvard team was trying to do this, working with IBM to process payroll for 3,000 of its employees on a service bureau machine. IBM granted companies that had placed orders preference in admission to its programmer training courses, and in the allocation of precious practice sessions on its own computers. Depending on the model, waiting times during the 1950s were from one to two years. This scarcity actually gave an incentive to gain a place in line by rushing in an order that could then be canceled or delayed later. The firm in question eventually had to order a machine to finish its trial project, which must have somewhat prejudiced the final conclusion. [283] This gave these firms a sporting chance of having some programs in a state of advanced development by the time the computer arrived – but it also made it hard to complete a thorough study without placing an order.[284]

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[282] For a book-length study of the process by which a firm planned for the installation of a special purpose machine, see Edward L. Wallace, Management Influence on the Design of Data Processing Systems (Boston: Harvard University, Graduate School of Business Administration, 1961). On Lyons, see David Tresman Caminer, "The Story of an Innovation", in User Driven Innovation: The World's First Business Computer, ed. David Caminer, et al. (London: McGraw-Hill Book Company, 1996).

[283] For the trial application see ibid, 40.

[284] Figures on shipment value are taken from Cortada, Information Technology as Business History: Issues in the History and Management of Computers, 56 in which they are attributed to a 1974 International Data Corporation report. For order backlog figures and average rental/purchase costs, see the early computer census included in R. Hunt Brown, Office Automation: A Handbook on Automatic Data Processing, 1959, contained in Market and Product Reports Collection (CBI 55), Charles Babbage Institute, University of Minnesota, Minneapolis, Section II, page L 2. For a discussion of the experience of a pre-installation practice session see Porter, "First Encounter with the 701". On the difficulty of completing a thorough study without ordering a computer, see Laubach, Company Investigations of Automatic Data

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An internal Univac memo, addressed to legendary computer pioneer Grace Hopper gives a sense of the symbolic nature of feasibility studies and the strictures under which they were sometimes performed. Its author, Edwin F. Somers, worked under her in its Automatic Programming group. Univac hoped to install one of its large computers in the service of its home state of Pennsylvania. It had received word from the Governor that the purchase would be made, providing an economic justification could be made by December 15 and the first application was in use the following July. Unfortunately, as the author admitted with unusual frankness, "A factual feasibility report cannot be completed by December 15 or even by January 1... The report will be as factual as the limited information gathered by the committee will permit.... [despite] many assumptions and projections, I feel that the report will be the best we can expect under existing conditions. We hope that it will be adequate enough to obtain the Governor's signature."[285]

This signature was, in the end, forthcoming. The author's summary of the "existing conditions" speaks volumes in a few words.

> 1) The various departments are rather autonomous, each with its own payroll system. The Commonwealth should decide whether we are to carry over each system as an independent application or whether all systems should be standardized.
> 2) Commonwealth personnel have not been properly acclimated to the introduction of electronic data processing and are, therefore, understandably reluctant to cooperate.
> 3) The timing of the study coincides with the heaviest workload period for most departments.
> 4) Many of the committee members are unfamiliar with payroll systems. Few know how to conduct a study. As a matter of fact, the

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Processing, especially page 60. For a case in which an order was actually cancelled see McCaffrey, From Punched Cards, Chapter 6.

[285] E. F. Somers, Internal Memorandum, 1957, contained in Edward F. Somers Papers (CBI 65), Charles Babbage Institute, University of Minnesota, Minneapolis. Hopper's fame derives from her invention of the compiler, popularization of the term "bug" to describe a flaw in a computer program, and her outlier status as a prominent woman in the U S Navy and the software field. But she worked actively as a Univac executive for many years, and was heavily involved in its efforts to help customers program the machines.

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programming talent of several of the members (who will eventually become the programming staff) is questionable.

5) The morale of the committee is quite low because of the lack of organization and direction, proposed salary scales, and uncertainty as to the future.

6) Three of the original fourteen committee members have been reassigned to the Department of Highways' 650. The remaining members are either on vacation now or planning vacations before the end of the year.

In addition, illness and the pressure of other assignments meant that only one Univac representative was working full time on the project. The author had grave doubts as to the likely success of the effort to convert payroll to the computer, unless substantial changes were made. He called for the use of Univac's pioneering Flow-Matic high level programming language, the training of programming staff and the addition of a number of Univac systems analysts to help with conversion and to standardize payroll procedures. As he warned, "I am more concerned about developments after the completion of the feasibility study. Although the sale seems to be a foregone conclusion, the whole situation may develop into another fiasco."

These were not problems that could be expected to go away with the conclusion of the study phase. The fig leaf provided by this particular feasibility study may have been extreme in its immodesty, but it was probably at least as typical of general practice as the elaborate and scientific exercises lauded in the management literature. Even the experts who described best-practice for the study admitted that most firms failed to follow it. Canning, for example, admitted that, "Too often, the phrase is heard, 'We are going to use the XYZ machine but we're just not sure how we are going to use it'." Case studies of the processes used by actual companies showed that the decision to order was usually made without detailed estimates of costs and savings, and certainly without the trial programming work recommended by the experts. In those firms where initial interest came from top management, rather than from lower level accounting, systems and procedures or tabulating personnel, purchase was still more likely to be authorized without detailed planning. Experts also accused firms of relying too closely on the estimates and studies

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provided by computer manufacturers. But even when no serious attempt to add up costs was made, the formality of the feasibility study may have calmed the nerves of managers, because they knew that other companies in the same industry had performed exhaustive studies before placing their own orders. [286]

## Doing the Same Things, Faster

Whatever the stated reason for ordering it, as the delivery date for a computer approached, the recipient had to choose specific tasks for it and undertake the necessary programming and conversion work. At this point, the wide-eyed enthusiasm of Edmund Berkeley and those hoping to use the computer as the foundation of a new approach to managerial decision-making was generally displaced by the urgent need to make the computer do something useful as soon as possible. A more pragmatic mindset took hold, as earlier language came to seem embarrassing. As the Harvard group concluded, "the so-called giant brains cannot think. Looked at in proper perspective, automatic data processing methods are merely an extension of present punched-card data-processing methods...." [287]

To cause a revolution, the computer would have to do something for businesses that they had not been able to achieve without it – whether an enormous reduction in clerical costs or a transformation of its operations. The evidence is clear that, in most cases, the administrative computers of the 1950s merely supplied what was already perfectly attainable with punched card machines or manual methods. The computer may have provided reports, totals and other output more rapidly than previous methods, and it almost certainly provided it at higher cost, but it did not substantially alter the domain of what it was possible to do.

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[286] Richard G. Canning, "Planning for the Arrival of Electronic Data Processing", Journal of Machine Accounting 7, no. 1 (January 1956):22-23, 30. For case studies of actual companies see Laubach, Company Investigations of Automatic Data Processing, 29-121.
[287] Laubach, Company Investigations of Automatic Data Processing, 3.

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In 1957 a survey conducted by the National Office Management Association found that half of the very largest firms examined (those with more than five thousand office workers) had already installed at least one large computer, such as the IBM 700 series. An additional 14 percent had ordered their first large machine but had yet to receive it. All of these firms were still running conventional punched card installations along side the new machine. At this point, more of the computers were currently running engineering computations of one kind or another (56 percent than payroll or inventory control (38 percent each) – reflecting the early dominance of scientific computing over administrative computing. However, companies still awaiting delivery of their first computer were much less likely than the pioneers to have earmarked it for technical calculations. The dominant corporate applications of large computers were already shifting from scientific and technical computation to administrative tasks. When asked about future intentions, 98 percent of the firms already using computers either had inventory control programs running or planned to deploy them in the future, making this by far the most widely considered application.[288]

The purposes to which the new million-dollar electronic computers were applied bore a striking similarity to those already performed by punched card machines. Punched card machines were in use by a full third of the overall sample, in contrast to the 0.4 percent using large computers. The average punched card installation ran six different jobs on its machines. The three leading punched card applications were (in descending order) sales statistics, payroll, and

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[288] National Office Management Association, Automation in the Office (Willow Grove, PA: National Office Management Association, 1957). Despite the well-known importance of actuarial tasks to Edmund Berkeley and the early work of Univac, the crunching of demographics and risk factors was not a common job for the first large computers, or for the much larger population of punched card machines. Although insurance companies adopted the machines enthusiastically, they were much more likely to use them for dividend computations (46 percent of those with large computers) or policyholder records (46 percent) than for actuarial purposes (7 percent). Even for punched card machines, payroll was a more common application than either actuarial work or cost accounting across every industry, including banking and insurance.

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inventory calculations – the same three applications that dominated administrative use of the electronic computer.

Why payroll? The payroll run had a number of attractive characteristics. It took place every week, and was handled in the same manner on every occasion. It applied to the whole company yet seemed reasonably straightforward and routine. A large company had tens of thousands of people on its weekly payroll, ensuring a respectable volume, and the job required enough calculations to be highly time-consuming by manual methods. Tax, overtime, union dues, retirement benefits, vacations, and bonuses all had to be taken into account. Much of the complexity in the process came from legislative requirements, making it a process that would be around for some time to come and could not be eliminated by procedures improvements or organizational streamlining. But, in principle at least, it was not so complex and full of special cases and human judgment as to be impossible to automate in a computer program. Many companies had standardized and centralized payroll operations, reducing the chances of conflict with divisional managers. As we have seen, many firms were already using punched card machines in their payroll runs, meaning that much of the data required had already been coded into machine readable form. Thus payroll stood as good a chance as any potential application of the computer to pay for itself through clerical savings.

The publicity given to GE's choice of payroll as the first administrative application for its Univac also steered the attention of subsequent computer installations toward payroll. This led the authors of the Harvard report to express worry that influential "leader" firms might lead follower firms astray if they blindly emulated their choices. Some observers, especially those with an orientation toward operations research or management theory, complained that to use such a powerful machine on such a mundane task was to squander its potential to make a real difference to the management of the overall company. The very routine, clerical nature that made payroll an easy choice also limited the potential benefit it could bring a company. But it was, in fact, the

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similarity of payroll and other early computer applications to those already performed by punched card machines (together with its potential for tangible job savings and the lack of upheaval to existing managerial culture) that made them so attractive to many firms. The Harvard team found this choice had been made quite deliberately at one of the firms they examined. On the advice of a consultant with a punched card background, it had chosen to "mechanize the existing system. In his opinion it was hard enough for existing clerical personnel to adapt to the process of mechanization without having to face changes in the system as well." Given the shambolic process by which many orders were placed, this attitude may have come to other companies primarily as a default, as they considered the alternative of a computer sitting idle while operations research specialists were hired and politically charged corporate reorganizations haggled over.[289]

In 1957, automation consultant John Diebold complained that, "there are already well over a thousand computers already in operation, but only a small fraction of them are functioning as more than punched card calculators." This conservative application of computer technology, as an extension of the punched card machine, triggered a rethinking of the role of punched card specialists in the new order of things. Early studies of the computer tended to play down the importance of punched card experience when working with the new machines. Thus the Harvard group advised those putting together study teams that the punched card people were likely to be too inflexible and tied to outmoded thought patterns – thus, as they snidely put it, "company executives need have no concern if punched-card tabulating equipment men were not available to work on an automatic data processing project." In practice, however, continuity in the tasks to

[289] For the Diebold quotation, see John Diebold, "Industry and the Automated Future: Problems Along the Way", Journal of Machine Accounting 8, no. 2 (February 1957):6-8, 28-29, 33. The precise quotation is from a case study of an unnamed shoe company in Laubach, Company Investigations of Automatic Data Processing, 126. The Harvard team gave the same firm's computer planning exercise a book length treatment in Wallace, Management Influence on the Design of Data Processing Systems.

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which the machines were applied was merely the tip of a much larger iceberg. Beneath the surface and inside the new computer department were to be found many of the people, attitudes, and occupational identities of the old tabulating group. It was the revolutionaries, not the punched card staff, who were most likely to feel out of place there.[290]

A 1958 Business Week report discussed in detail the dreadful problems that firms were having in making computers pay off economically, and the highly conservative way in which they were being used in practice. Yet not once did the author's faith in the manifest destiny of the computer falter. Consider the opening of the article:

> Just four years ago, at Louisville, Ky., a new industrial revolution started.... it has become perhaps a most perplexing and disgruntled--but inevitable--revolution. It's perplexing because industry, which has adopted the marvelously complex electronic computers with an almost religious fervor, often seems unsure of what to do with them after it has them. It's disgruntled, because early results have fallen far short of the rosy dreams in which they came wrapped. Yet it's inevitable, because the computers still hold the key to new systems of organization for the sprawling giants of industry, commerce, and government...[291]

The idea of revolution was hard to kill. These early, revolutionary hopes bequeathed to the field of computing a legacy with which it has been grappling ever since. While results have always lagged expectations, the ever advancing nature of the technology ensured that there was always a new revolution waiting just around the corner. After the first generation of machines came a second, and then a third. Any number of technologies have been promoted at the core of fourth and fifth generations of computing, including data bases, end-user programming systems, artificial intelligence, and expert systems. More recently, the Internet and on-line business were at the heart of a very similar bubble of expectations, as the concept of an "electronic revolution" in business received its latest spasm of attention.

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[290] Laubach, Company Investigations of Automatic Data Processing.

[291] Anonymous, "Business Week Reports To Readers On: Computers", Business Week, no. 1503 (21 June 1958):68-92, page 59.

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Yet if hopes of revolution and transformation have always driven the hopes of corporate computing, its reality has remained closer to those early uses of computers as simple replacements for punched card machines. Astonishing advances in technology have been paired with general conservatism in its use. As we shall see in the following chapters, use of the computer during the 1960s and 1970s evolved only very slowly from this pattern. The computer's corporate home was the data processing department – a hybrid of the existing punched card department with the systems and procedures group. This was accompanied by a new occupational identity of "data processor," closely tied to the computer, the data processing department and to the older practices of punched card work.

This tension between revolutionary dream and evolutionary reality remained a vital force in the development of computing. At the very end of the 1950s, the concept of the computer as the heart of a new approach of management was to resurface, with new force, as the "total management information system." During the 1960s this idea rose to achieve widespread acceptance as the rightful destiny of corporate computing. To this day, the tension between "technical" and "managerial" areas of expertise makes the relationship of information technology to corporate strategy a divisive and unresolved topic. Attempts to impose conventional management techniques, such as maximum utilization, charge-back accounting systems or return on investment calculations, to the field of computing invariably proved at best incomplete solutions, and at worst disastrous. Investment in computer technology continued to require an act of faith, yet ever advancing technology delivered enough miracles to make the separation of sensible investment from foolhardy wager into an almost impossible task. Despite the spectacular advance in every area of administrative computing technology, one might fairly say that the seeds of everything that was to follow in corporate computing was present here, at the conclusion of the first act in this great drama.

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## 6. BUILDING THE DATA PROCESSING DEPARTMENT

Executives viewed the computer as a new piece of equipment that would save money in clerical operations and improve throughput, the same way that a new milling machine might improve efficiency on the shop floor. But when they authorized its acquisition they were also, more or less knowingly, creating a new department with its own culture and its own interests. When it signed for a computer, the company was also contracting to build a new organizational function around it. Few had any idea what a massive commitment this would turn out to be.

In the early 1950s there was no computer department because there was no computer. As we have seen large companies had "systems and procedures" departments, home to small groups of "systems men" responsible for the analysis and improvement of clerical procedures and administrative techniques. The same companies generally possessed IBM or tabulating departments staffed by the machine accountants. Meanwhile the activities to which the computer would soon be applied, such as accounting, inventory management and payroll, were performed by a combination of staff specialists and administrators in operating departments. Then there was the massive volume of keypunching activity needed to transfer records to the computer and provide it with updated information. The computer was also of vital importance for many other specialist corporate activities. For example, a small but rapidly growing number of companies were experimenting with operations research techniques by forming a separate group to apply statistical and mathematical techniques to the problems of management. Likewise, many companies operated separate groups responsible for scientific and technical computation.

The computer pushed punched card work, operations research, office management, and systems and procedures groups toward cohabitation, but did not in itself provide much guidance as to exactly how these different groups might work together or how the resulting conglomeration might be structured. This triggered a process of negotiating and experimentation, beginning

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during the feasibility study itself, which in its most developed form included some sample programming and careful evaluation of potential areas of application. By the time the computer was due to be installed, there clearly needed to be some kind of specialist group or department to operate it.

Certain activities were inescapable, and four broad job categories appear very early in the best-practice literature of administrative computing and endured for decades afterwards. The first was systems analyst – looking at the work to be tackled by the computer, drawing charts of the processes involved and specifying the inputs and outputs required for each part of the new system. This was usually seen as the natural job of existing "systems and procedures" and "clerical methods" staff. The second was operator -- to actually run the computer and all its associated peripheral machines. This involved a lot of feeding tapes in and out of drives, setting control switches, tending to electronic and mechanical glitches and the like. Although this was a new function for many scientific and engineering computation groups, to most administrative organizations it seemed an obvious extension of their existing punched card operations. The third task, programmer, was the least familiar. Basically, the programmer was supposed to sit between the analysts and the operators and turn plans into programs. The final job was that of departmental supervisor or manager. The department's leadership was most often composed of existing punched card supervisors, or some of the more junior accounting managers involved in the feasibility study. Firms often maintained their "automation committee" to provide steering and oversight for the new operation.

The computer thus sat at the intersection of two existing activities – systems and procedures and punched card work, and involved the development of a new one between them – application programming. But even the four functions described above were by no means unproblematic or constant over time. How these different jobs were defined, which held the most status, whether one could ascend from one to another, which should be centralized and which

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distributed, whether existing functions should be merged together or merely collaborate – these unresolved questions held great interest for those involved and were earnestly debated. Given the rapid adoption of the computer and the lack of accepted and proven models, the struggle to negotiate an advantageous solution was played out in hundreds of companies and a variety of different arrangements were formulated. Because computer work recombined existing tasks in new ways, the internal organization of the data processing department was intimately related to the place assigned to it on the organizational chart.

The dominant response, however, was the creation of a new hybrid department: data processing. The data processing department typically included separate groups to operate the computer, to program it, to punch data onto cards, to run conventional punched card machines, and to perform systems analysis. This required both the creation of a new corporate department and the corresponding evolution of a consciousness among those who worked there of themselves as data processors rather than punched card people, systems experts or accountants. With the new department came a new profession, also called data processing. Both the data processing department and the data processing profession were explicitly corporate creations, limited to administrative computing and punched card work. Despite some attempts to broaden this base, they held little appeal as a platform from which to build a more general computing profession to include scientific, academic or technical computing. Within the corporation, meanwhile, their close association with machinery limited the potential of data processing as a managerial force. Despite these limitations, however, data processing proved highly attractive to former punched card staff as a means of social mobility within the corporate hierarchy.

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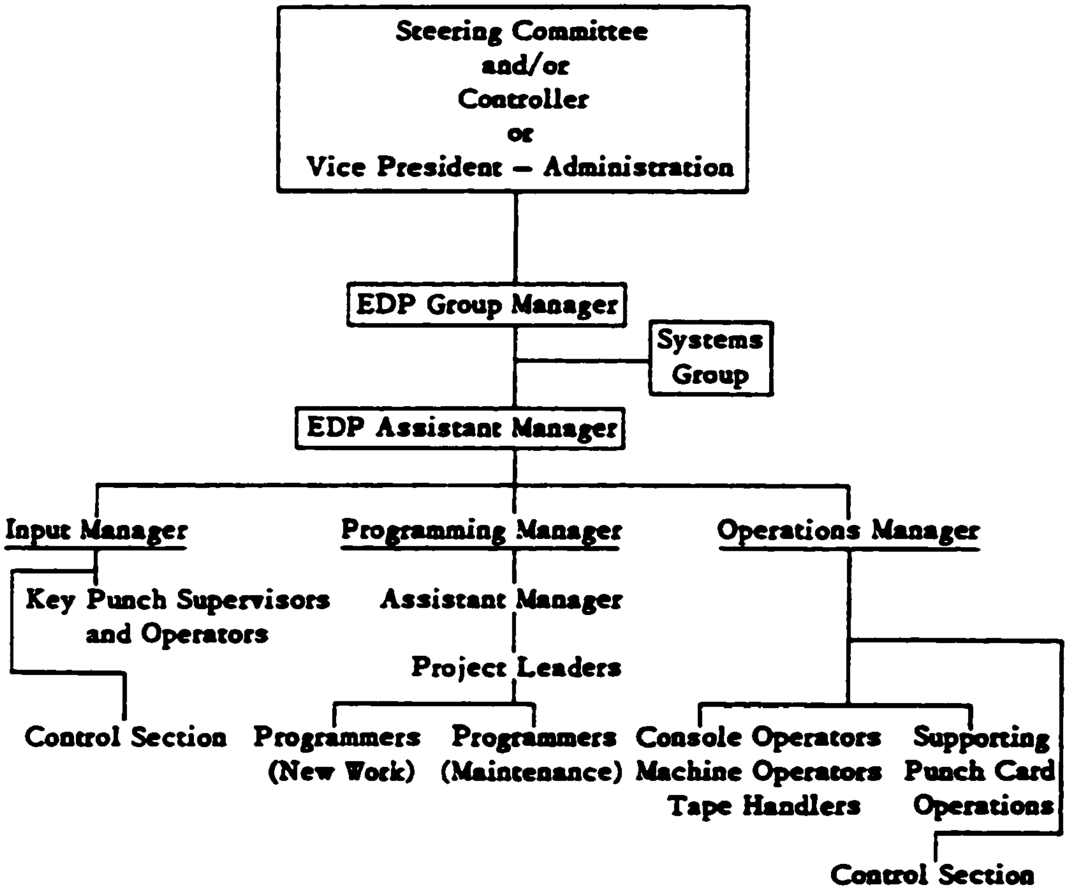


**Figure 14: One early proposal for the structure of the data processing department. Note that systems work remains clearly separated from programming and operations.[292]**

The typical name, organizational location, occupational culture, internal structure and managerial mandate of the data processing department had been essentially standardized by 1958, and changed only very slowly through the 1960s, despite the considerable expansion and profusion of such departments and the deployment of two further "generations" of computer hardware. Yet, the initial template of the data processing department came from a convergence of factors quite specific to the 1950s – such as the need for punched card equipment to work along

[292] Conway, Gibbons, and Watts, Business Experience With Electronic Computers, 80.

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side computers, and the need to integrate formerly separate tabulating departments and analysis groups.

One of the first serious attempts to provide a blueprint for the structure of the new data processing department was offered by the industrious Richard Canning. Canning was one of the most prolific, thoughtful and well informed of the era's commentators on data processing management. As well as working as a consultant and publishing a huge number of articles and textbooks he was the publisher, and main contributor to, a newsletter called EDP Analyst and a founder of the pioneering Data Processing Digest. In his 1956 book, Data Processing for Business and Industry, and the managerially-oriented 1957 follow-up, Installing Data Processing Systems, he presented a detailed and widely influential template for the establishment of a computer department.[293]

One of Canning's distinguishing beliefs was that the computer should be viewed first and foremost as a tool for better management rather than as a direct replacement for punch-card machinery to perform an equivalent job. As such, he was an early promoter of data processing as a new kind of identity that stretched far beyond the traditional domains of machine accounting. Canning's definition of data processing was therefore a broad one. His major case-study documents the creation of a new Manager of Procedures and Data Processing in a manufacturing company. To create this new department, the entire Systems and Procedures group was removed from the control of the Chief Accountant and merged with a new Operations Research group and the programmers and analysts getting ready for the delivery of the computer. This original plan was soon modified to transfer the existing tabulating operations to the new department, rather than leave them with the accountants as first planned. The final department had three main subdivisions – Procedures, Operations and Operations Research. Systems analysis and

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[293] Canning, Electronic Data Processing, Canning, Installing EDP.

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programming were both the responsibility of the Procedures supervisor, while the Operations chief was responsible for running both the computer and the existing tabulating machines.

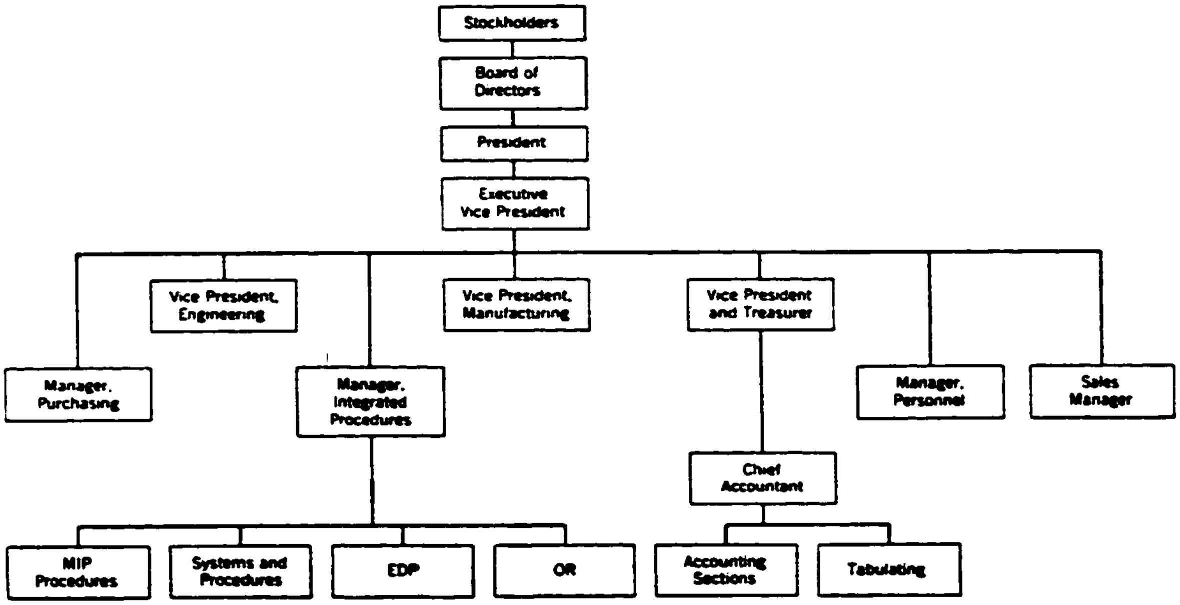


**Figure 15: New organizational chart planned for the "AAA Manufacturing Company" with the introduction of data processing. The Manager of Integrated Procedures is a new post, and an existing Systems and Procedures group formerly under the jurisdiction of the Chief Accountant has been moved here.**

One of the main controversies involved in the creation of the new department was the kind of background needed to head it. Was it more important to be an expert on computer technology or someone with previous experience of the areas of business to which the computer is to be applied? In any given situation the answer obviously depends on a lot of factors, but answers to the general question have tended to be determined by one's background. Canning managed to split the difference. His example had the entire Procedures and Data Processing operation headed by the former head of the freestanding Systems and Procedures department, but the manager responsible for data processing was brought in from outside and had previous computing experience. Although Canning personally favored the association of programming and

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systems as separate groups within the same department, this arrangement was by no means universal.

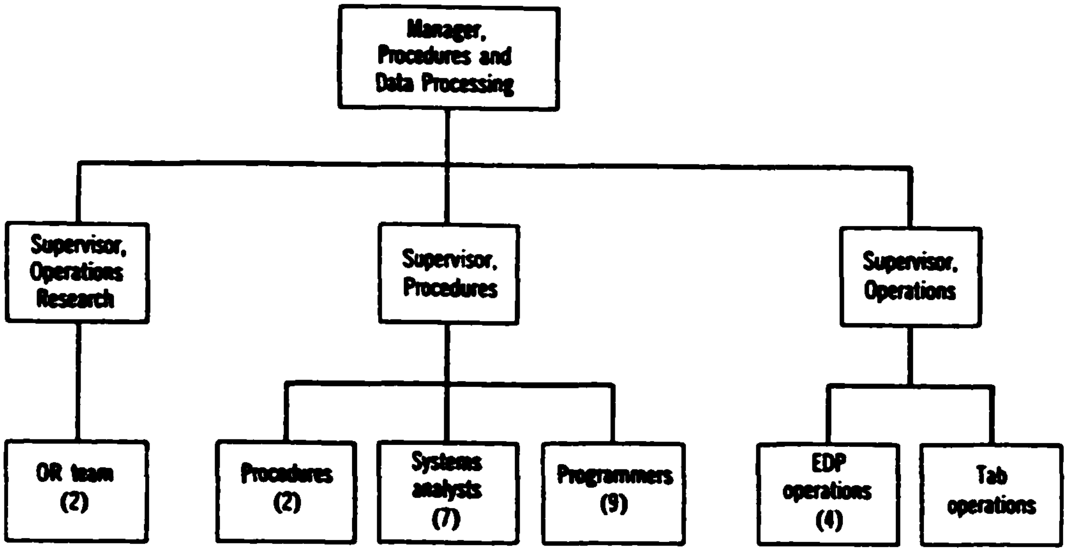


**Figure 16: Final structure of the Procedures and Data Processing group discussed by Canning. Note that tabulating operations were eventually moved into this department, and did not remain with the Chief Accountant as first planned.**

Another, and closely related question was where in the organization to put the computer. This depended to some extent on how centralized the firm was in the first place, and of course on where the push to acquire it actually came from. Some management writers argued that the computer would, by its very nature, impose centralized control. For example, in 1955 a former Harvard Business School staff member and partner in the consulting firm of Cresap, McCormick and Paget suggested that the presence of the computer would "force the change" to a "new concept of management" in which all administrative work was performed in an integrated manner and under the control of a strong centralized systems department. This was one of the first statements of a recurring idea among managerially-oriented computer enthusiasts – that the

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machine would be the seed around which the corporate oyster produced a pearl of omniscient technocratic control.[294]

In practice most companies seem to have deployed the technology in accordance with their existing structures. General Electric, one of biggest users of early computers, allowed its many different divisions to make their own choices about computer use. Its first administrative computer was under the authority of the controller of its Major Appliance Division in Louisville, and was intended to do payroll, scheduling, inventory control, order service and general and cost accounting for the whole division. But even with GE's scattered divisions, plans differed noticeably. Its second administrative computer, installed at Schenectady, was intended to process payroll for no less than fourteen different groups – but because no standards forms, controls or methods existed each of the groups was expected write its own programs! Thus physical centralization of the computer did not necessarily mean a plan to impose centralized control over the jobs it ran. Westinghouse, another decentralized firm, rejected altogether the idea of installing a central computer to perform company-wide cost accounting and payroll calculations. Instead its first big computers were purchased by individual plants, and used for a mixture of administrative and engineering tasks.[295]

What did the typical data processing department look like by 1960? That was the year in which Business Automation magazine first commissioned its large scale annual salary survey. This initial survey, in 1960, covered 489 companies and more than seven thousand employees. An average installation employed twenty-five people and paid fifteen hundred dollars a month in rent for its equipment. Although forty-six of the firms had large Univac or IBM computers (the

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[294] T. F. Bradshaw, ed., Automatic Data Processing Methods (Boston: Graduate School of Business Administration, Harvard University, 1955).

[295] For GE see Osborn, "GE and UNIVAC: Harnessing the High-Speed Computer". For Westinghouse see Frank H. Muns, "Problems of Decentralization", in Automatic Data Processing Conference, ed. Robert N. Anthony (Boston: Graduate School of Business Administration, Harvard University, 1955).

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most popular being the 705, an improved version of its initial 702 model) the most common model by far was the smaller 650, of which seventy-four were reported. The data processing personnel were categorized used the, by now standard, divisions – managers, analysts, programmers and operators. The survey sorted each into a number of grades according to responsibility and experience.[296]

Comparison of pay for the different activities is very revealing. As expected, the computer department manager was the best paid, receiving an average of 218 dollars a week. However, the systems and procedures supervisor earned only a little less – 191 dollars. At each level of experience, from manager to trainee, procedures analysts earned more than programmers and programmers earned more than operators. Most of the firms required a college education for their programmers and analysts.

The biggest disparity came between tabulating machine and computer personnel. The managers of punch-card only installations earned a median of just 163 dollars – 30 percent less than managers of computer installations. In companies with computers, the supervisors of the punched card facilities earned $148 a week – much less than their counterparts heading the analysis, programming and operations groups. The worst paid data processing staffs, unsurprisingly, were those in clerical occupations – key punch operators, Flexowriter operators, teletype operators and control clerks. All these positions paid an average of about 77 dollars a week.

Only two of the companies reported having a female manager, and only one company had a woman in charge of its programming team. Less than 15 percent of all the programmers included in the survey were female. Like the better-established systems and procedures and

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[296] Anonymous, "National Survey of Computer Department Saleries", Management and Business Automation 3, no. 6 (June 1960):20-25, 52.

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tabulating machine supervision jobs, corporate programming was always an overwhelmingly male occupation.

## Punched Card Machines + Computers = Data Processing

Although it has often been noted in passing that for most of its history the administrative use of computers has been called "electronic data processing", few historians have given serious attention to the concept of data processing or to the factors that shaped its development. A history of data processing would look very different from the history of computing as it currently exists. For historians of technology in general, and of computing in particular, a sticking point has been the sheer scope and size of such a project. One cannot address the use of computer technology within a particular social space (such as the laboratory, office, service bureau, management suite, school factory or academic department) without devoting considerable attention to the earlier history of this setting, the people to be found in it, and the objectives to which the computer is put. Thus, while coherent one-volume histories of the computer hardware industry and its technologies can be written, it seems unlikely that we can hope to produce a single coherent narrative around the use of the computer, or of the associated tasks such as analysis, programming or operation. In short, the history of computing is not the history of the computer – or even, for the most part, the history of computation.

Linguistically speaking, early computing was a mess. No term, from program to file, was so self-evident that it was not widely quibbled with, and usually for good reason. "Computer", for example, was a confusing name. Firstly, it had traditionally referred to a person. Secondly, and more importantly, it referred to a person who performed scientific or technical calculations. As Robert Mauchly, one of the inventors of the UNIVAC, observed in 1953, "To call these devices computers is nowadays a misnomer. Their job is really the handling and processing of information. The savings which they can affect arises, in large part, from the highly automatic

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character of their operations. The phrase 'automatic clerical equipment' would better describe what we are talking about" It would have made more sense to call the machine a clerk or an accountant than a computer. While "calculator," IBM's original term for its "calculating punches" and the large 701 scientific computer, was well suited to these machines, it was equally unsuited to describe and machine used primarily for business applications. Tabulating machines had been known more formally by IBM as Accounting Machines since the 1930s, so the term "Electronic Accounting Machine" fitted well here for the new electronic models – but this was altogether an inadequate term to describe the larger devices. On the other hand, "electronics," as in "electronics for the office," was hopelessly vague.[297]

As we know, "computer" was the term that eventually triumphed. By the mid-1950s it was already widely used to describe administratively oriented machines, albeit with reservations. What may not be as apparent to the modern reader is that during the 1950s and 1960s its use was somewhat colloquial. IBM's adoption of the term "Electronic Data Processing" (EDP) to formally describe the new activity of business computing was one of the cleverest marketing moves in its history. Its masterstroke was to rename all its existing punched card gear as "data processing" (DP) equipment. Just as the shift from "tabulating equipment" to "accounting machines" in the 1930s reflected a symbolic broadening of the role of their products, so DP and EDP announced that the new machines were good for more than just accounting. More importantly, the nomenclature showed that computers and punched card machines were different flavors of the same thing and belonged together. These phrases were used very widely until the 1970s to describe administrative computers themselves (electronic data processing machines), the departments in which they were placed (the Electronic Data Processing Department), the people

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[297] John W. Mauchly, "Electronic Accounting", The Hopper 4, no. 12 (December 1953):2-4, page 2. Prominent author, consultant and published Richard Canning, for example, initially felt that the electronic data processing machines should not properly be called computers or vice versa. Canning, Electronic Data Processing.

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working in the computer department (data processing personnel), and the would-be profession they were part of (the data processing profession).

IBM also retained a standard numbering system for all its products. This gave rise to the "number soup" that makes reading any discussion of early computing a frustrating mess of 602As and 709s likely to baffle all but the most committed of readers. The uninitiated are liable to feel that they have inadvertently strayed into a corporate history of Levi's jeans. But how better to emphasize the continuum from the humble punch to the biggest computer than to quantify it as the difference between 024 and 705?[298]

The power of this approach was not lost on IBM's competitors. A 1957 study commissioned by Burroughs Corporation on its "corporate image planning and development" suggested that IBM had succeeded in using the concept of data processing to steal a march on other office equipment firms. Burroughs was still the leader in adding, calculating and bookkeeping machines and had acquired the Electrodata Corporation as the foundation of its computer range. While an earlier 1953 study had concluded that, "IBM's technical monopoly was due to disappear rapidly because of the imminent advent of electronic data processing," the image consultants were now forced to report that the enemy had turned this new technology to its advantage. "IBM has tended to use the term 'data processing' to designate the general area. This term, though unsatisfactory in many respects, has become generally accepted making it difficult for would-be competitors to define the field and their equipment in it in any other way." The report urged Burroughs to follow IBM in offering a "stepped-up line of machines, proceeding from the least complex and inexpensive to the most complex and expensive." This should "be a 'data processing line' rather than a 'business machines line'." While IBM only began to unite its

[298] While Levis' classic 501 never shared its designation with an IBM model, the 501 was an RCA mainframe. In Japan, more obscure pants such as the 701 and 702 are highly collectable today and share their names with IBM's first large computers.

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range technologically during the mid-1960s, with the famous System /360 range, it had already achieved a much broader semantic compatibility via the concept of data processing.[299]

For IBM, then, the definition of the computer as part of a larger, hybrid activity of data processing, rather than as a revolutionary departure from punched card methods, was the foundation upon which it could marshal its existing dominance of the punched card industry to crush insurgents, such as RCA, GE, Philco and Sylvania, despite their superior credentials in electronics. But this evolutionary approach had equally profound and less widely appreciated consequences for the punched card staff. Punched card staff were to dominate the new data processing departments, and to seize on the identity of data processing as a bridge to the new world of computing.

The installation of thousands of computers meant the creation of thousands of supervisory jobs. As Thomas J. Watson, Jr., the head of IBM, told his audience of punched card supervisors at their 1954 conference, "those with the best background for stepping into the "electronic office" of the not too distant future [are] the managers of today's punched card installations." He reiterated this on his return in 1958, challenging his audience to demonstrate the professional characteristics that their future in data processing demanded. Now, however, the generality of electronics has been replaced by the more clearly defined data processing. "[T]he very name that we have applied to our jobs - Data Processing," suggested Watson, implied a new focus on the provision "of relevant facts on a timely basis, on a basis equal or better that our business competitors. You will gain prestige and responsibility from the excellence of the facts, counsel and advice that you supply." If they could "become more professional than ever before"

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[299] Nowland & Company, Management Report: Burroughs' Corporate Image Planning and Devlopment, 1957, contained in Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis.

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then soon "top management will have begun to look for data processors to infiltrate into the very tops of their businesses." [300]

Just as tabulating departments were transformed in data processing departments, so too the putative profession of machine accounting was replaced by more impressive sounding but equally tenuous dream of a truly professional data processing organization. As we saw earlier the NMAA (National Machine Accountants Association) grew rapidly during the 1950s, reaching the 10,000 member mark by 1957. The association's staff represented the most senior main group of data processing personnel – the supervisors and managers of data processing installations. Throughout the 1950s (and 1960s) it was by far the largest "professional" association identified with the computing field, and its concern with data processing was unchallenged by the scientifically oriented Association for Computing Machinery (ACM) or the computer groups of the engineering societies (the Institute of Radio Engineers and the American Institute of Electrical Engineers).

In 1962 the association adopted a new name: the Data Processing Management Association. The transformation from machine accounting to data processing was the ultimate expression of the evolutionary progression through which the new institutions of data processing formed around the older ones of tabulating. The association faced many obstacles in its quest to build a new profession of data processing – foremost amongst which was its own membership. Every attempt by pro-computer modernizers within its leadership to break with its past was thwarted or blunted seriously by the continuing power of older, more conservative, punched card

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[300] Anonymous, "Glowing Future for Machine Accountants Described by Convention Speakers" and Thomas J Watson, Jr., "Address by Thomas J. Watson, Jr., President, International Business Machines Corp." in Data Processing (1): 1958 Conference Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1958). For examples of the early discussion of the challenges and potentials of computer technology within the community of punched card supervisors, see Robert G. Wright, "Electronics Challenge to Machine Accountants", Journal of Machine Accounting 7, no. 4 (April 1956):4-7,27, Hill, "The Machine Accountant and his "Electronic" Opportunity".

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oriented men. But its weakness was also its strength. The association's strong punched card roots ensured its preeminence in the hybrid field of data processing.

## Operating The Computer

When we think about early mainframes, we think of polished consoles, plate glass windows, banks of inscrutable machine, whirring tape drives. We think of the carefully composed publicity photographs issued by almost every company that installed a computer. These pictures vary only minutely. An intense looking young man in a severe suit with short, slicked back hair and heavy, thick rimmed dark glasses holds up a sheet of printout or gestures towards a piece of equipment. He is a systems analyst, part of a new breed of men. An older powerful looking man surveys the new installation with confidence. He does not understand what he sees, but if he feels intimidated by the tubes and tapes, the thousands of words of core and the tenths of milliseconds, then he does not show it. He is a manager, and he is in command. If we see anyone else, then it is most probably an attractive young woman wearing fashionable clothes. She may be keying information onto punched cards, or perhaps holding a magnetic tape.[301]

These is, of course, much that we do not see on this picture. We don't see the mess, the elusive bugs, the missed schedules, and the failed projects. In fact, we don't see a program or a programmer at all. The need for programmers was far from apparent to many firms when they placed an order for their first computers, and its true magnitude became clear only slowly after it arrived. But if the programmer was left out during the 1950s then we are today well enough aware of the need for programmers that we will look for them. The history of programming has received a good deal of attention, though the bulk of it has looked only at the intellectual history of programming languages rather than at the practice of programming. There is another figure

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[301] Such publicity stills, from manufacturers or users, are the source of almost all pictures of computer installations used to illustrate historical works. For complete, if badly reproduced, booklet from the period see McCaffrey, From Punched Cards.

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who is missing both from the pictures of the 1950s and from subsequent historical discussion. That figure is the operator.[302]

The persistent invisibility of these technicians should not, perhaps, be a surprise. The computer was supposed, from the beginning, to be the epitome of automation. Unlike a punched card machine, it would follow all the steps of its program automatically, untouched by human hands. As we have see, it took a variety of different kinds of punched card machine to undertake a job. Running a job required a lot of human activity to move cards between machines and to configure each machine for its task. This configuration activity was not called programming, nor did it resemble anything that would later go by that name. Some configurations were needed more than once, as would be the case for the settings used to produce totals, subtotals and a listing in a report issued each month. In this case the entire board could be removed and stored safely until needed later. A fully wired board could resemble a dish of spaghetti. Wiring these boards required considerable skill, but it was primarily a craft activity involving considerable trial and error. Doing it well required several years of experience, but was not generally thought to require a college education or any particular knowledge of intellectual background.

The appeal of the computer issued, in part, from its promise to do away with all this – in the "[e]limination of human beings except as input points and as system supervisors." This promise was most clearly articulated in 1953, when Richard W. Sprague confronted his audience of punched card supervisors with the disturbing question, "Are Punched Card Machines on the Way Out?" The author was at this point in charge of applications and sales for Computer Research Corporation, a then small manufacturer of computers he had co-founded a few years earlier. Sprague's answer was a qualified "yes." He predicted the imminent "[e]limination of human beings except as input points and as system supervisors." While he accorded the punched

[302] The one exception to this neglect of the operator is Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work.

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card itself a secure future as a medium for information exchange, he suggested that the traditional punched card machine was about to be cut down in its prime. Sprague's reasoning preserves for us the power attributed to the computer at a singularly optimistic moment in its history. Electronic computers had been shown to work, and their commercial development was proceeding apace. The computer's potential was clear, but it was, as yet, unsullied by the practical frustrations and limitations that would become apparent as earnest attempts were made to use it on the problems of administration. While Sprague's employment as a salesman gave him little incentive to express reservations, his address was marked by the unmistakable fervor of a true believer.

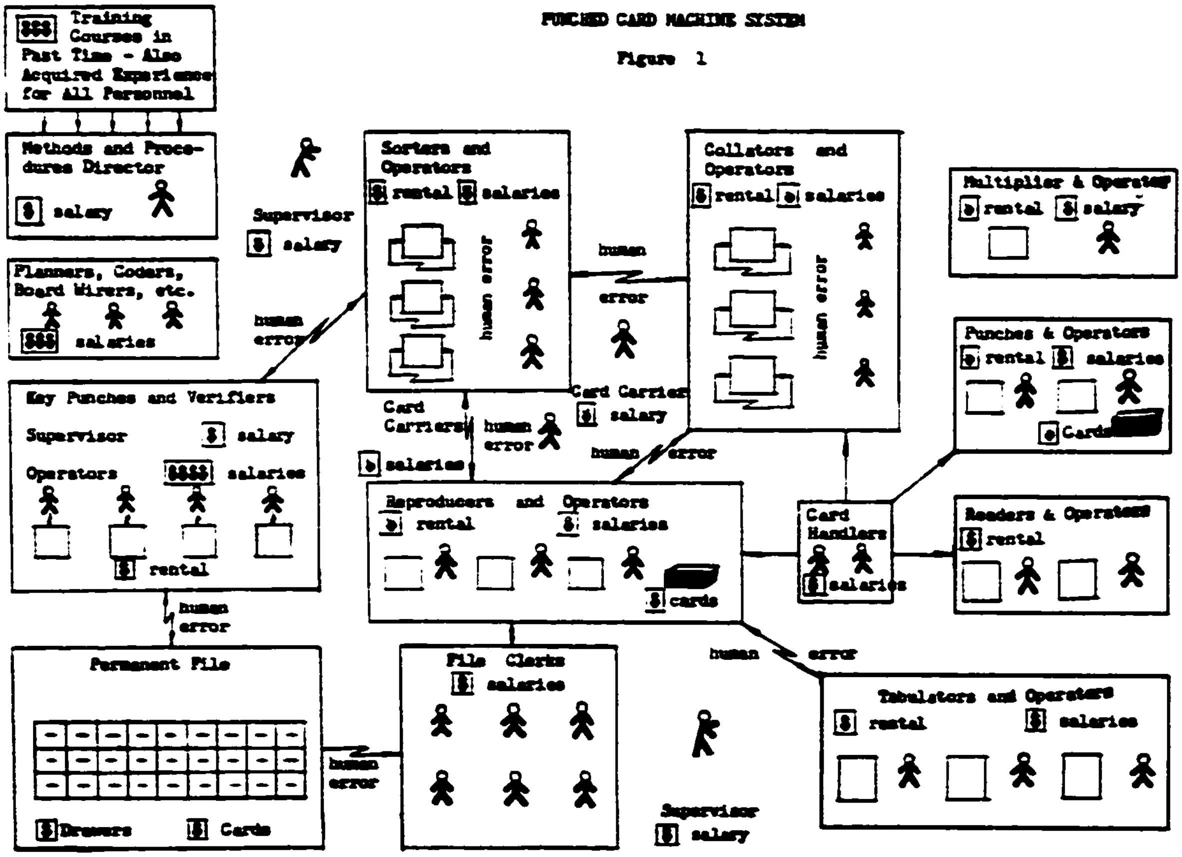


**Figure 17: Sprague's depiction of the "Punched Card Machine System". Note all the human sources of salary and error.**

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According to Sprague, the power of the computer lay not just in its speed or in its superiority to particular kinds of existing punched card machines, but in its power to replace the entire combination of humans, machines and procedures that made up a punched card installation. He suggested that, "the electronic machine is capable... of performing automatically and with no human intervention not only all of the functions being accomplished by all of the card machines, but also all of the functions performed by all of the people involved in a punched card system up to and including the head of the department." Sprague saw the replacement of the punched card staff as a boon to efficiency. "People drop cards, forget to pick up cards, get called away for something and let cards pile up, forget what they are supposed to do with them..." When listing the human foibles to which the computer would be immune, Sprague mentioned cigarettes, Cokes, pregnancy, resignation, psychological problems and union membership. Furthermore, modifying a punched card operation or introducing a new one required retraining the operators of each kind of machinery and putting up with a period of inefficiency and inaccuracy until the new job had been mastered. A computer could take a new program and run it perfectly every time. [303]

[303] Sprague, "Are Punched Card Machines on the Way Out?" 3, 6, 7.

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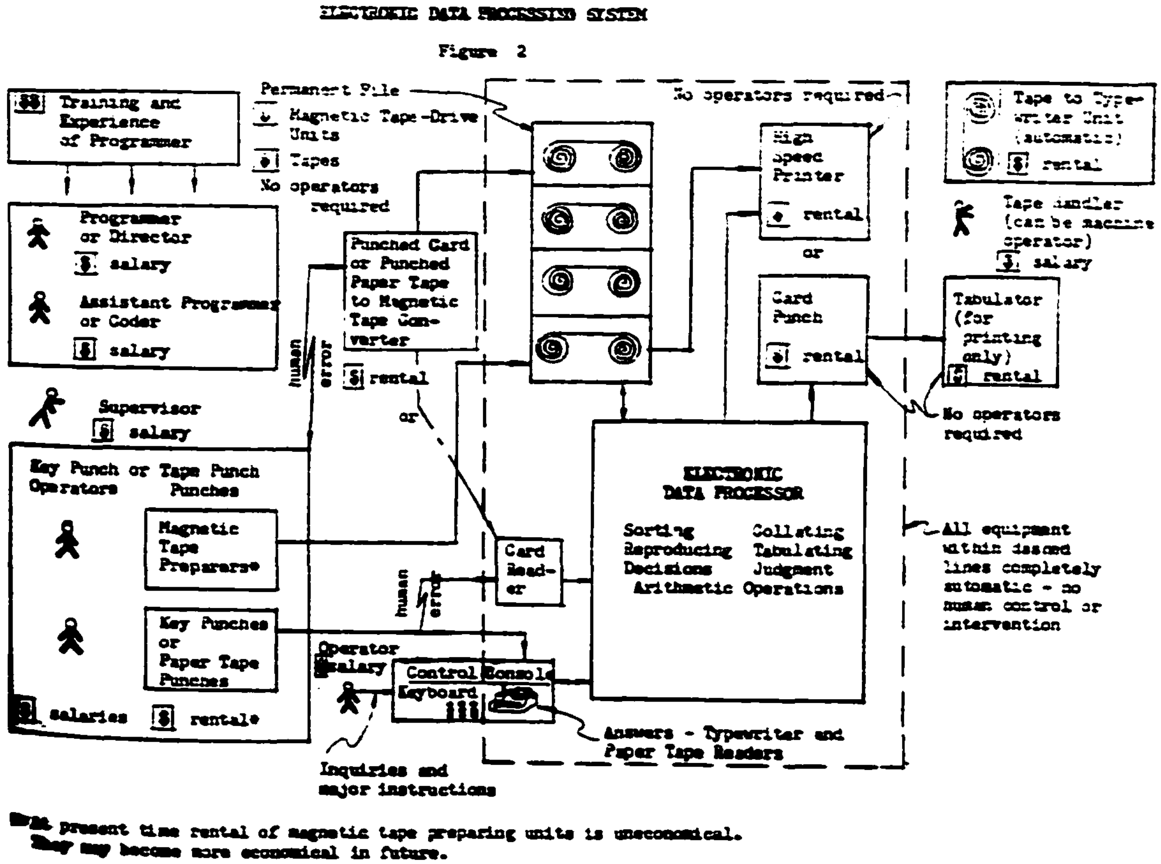


**Figure 18: Sprague's depiction of an Electronic Data Processing System. Note his claim that the computer, printer, card readers and tape drives functioned with "no operators required."**

The flip side of this flexibility was that it took a great deal of work to program the computer to undertake any single specific task. To achieve this level of automatic operation, the program had not only to carry out the operations performed by the more specialized machinery of the punched card machines but also to replace the procedures, judgment and handling of "exceptions" and errors formerly supplied by the work of the machine operators. When Sprague wrote his article in 1953, almost no programming of administrative tasks had yet been undertaken. His expectations for the programmer were rather high. "He can program in all of the sets of rules being followed by all of the present card machine operators, supervisors and department heads. He can include all of the exceptional cases that have occurred, and are likely to

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occur, and instruct the machine as to what to do about them. He can program the function of upper management in making decisions if he puts in all the possibilities."[304]

Sprague had a compelling sales pitch, and one that opened up some very fundamental issues. But he was decades ahead of reality, and anyone who ordered a computer on the strength of this portrait would soon have reason to suspect that Sprague was living in some strange parallel universe, with an alien computer technology bearing little resemblance to that found on Earth during the 1950s. Early computers did not have operating systems. The automatic computer room was no closer to realization during the 1950s than was the automatic factory. Operators were as essential to the smooth operation of the computer as they remained to the operation of the punched card machines running alongside it, though the character of the job was slightly different.

It was true that there was no need for an operator to rewire a control board in order to get the computer ready. And, within a program, the computer could advance from one instruction to the next without the need for the operator to pick up a pile of cards or flick a switch. But readying the computer to run a new job and shepherding the job to completion was not the effortless jaunt that Sprague promised. The most senior operators would schedule jobs and work the computer console – basically a large desk filled with switches. Jobs here included resetting the computer and configuring it for each job, loading programs into memory, restarting the computer after hardware or software errors – ideally without losing all the work in progress, responding to errors raised by the application program, terminating a program that had malfunctioned and supplying the programmer with clues needed to debug it. Tasks for the more junior operators included the

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[304] Ibid, page 4.

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mounting and un-mounting of tapes into drives, copying cards onto tape, sorting cards, configuring printers and loading them with appropriate forms.[305]

By general consensus the operator was the least prestigious and worst paid of the main data processing jobs, the analyst was the most important and best paid and the programmer was somewhere between the two. This hierarchy was agreeable to the culture of established managerial groups because it ran downward from the managerially-oriented analyst (immersed in business problems and insulated from technical detail) toward the quasi-blue collar operator toiling close to the machine. These distinctions were borne out in the pay range received by each group.

Whereas punched card operators shifted gradually between the slavish execution of existing procedures and the design of new ones as their careers progressed, with the computer the act of programming was far more distinct. Computer operators might therefore be seen as deskilled when compared to punched card operators, a part of their skill and autonomy transferred to the machine itself. But in practice the job of computer operator seems to have been better paid and more respected than that of punched card operator – if less well paid than that of programmer. Work as an operator had the additional advantage that, although a separate activity, it was closely allied with programming and could become an avenue for upward mobility within the computer department. It provided rank-and-file punched card personnel with a bridge into the computer age.

Programmers came to rely on good relations with operators. A friendly operator might push the programmers' test program a little up the queue. Just as importantly, as programmers

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[305] The first operating system for a large IBM computer, SOS (the SHARE Operating System) was released in 1957 and developed as a collaborative effort between users (like today's open source software such as GNU/Linux). Although this system and its successors made many tasks easier for programmers and operators, it was only really during the late 1960s that operating systems really began to reduce the need for human operators. Even this claim may be optimistic – contemporary sources actually claim that the increasing complexity of "third generation" computers demanded more skilled and better paid operators.

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generally did not have direct access to the computer, only the operator could pass on the clues needed to debug its operation. Few programs worked as intended when first executed, and very many did not work at all. They tried to execute an invalid instruction, such as division by zero, a jump to a location outside memory, or a code that did not correspond to anything the computer understands. Or they trapped themselves in endless loops, circling the same instructions waiting for conditions that never came true. Some programs would halt without ever presenting the expected output. The computer itself gave some aids in determining why – though the programmer could not generally use these directly. Computers provided the operator with a console – a desk with banks of switches and flashing lights. The switches could be used to load programs and data directly into memory, and to move through a program one instruction at a time to hunt for trouble spots. The lights displayed the contents of its "registers," allowing an expert operator to determine what point a program had reached, what errors had been produced, and what values were currently being worked with. To do so, one had to read numbers in binary and translate them into the corresponding instructions. When a program failed to work as expected, the programmer relied on the operator to pass on these clues.[306]

Sample staffing figures presented in 1956 by the Controller's Institute report suggested that a large computer installation would require three operators per shift plus a chief operator and a tape librarian – giving a total of eleven operators for three-shift operation of the computer. In contrast, only four programmers were budgeted for, which was likely a substantial underestimate. But despite the greater number of operators required, the business computing literature of the late 1950s paid much less attention to the problem of hiring operators than it did to the hiring of programmers. This is because a convenient source of operators lay at close hand: punched card

[306] Joan Greenbaum recalled that informal mixing between programmers and operators, often in the machine room itself, was still common during the early 1960s and became less frequent later with the installation of third generation machines later in the decade. Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work, 16-17.

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machine operators. As Computing News advised its readers in 1957: "As a rule, your good tab operators will make good EDPM operators.... Your operators know their present jobs -- a paycheck is still a paycheck, even when processed by EDPM. Through experience, they know the pitfalls and exceptions."[307]

The traditional assortment of sorters, collators and tabulators worked alongside the electronic marvel of the computer. Throughout the 1950s, computers were more likely to supplement punched card systems than to supplant them. As a 1959 study for the US Navy concluded, "The successful use of a computer is so thoroughly dependent on punched card support that it is imperative that there be no division in data processing direction." Even the IBM 650, a class of computer universally referred to as "medium sized" still relied on punched cards for input and output. The first 650 models could not even print without the intervention of a regular tabulating machine, nor could they handle alphabetical characters – the machine having been initially conceived as a specialist scientific device and calculating adjunct to traditional tabulators. Although nobody was in any danger of mistaking a "large" computer, such as the Univac I or the IBM 702, for a mere tabulating machine even these monster computers were almost invariably used alongside punched card machines.[308]

There was no means of punching input data directly onto magnetic tape – the first such machine was produced only in 1965. Neither did any business computer of the 1950s allow the entry of data directly into its internal memory from a keyboard. Instead, all input was punched onto cards. Every time a new job was converted for the computer it required an army of keypunch

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[307] Anonymous, "Staff Organization and their Training", Computing News 5, no. 95 (February 15 1957):8-11. The quotation was reproduced in R. Hunt Brown, Office Automation -- Selecting, Training, and Organizing Computer Personnel, 1959, contained in Market and Product Reports Collection (CBI 55), Charles Babbage Institute, University of Minnesota, Minneapolis and so reached a wider audience and retained some appeal two years later.

[308] The quotation is from Dillon, Data Processing in Navy Management Information Systems, SecNavInst. P 10462.7, V1. On the evolution of the 650, see Bashe et al., IBM's Early Computers, 73-101, 65-86.

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operators to enter every single account code or transaction record onto cards. Keypunch workers made up the majority of all data processing staff at most computer installations – outnumbering programmers, operators, analysts and managers combined. This was an incredibly time-consuming activity -- in the first textbook of administrative programming, Daniel D. McCracken noted that conversion could take more man hours than everything else combined, while Business Week reported that an unnamed insurance company spent twelve million dollars readying its files for the computer. Each record was often entered twice, to verify its accuracy. Consolidating existing files could require a great deal of computer time and special programming. Paper records themselves often contained many errors and inconsistencies, so although the "clean up" mandated by a computer conversion could be rationalized as a long-term benefit, it was also difficult enough to cause many early efforts to overrun badly.[309]

Continued reliance on clanking keypunches was more than the computer revolutionaries could stand. Many experts of the mid-1950s were convinced that the computer would soon be able to read paper forms directly – deciphering not just typewritten characters but even handwriting! Berkeley himself had been upbeat on the prospects for this approach, and companies such as IBM and the English LEO devoted considerable resources to the development of optical reading technology. Indeed, a history of the Dutch Giro system during the mid 1950s reported that Optical Character Recognition (OCR) had been so central to its early hopes for the computer that considerable internal friction resulted when the idea was dropped from the eventual prototype study. Although optical input technology did make advances, these were very slow. Computer

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[309] Anonymous, "Business Week Reports To Readers On: Computers". For the eventual arrival of equipment to transcribe directly onto tape see Albert L. C. Chu, "Key-to-Tape: K.O. For the Keypunch?" Business Automation 17, no. 4 (April 1970):52-59.Using the computer itself to read the cards and transcribe the information onto tape was a highly inefficient use of its precious cycles, so specialist machines were soon produced to tackle this task. Daniel D. McCracken, Harold Weiss, and Tsai-hwa Lee, Programming Business Computers (New York: John Wiley and Sons, 1959), 386.

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scanners to automatically interpret typed characters were one of the many technologies that remained a few years away from predicted mass acceptance for decade after decade. [310]

Even once a job had been converted to the computer, there were some things that punched card machines remained much better at. The most notable was sorting records into a particular order. In a punched card system, each record had its own card. (For this reason, "unit record equipment" gained widespread use as a formal term for punched card machines during the 1960s). Sorting was very important in punched card or early computer routines, because neither kind of machine could generally work on one record at a time. For example, to update account balances or print statements, it was necessary to sort all new transactions records in order of their account codes, and then "merge" information on the latest transactions with information from the master account records. Sorting records on punched cards was easy – you shuffled the cards themselves into order. As it was not possible to cut the tape into little pieces and string it back together in the right order, performing a sort using tape drives demanded at least three drives (two for reading, one for writing), a complex program and a large number of repetitions before the file was finally sorted. Coupled with the unreliability of early tape drives, this was often enough to negate their raw advantage in terms of speed. It could pay to sort the punched cards mechanically

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[310] As early as 1956, Wallace had reported that, "automatic document sensing" would soon reduce input costs significantly. Wallace, Appraising the Economics of Electronic Computers, 42.Early Dutch hopes for optical sensing are discussed in de Wit, "Caught Between Historical Experience and High Hopes: Automation at the Dutch Postal Cheque and Clearing Service, 1950-1965". IBM invested a considerable amount of research in general purpose character recognition from 1950 onward, and offered several products in the early 1960s. Bashe et al., IBM's Early Computers, 498-507. For a first hand account of trying to make an early system work in Britain, see Reg Cann, "The LEO Approach - An Evaluation", in LEO: The Incredible Story od the World's First Business Computer, ed. David Caminer, et al. (New York: McGraw-Hill, 1996). Use of optical sensing technology was negligible during the 1950s and remained marginal through the 1970s. The picture would not be complete, however without noting that 1950s technology succeeded admirably when applied to a modest but important goal: the magnetic reading of account numbers from checks as a key part of the ERMA bank automation system. For a contemporary report, see Robert Forest, "ERMA Comes of Age", Business Automation 6, no. 3 (September 1961):20-25. On the history of ERMA, see Amy Waver Fisher, "The Development of the ERMA Banking System: Lessons from History", IEEE Annals of the History of Computing 15, no. 1 (January-March 1993):44-57 and James L. McKenney and Amy Weaver Fisher, "Manufacturing the ERMA Banking System: Lessons from History", IEEE Annals of the History of Computing 15, no. 4 (October-December 1993):7-26.

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before transcribing them onto tape. As it struggled to improve its efficiency, GE's pioneering payroll effort was eventually forced to go one step further - using three clerks to sort the pay checks themselves after they were printed, rather than wasting hours of valuable machine time on the task. [311]

Sorting was perhaps the most common task where computers fell short, but it was far from being the only one. The sequential nature of tape storage meant that it was prohibitively slow for cases when a single record needed to be looked up – the computer might have to read through the entire file to find it. If the file was big enough to justify a computer, then it was too big for this search procedure to be cost effective. Clever programming allowed such requests to be batched together and combined with routine updates – but even in the best case this meant that the information could not be retrieved until the next day. The only solution was for the computer to print out enormous report books, so that the detail or summary information required could be looked up manually when required. Because these operating reports could easily reach a size that demanded the use of hand carts or small trucks to deliver, this situation led to a great deal of interest in microfilm as a possible distribution mechanism for computerized reports.[312]

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[311] On the importance of sorting, see McCracken, Weiss, and Lee, Programming Business Computers, 300-30. On GE's reintroduction of manual sorting, see Anonymous, "Business Week Reports To Readers On: Computers". Sorting algorithms were one of the key research areas in the early days of computer science, and received their definitive statement in Donald Ervin Knuth, The Art of Computer Programming, Volume 2: Sorting and Searching (Reading, Mass.,: Addison-Wesley Pub. Co., 1968).

[312] Microfilm was mentioned as a means of storing tabulator output in Bishop and Woodward, "Two Tabulating Case Studies" and as a part of data processing in Haskins & Sells, Introduction to Data Processing: An Outline of Basic Data-Processing Operations and Methods (New York?: Haskins & Sells, 1957). For case studies and discussion of microfilm see Anonymous, "Billing at Playboy Serious Business", Business Automation 10, no. 3 (September 1963):32-33, Edward J. Menkhaus, "Essential Tool in a Total System", Business Automation 12, no. 10 (October 1965):45-49, Joel R. Weber, "Microfilm Makes it Easier to Fly", Business Automation 15, no. 10 (October 1968):38-41, Edward J. Menkhaus, "The Many New Images of Microfilm", Business Automation 15, no. 10 (October 1968):32-43, 58, Richard D. Kornblum, "A Macro-View of Microfilm", Business Automation 12, no. 10 (October 1965):32-36. Although the use of microfilm to distribute computer output was discussed during the 1950s and 60s, interest in the production of microfilm output directly from a computer using some kind of photographic system (known as Computer Output Micrography or COM) peaked around 1975. The history of microfilm is the subject of Susan A. Cady, "Machine Tool of Management: A History of Microfilm Technology" (Ph.D., Lehigh, 1994).

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Business computers of the 1950s were also unable to exchange data with each other directly, or to drive remote terminals. Whenever a company wished to transmit information from a remote site for computer processing, for example sending orders from sales offices to a warehouse, or time sheets from plants to the payroll office, this required another set of intermediary technologies. The same forward looking firms that flocked to the computer were also fitting their offices with communication systems such as pneumatic tube networks and centralized dictating systems during the 1950s. But the most versatile technology for data transmission was the five-track paper tape – a ticker tape punched with up to five holes across which was widely promoted during the early 1950s as a "common language" for the interchange of information between different kinds of office machine. It could transfer information from bookkeeping machines into punched card systems, or automatically operate specially adapted typewriters called "Flexowriters."[313]

The tape encoded just thirty-two possible characters – which was enough for the minimal alphabet of telegraphic transmission. As a result, paper tape was universally used as the medium for automatic data transmission over long distance "leased lines." A number of companies built up elaborate networks, where lines from their offices and factories converged in a central switching office. Human operators in the switching hub pulled off strips of paper tape, examined their destinations and retransmitted them to their destination. If the data was ultimately destined for a computer then it was run through another machine to transcribe from paper tape to punched cards, and perhaps converted again to magnetic tape if necessary. If you weren't in a hurry, or

[313] On use of pneumatic tubes along side computers, see Albert Newgarden, ed., Men, Machines and Methods in the Modern Office (New York: American Management Association, 1958), 7.

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you had to send more than a brief message, then it was a lot more effective just to send the tape or cards by mail.[314]

## The Shock of the New Furniture

For the punch-card staff who became the operators of the new machines, the arrival of the computer brought an immediate upgrade in terms of status and organizational prominence – if not in formal authority. They moved, quite literally, upwards and into the light. However useful the punch-card machine might have been, it was unlikely to have been a tourist attraction for visiting dignitaries. The punched card machine was a quite humdrum technology. It stood, admittedly, at the very apex of office machinery – one of the most complex mechanical devices ever to be mass-produced. Its thousands of parts, miles of wire, enormous speed and formidable accuracy earned it a place in the heart of the mechanically inclined. In its earlier years it had not been a stranger to hyperbole. But the spread of punched card technology had been so gradual that the capabilities of the machines – and their limitations – were a matter of factual knowledge rather than poetic fancy.

Nowhere was this difference more pronounced than in the physical environment accorded to the two technologies. The tabulating department was a noisy, stuffy, cramped and often uncomfortable place. Edwards' dissertation spoke of departments crammed into the "left-over space" of existing buildings, so that, "[t]he space is often overcrowded by the machine and operators have almost no room in which to maneuver." McCaffrey remembered working stripped

[314] For an examples of such systems, see Donald L Rehburg, "Putting IDP to Work", The Controller 25, no. 8 (August 1957):380-82, 404-05 and Rudolf Borchardt, "The Coming Revolution in Information Handling", Systems and Procedures 8, no. 3 (August 1957):28-31.

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to the waist, and ironing cards left wet by a thunderstorm. The contrast between the traditional tab room and the showpiece computer installation could not be more striking.[315]

If there is one aspect of corporate administration, therefore, in which early computer installations truly launched a revolution, then it is an unexpected one: interior design. This style appears to have been pioneered by IBM with its 1948 SSEC, a one-off machine whose role was in the field of public relations more than anything else. It boasted flashing lights, glass panels and a publicly accessible location on the ground floor of its World Headquarters in midtown Manhattan. Nomadic computer pioneer Herb Grosch took this aesthetic with him when he moved from IBM to head the first computer installation (a scientific one) at General Electric. Although the computer was originally slated for installation in a basement, Grosch soon had it housed in what he claimed to be the world's first specially designed computer building. Grosch chose futuristic Herman Miller office furniture, modernist design, large windows and a carefully coordinated color scheme. The building's unveiling was part of an event attended by a host of senior GE and airline executives, IBM's leadership, and the top brass of the armed services. But while its wooden floors and tropical fish tanks impressed international visitors, they also attracted the ire of GE managers working in more dowdy surroundings (or, as Grosch put it, "my peers and their jealous minions"). Meanwhile, the gradual transfer of power within IBM between the Tom Watsons senior and junior led to a redoubled interest in industrial design in its regular product range – giving IBM its own prestigious showpiece 702 installation behind plate glass windows and on perpetual display to passers by.[316]

A distinctive architectural style developed, as firms maximized the visibility of their computer room in the most literal sense, placing it behind huge plate glass windows and applying

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[315] The first quotation is from Edwards, "The Effect of Automation", 156. The second is from McCaffrey, From Punched Cards.

[316] On SSEC and the GE installation see Grosch, Computer: Bit Slices from a Life. On IBM and design see Watson and Petre, Father, Son & Co: My Life at IBM and Beyond, 199, 259.

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diffuse lighting to illuminate it against a brilliant white background. Throughout the 1950s, the novelty and symbolic modernity of a large computer installation could be counted upon to unleash a flood of positive local news stories about the newly installed giant brain. Whether or not the computer was yet doing useful work, it became the site of a Potemkin village of clattering printers, spinning tape drives and flashing lights. Visitors and reporters were unable to judge the usefulness of what was being produced, still less its cost savings, so for this purpose it was more important that the computer should operate and look modern than that that it should improve managerial effectiveness. An industry magazine reported with approval, "A computer installation can have tremendous public relations value to a company. Attractive, long windowed corridors permit an unobstructed view for the visitor without interfering with the system.... The dull and drab grays and blacks, once the official colors of the machine accounting industry, have given way to the rainbow." [317]

Many of the earliest jokes in computing culture revolve around the tension between the computer's role as a public show piece and the technical and often mundane day-to-day relationship its staff had with it. In one of the best known, a visitor tarrying behind as the main party moves through the computer room glimpses an unnoticed door open in the base of the machine. Opening it, he glimpses a man inside, eating a sandwich. Sensing the intrusion the man gets up and leaves. The visitor asks a computer operator who he is. The man is in fact a technician replacing a tube, but sensing the visitor's gullibility, the operator identifies him as the Oz-like figure who sits inside the computer and performs the calculations.

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[317] A good overview of the new physical environment of the computer is given in Anonymous, "Basic Elements of Computer Environment", Management and Business Automation 4, no. 5 (November 1960):28-30, 32, 48, the quotation is from pages 29 and 48. These issues are also discussed in D. Robert Daniel, "Getting the Most Out of Your Computer", in EDP: The First Ten Years. Highlights of Management Experience and a Look Ahead, ed. McKinsey & Company (Chicago: American Society for Public Administration, 1961) and retrospectively in Tad Kishi, "The 701 at the Lawrence Livermore Laboratory", Annals of the History of Computing 5, no. 2 (April-June 1983):206-10.

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While the fish tanks, glass windows and designer furniture were of symbolic importance, the computer really did demand a quite different environment from the traditional punched card machine, due primarily to the large numbers of temperamental electronic components they contained. The vacuum tubes themselves were prone to burn out unexpectedly, especially on start up. Many companies got their first taste of this with electronic punched card machines, such as the 603 and 604. When the machine was first installed they turned it off over the weekend – but after discovering that turning it back on usually resulted in the failure of a vacuum tube his colleagues realized that they should leave it turned on permanently. This was their introduction to the electronic age. When computers arrived, things only got worse. [318]

The only thing that early computers could be relied upon to do was break down. Consider General Electric's first computer, an IBM 701. During 1955 GE kept power on for 6,600 hours – paying the additional rent to IBM for three-shift operation. About 1,400 hours of this was lost to maintenance (most of it scheduled). The unreliable electrostatic memory used on the 701 was to blame for most of this downtime – within a year or two the superior core memory of the 704 had reduced it dramatically. A Univac I installation occupied around 2,500 square feet and the 5,000 valves in its central processing unit burned enough electricity to require a two and a half ton power supply. Cooling all this involved not only a system of internal water pipes, but also an air-conditioning system. Air conditioning was still a novel technology for use in offices, and the equipment remained bulky and temperamental. As a magazine article reported, "For the average punched card installation these things were considered luxury, but for a computer system these are absolute necessities." The mass of cables, pipes and power lines demanded by the installation prompted most firms to install raised floors and false ceilings. These not only preserved the clean,

[318] The unreliability of the 604 is discussed in McCaffrey, From Punched Cards. On the need for air conditioning with a 603 or 604 see Belford J. Lappeus, "Moving Day... In the Machine Accounting Department", The Hopper 3, no. 3 (May 1952):20-26, page 25.

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modern look of the computer installation but also spread the enormous weight of the equipment more evenly and absorbed noise. Fitting this equipment into an existing building might require the temporary removal of a large part of a wall, the installation of a large number of temperature and humidity monitors to ensure even airflow, the removal of existing sprinklers, the sealing of walls and floors to reduce dust and the installation of expensive vinyl flooring.[319]

Magnetic tapes were even more temperamental. Early users of the large IBM computers found that they needed to clean each tape twice daily to ensure reliability. Even the tape storage area had to be kept at carefully controlled levels of humidity and temperature. Tiny amounts of dust could wipe out data, meaning that a computer installation might require its own meticulous janitor. Although IBM engineers were able to design much more reliable models than their counterparts at Univac, even IBM drives functioned well only under a very narrow range of environmental conditions. A careful regime of dust control, air conditioning, humidity regulation and the cleaning of each tape twice daily had reduced this to one error in 25,000 records – still enough to cause problems. No wonder that one of the many new operator jobs created by the computer was that of "tape librarian." The IBM 650 didn't have a large electronic memory or tape drives (initially), but it did have a magnetic drum. The heads of this drum had to be adjusted so frequently that this operation alone led to 10 percent downtime.[320]

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[319] For GE's experience with its 701, see J. B. Hughes and D. D. McCracken, "IBM 700 Series", Journal of Machine Accounting 7, no. 10 (October 1956):26-29, 48, page 6. Other figures are taken from an internal IBM intelligence report on the UNIVAC – W. R. Elmendort and W.W. Peterson, A Study of the UNIVAC, 1954, contained in Cuthbert C. Hurd Papers (CBI 95), Charles Babbage Institute, University of Minnesota, Minneapolis, 42. For a detailed account of physical installation, see Canning, Installing EDP, 103-14.

[320] The unreliability of IBM tape is discussed in Hughes and McCracken, "IBM 700 Series". On user experiences with the 650, see R. R. Haefner, "The 650 at Savannah River", Annals of the History of Computing 8, no. 1 (January-March 1986):84-85.

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**Systems Analysis and Flowcharting**

While operation of the computer fell for the most part to the staff and supervisors of existing punched card departments, its application to the problems of administration was coordinated by a different figure: the systems analyst. The analyst was expected to serve as an intermediary between the technical internals of the machine and the needs of different managerial and operational groups within the corporation. The primary tool of the systems analyst was the flowchart – a symbolic description of administrative procedures intended to provide an unambiguous description to guide their successful computerization. As one of their number wrote in 1957, "It is not too far amiss to think of the systems profession as stemming in large part from the development and refinement of the flow chart."[321] Its power to impress managers was familiar to the machine accountants, who were told at their 1959 conference that, "flow charts are one of the most effective means of communication available today to the machine accountant."[322]

Yet neither the role of analyst nor the techniques of flowcharting originated with the computer. As a result, their relationship to rest of the computer department was initially uncertain. Their tools and approaches sometimes had more to do with managerial aspirations than with the specific demands of early computer technology.[323]

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[321] Richard W. Pomeroy, "Basic Flow Charting Techniques", Systems and Procedures 8, no. 3 (August 1957):2-8. Pomeroy was a management consultant, and his article was, revealingly, a plea to his fellows not to abandon their unglamorous yet proven techniques of flowcharting in the face of the new fervor over electronics.

[322] C. H. Naukam, "Effective Communication or Breaking the Language Barrier", in Data Processing: 1959 Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1959).

[323] Very little has been written about the origins of the systems analyst within business data processing. Kraft, Programmers and Managers: The Routinization of Computer Programming in the United States, 32-41 claims that the work of the analyst was originally handled by programmers, and traces the separation to the System Development Corporation's attempt to "mass produce programmers" for the SAGE project of the 1950s. Before this, suggests Kraft, the apprentice/master pattern of skilled craft work was used. After this, programming well was on its way towards the rationalization and deskilling of assembly line work . A related argument is made in Nathan Ensmenger and William Aspray, "Software as Labor Process", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002), 148-9, which suggests that systems

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Most of the articles written about computers for a managerial audience came from computer vendors eager to promote their own skills in systems analysis, from corporate systems men or from consultant systems experts – and indeed many prominent individuals switched repeatedly between these roles. These systems-oriented experts were keen to point out that the benefits of computerization would come more from the attention given to the rationalization and improvement of procedures in preparation for automation than from the computer itself. As a result, the idea that, "quality systems analysis is the key" to real savings had become a cliché long before there were any real savings to examine. [324]

As experts on the formalization and improvement of business procedures, the systems men of the SPA were assured an important place in the preparation for the computer's arrival. Among the most widely practiced duties of the systems and procedures department were the design of forms, the writing of procedures manuals and the evaluation of office machinery. Systems men believed that their existing methods would prove sufficient for use with the computer. Indeed, adoption of the computer would trigger a massive boom in the business of documenting and redesigning clerical procedures. A 1957 survey of systems work observed that, "the reorganization and organization of so many systems departments within the past decade has been kicked off primarily by rumors of what electronic data processing can do." Systems men

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analysis developed as a corporate specialization when a elite group of engineers and scientists who dominated programming in the 1950s were threatened by an influx of less educated programmers. As a result "a hierarchy developed within the software professions." While both arguments recognize the status granted to systems analysts within the data processing hierarchy, neither acknowledges that corporate systems work predates programming. Both romanticize the autonomy granted to corporate programming teams during the 1950s. Whereas scientific computing might have begun with a more egalitarian social order, administrative computer use was segmented from the beginning. As we shall see later, administrative programming and analysis work actually moved closer together during the 1960s and 1970s.

[324] The quotation, an early example of what was already a mantra, is from Chapin, "Justifying the Use of an Automatic Computer". While on the one hand, the stress on systems analysis was also a call for business reorganization (and hence for revolutionary rather than incremental change), it was also a claim that office systems experts had made about dictating machines, accounting machines and many other previous technologies. This stress on the analysis of business systems over technical knowledge was very familiar in theory – if not widely followed in practice.

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were often involved in the ad-hoc teams convened to perform "feasibility studies" to evaluate the potential of the computer and select a suitable model. These teams became the nucleus of the new computer departments that grew up around the machines. But although many individual systems men were involved in administrative computing efforts from the beginning, the assimilation of systems work as a whole into the new computer department was a slow and uneven activity.[325]

In 1959, James D. Gallagher, former data processing expert for Sylvania and then a systems man for Lockheed, stated that, "The most common organizational problem discussed in data-processing circles centers around where systems and procedures responsibilities end and where programming starts. We have heard much of the 'gray area' that supposedly exists between systems work and programming...." It was his belief that the key to success was close collaboration of both groups with each other, and with the operating departments involved with each new application. He did not, however, think that the systems group should be contained entirely with a computing operation. "Care must be exercised, however, in not providing for the elimination of the complete identity of these two departments. There will always be areas in purely systems and procedures work which will require systems specialists, and which will necessitate the separate maintenance of a systems and procedures department and a programming group."[326]

Most of the specific techniques of the systems men had been pioneered well before the Second World War by William Henry Leffingwell and the other office management reformers. As well as the contributions discussed earlier, Leffingwell also pioneered clerical application of the technique of flowcharting, where the physical path of a form or letter through the office was

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[325] Place, Administrative Systems Analysis - Michigan Business Reports, Number 57.

[326] James D. Gallagher, "Organization of the Data-Processing Function", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).

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charted together with all the operations performed on it. Leffingwell's version was almost a time-and-motion study of the movement of paper – the physical movement of forms and records was superimposed on a detailed map of the office. [327] This appears to have been one of the first public presentations of charting techniques to clerical operations, although the use of industrial process charts was more influentially examined by Frank Gilbreth, an associate of Frederick Taylor, as part of his quest to document the atomic operations (Therbligs) into which all procedures could be broken down.[328]

Following its origins in scientific management, the flowchart achieved widespread use in the documentation of punched card procedures. As these techniques developed, the flowchart moved further and further from its origins as a literal depiction of the physical flow of paper through an office. By the time Richard Neuschel wrote his 1950 Streamlining Business Procedures, the manifesto of the systems and procedures movement, a wide variety of charting techniques were in use. The layout flowchart – where document flows were superimposed on a drawing of the office – was the closest to Leffingwell's original. Then there was the work distribution chart – a visual representation of who did what. The popular vertical flowchart was much more schematic and closer to Gilbreth's technique, using rows to show each step in a procedure and columns to show different kinds of activity – production, transportation, inspection and filing. The more complex horizontal chart mixed organizational structure and clerical

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[327] Leffingwell included a beautifully detailed office flowchart in his Leffingwell, Scientific Office Management.

[328] Gilbreth was a well-known figure during the 1910s, and worked toward the study of basic "motion cycles" in his work of the late 1910s. According to David Ferguson, Therbligs: The Keys to Simplifying Work (2000 [cited 31 August 2002]); available from http://gilbrethnetwork.tripod.com/therbligs.html the Therblig concept and his specific definitions were only published in full after his death in 1924, and so their public dissemination would have followed Leffingwell's own charting experiments.

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operations. Each row showed each stage in a procedure and columns to show the activities talking place in different departments. Arrows showed the transfer of papers between departments.[329]

Punched card equipment companies had used flowcharts since the 1930s to illustrate the physical transfer of cards between different kinds of machinery, the role of humans in providing inputs to the system and as machine operators, and the various files, forms, and printouts involved in the machine operations. As internal systems departments turned their attention to punched card applications, they adopted the same methods. Both Remington Rand and IBM made stencils available to their customers to assist in the production and standardization of these charts. Tabulating specialists sometimes produced charts at different levels of detail. An "application flow chart" showed the overall outline of the job – how the original records and accounting transactions were combined to produce work files, report sheets and so on. This was intended to communicate the purpose of a procedure to management in terms it could understand, by describing the "accounting job which a procedure accomplishes." In contrast, the "operational flow charts" were more voluminous and dealt with "machine and clerical operations in their proper sequence and the movements of cards for operation to operation." Each step was numbered, and cross-linked to a written description for the machine operator. Such elaborate formal procedures were far from universal in the punched card world. Many punched card groups never even bothered to diagram their control board wiring patterns, and were content to leave elaborate procedures in the heads of punched card staff. The important thing, however, is that more formal techniques existed and could be adapted for use with computers.[330]

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[329] Neuschel, Streamlining Business Procedures. For a history of the flowchart and guide to common types of the 1950s, see also Naukam, "Effective Communication or Breaking the Language Barrier".

[330] Whitney, "How to Prepare Machine Procedures".

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In practice, however, the concerns and techniques of the systems analyst diverged sharply from those required for the generalist systems man. Whether written for clerks, bookkeepers or punched card machine operators, they were read and followed by humans – not by machines. Humans are able to tolerate ambiguity. Even the most detailed instructions written for human clerks do not begin to approach the crushing literalness required in those given to a computer. When an "exception" occurs (a case for which the standard procedure cannot be applied) then a human will be quick to ask a colleague or to call for a supervisor. A clerk will notice when codes, amounts or dates written on a form are missing or obviously incorrect. Should a clerk run out of paper or need to sharpen his or her pencil then he or she will deal with this hardware failure without undue problems. Neither was the clerk forced to transcribe all information before reading it, or to squeeze both instructions and data into a few thousand characters of memory.

Systems analysis for the computer thus came with its own set of problems. Most of the managers who placed orders for computers during the 1950s were aware that some effort would be needed to translate existing procedures into a form suitable for machine execution. But few grasped the enormous gulf separating a satisfactory clerical procedure from a computer program. It was often assumed that the task of systems analysis would concern itself only with managerially-oriented questions of policy and procedures; the work of translating these flowcharts into computer programs was a lower status, and often entirely separate, activity. (Early on, detailed diagrams of computer program logic were often called "block diagrams", to distinguish them from the true flowcharts that showed the flow of documents through office systems). Thus, in many firms, the systems and procedures department remained a separate entity from the new computer department, and only programmers were given detailed instruction in the workings of the computer.

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## Programming – The New Task

In 1956, Reynolds Metals Company ordered an IBM 705 computer for its Louisville, Kentucky plant. This large, business oriented machine was expected to replace an entire room of punched card equipment, run in part by our friend John J. McCaffrey. The order was placed by the controller of the Parts division, on the advice of the head of the systems department. The division had a reasonably large punched card installation – with six 407 tabulators running around the clock, but this remained a major expansion. While McCaffrey had been manager of the tab department, he was still eager to become a mere staff programmer for the new machine, and was sent away to IBM for its standard programming course. He learned to prepare flowcharts and code the corresponding routines in symbolic assembler. (Unfortunately for McCaffrey, the corporate headquarters in Richmond had not been informed of the decision to order. When it found out, the order was cancelled and the programming staff disbanded after almost a year of preparatory work. The punched card machines could relax again. Not until 1962 did Reynolds finally install a computer, and by 1965 it had finally converted almost all its punched cards jobs).[331]

Although the decision by Reynolds to cancel its order was unusual, its approach to the recruitment and training of programmers was not. Because the design and specification of the program had been assigned to the analyst, the job accorded to the programmer was a heavily circumscribed one. The idea was that analysts could hand high-level flowcharts showing overall runs and processes to programmers, who would fill in progressively lower level charts before handing explicit block diagrams of program logic over to separate coders for translation to machine instructions. At one company, the job was defined as follows: "The programmer is expected to take the broad flow charts presented to him by the systems analysts and to develop

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[331] McCaffrey, From Punched Cards, ch. 6.

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the detailed flow charts for the computer runs." The programming of administrative applications was constructed as an extension of the higher-level, more managerially focused, work of analysis to bring its results closer to the form demanded by the computer. Most authorities of the 1950s held that the final translation of this detailed chart into the instructions that the computer could actually run was not part of programming itself, but a third activity called "coding." This hierarchy enshrined the assumption that the business knowledge claimed by the analyst was more important than the machine knowledge held by the coder or the operator. More importantly, it implied that a simple, one-way process of translation would accomplish the job – programmers would learn everything they needed to know from the analysts' diagrams, while analysts could learn everything they needed to know about computers in a one-week course. [332]

Of the four main data processing jobs (supervisor, analyst, programmer, operator) there can be little doubt that programmer was the biggest departure from the earlier practices of punched card work. But even here, programming was initially viewed more as a redistribution of responsibilities previously split between operators and analysts than as a revolutionary departure. Managers preferred to see programming as a new activity that their existing staff could pick up than as a new profession. Through its entire history, the corporate applications programmer has been squeezed between the machine-oriented, craft knowledge of the machine operator (later the systems administrator) and the ostensibly business-oriented domain of the analyst. The new role was constructed on rickety foundations in space hurriedly cleared between these two much older occupations.

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[332] Canning, Installing EDP, 41. Canning's stress on the separation of analysis from programming struck at least some of his contemporaries as unrealistic, suggesting that a variety of approaches could be found between different companies. See W C McGee, "Book Review – Installing Electronic Data Processing Systems", Computing News 5, no. 115 (December 15 1957):12-14. These jobs may have been more frequently separated in administrative computing installations than in technical computing installations.

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The structure of the data processing department was arranged in accordance with the managerial conception that business knowledge was higher and more valuable than technical knowledge. (The boundaries between the two are arbitrary but powerful). This created a data processing career ladder, in which as one moved from operator, to coder, to programmer, to analyst, to data processing manager and finally to general manager, one moved ever further from the machine and gained ever more prestige and pay. The intimate rapport with the machine demanded of a good programmer during the 1950s drew the programmer ever farther from the human world, and into a specialized occupational subculture. Career success in data processing, however, oriented the programmer toward a career in data processing management or systems analysis.

Despite some early hopes that the programmer would be working to automate the work of top management, the work of programming instead involved heroic efforts to make underpowered computers perform conceptually trivial administrative tasks with a modicum of efficiency. Even if the programmer did not physically interact with the computer's hardware, it was never far from his or her mind. Effective programming demanded clever sequencing of operations and juggling of resources similar to that practiced by punched card operators for a generation. General Electric, for example, found that its elaborately charted payroll program required 80,000 instructions and 36 hours to run once converted to code.

Results such as this demonstrated the problems involved in treating analysis as a self-contained operation, performed without close attention to the details of the computer itself. As we have seen, the tiny internal memories of first generation computers meant that a job like payroll was split into dozens of separate runs. During each run, a small program updated one or more of the master files or produced temporary working files to be processed further by the runs to follow. Some runs would do nothing more than sort or check data. Efficient use of the computer demanded that the number of runs be kept to a minimum. It was the job of the systems analyst to

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break a job into separate runs and sketch the requirements for each – yet without a strong background in the arcane details of programming, it was impossible to judge exactly how much the computer could be expected to accomplish on each pass. In one case, attempts to handle all "exceptions" manually created a payroll program that required ninety separate runs to produce the weekly paychecks. Small variations in the quality of the code could dramatically increase or decrease the feasibility of a particular overall structure. [333]

Because of the limitations of early machines and programming techniques, a great majority of administrative programs of the 1950s were written in low-level, machine specific languages. The GE payroll program was coded directly into the form executed by the computer – all instructions were punched as a series of octal (base 8) numbers. Most computer installations soon adopted "automatic coding" techniques to assist in the preparation of this code – including the use of symbolic assemblers to translate mnemonic codes into instructions, assign convenient labels to specific memory locations and "assemble" various subroutines into a single executable program. But the programmer was still in the business of writing each instruction that the computer would run – it was just that the notation had become a little more convenient. By the mid-1950s, the use of generalized routines to perform input and output, generate reports and manage files was also well established. The highly constrained resources available to the programmer forced many computer installations to adopt rigid standards on things like the organization of memory, the means by which subroutines communicated with the main routines that called them, and even the specific tape drives to be used for different purposes.[334]

Thus, while analysis methods could only succeed when closely tied to consideration of programming and operations issues, experience of programming tended to thrust one deep inside

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[333] Laubach, Company Investigations of Automatic Data Processing, 52.

[334] The best single source on early administrative programming is the first textbook devoted to the topic, McCracken, Weiss, and Lee, Programming Business Computers.

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the world of the machine and away from the considerations of business. This tension was hard to deal with. Some companies of the 1950s explicitly combined programming and analysis roles, or at least grouped both programmers and analysts into project teams rather than separate departments. However, through the 1950s and 1960s, programming and analysis remained notionally separate in most firms, and analysis was always the higher status and better paid job. Within data processing, the question of whether programming and analysis should be separate careers or different stages in the development of a single career was widely debated. In practice, the business-oriented aspects of analysis were often neglected, as the title came more and more to be a way of giving additional status and a higher pay scale to someone whose job was really that of a programmer.

The relationship of programming to operation was also unclear– though these boundaries were resolved more generally and appear to have been enforced more successfully. According to one consultant, when organizing your data processing department "the fundamental number one rule is to keep the programmers out of the machine room." The separation of programming and operation duties occurred very early in the history of administrative computing, though programmers were not always complete strangers to the hardware of the computer. Many pioneers recall with pleasure the chance to operate the machines during their brief testing sessions with IBM's installations, a few months before their own computers arrived. In some cases, programmers may have been able to gain access to the machine during the night, (although most computers of the 1950s were leased from IBM, and running the computer for an extra shift added 50 percent to the cost of its lease.) Companies using the smaller 650 computers were less likely to enforce a rigid separation between programming and operation. In some companies, operators were given the same basic training as programmers. At least a few companies of the mid-1950s experimented with the combination of coding and operation – seeing these two skills as complementary, because they both demanded an intimate knowledge of the computer's workings.

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At least one firm tried another combination, teaching its keypunch operators enough coding syntax for them to turn detailed logic charts produced by the programmers directly into code on punched cards. [335]

Despite such efforts to rigidly separate different stages of programming and coding, by the mid-1950s it was increasingly recognized that both activities should be performed by the same group of people. Canning's 1957 book reported simply that, "Experience indicated that the best programmers were also the best coders." Efficient coding proved vital to the success of a project, and there was no way for the programmer to communicate unambiguously exactly what code was required without effectively doing the coding his or her self. It appears that strict separation of coding was rare in practice, despite its continuing presence as a job title in some firms and in the standard job descriptions issued by the U.S. Federal government. [336]

The attempted separation of programming and coding represented a managerial instinct to assert an industrial style division of labor and to make a chaotic process more orderly. It reveals a kind of assumed ladder descending from the human world of management to the

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[335] Theodore Stein, "Managing the Data Processing Department", in International Data Processing Conference of the Data Processing Managment Association (Chicago: National Machine Accountants Association, 1962). For case studies in which operators and programmers are selected as part of the same pool, share training or share tasks see Brown, Office Automation -- Selecting, Training, and Organizing Computer Personnel and Canning, Electronic Data Processing, 45. While little explicit attention has been paid to computer operators, the job is sometimes assumed to have arisen from a gradual, managerially imposed separation of job specialization on work formerly performed by programmers. See, for example, Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work, 65. There is undoubtedly some truth in this, particularly in scientific installations where an "open shop" system was sometimes operated in which scientists or engineers wishing to perform computations could sign up for a block of computer time and operate the machine themselves. This reflects scientific custom, the one-off nature of many technical computation jobs, and the lack of long established punched card departments in most technical fields. In most data processing departments, however, it is clear that operations work formed more as a continuation of existing punched card practices than a deskilling and specialization of programming work.

[336] Canning, Installing EDP, 85. On the failure of efforts to establish coder as a separate job, see Conway, Gibbons, and Watts, Business Experience With Electronic Computers, 88-90. As late as 1972, an attempt by the General Services Agency to standardize job descriptions and requirements for Federal contracts included "Coder/Programmer's Aide" as one of its ten categories of data processing worker. (Standard categories were expected to make the rates being charged for labor more easily comparable between contractors). Jr. E. Drake Lundell, "DP Titles Standardized by New GSA Guidelines", Computerworld 6, no. 16 (1972):1-2.

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internal and technical world of the machine itself. The idea was that analysts could hand high-level flowcharts showing overall runs and processes to programmers, who would fill in progressively lower level charts before handing explicit block diagrams of program logic over to coders for translation to machine instructions. This hierarchy enshrined the assumption that the business knowledge claimed by the analyst was more important than the machine knowledge held by the coder. As work descended from manager to analyst to programmer to coder to keypunch operator each step of the ladder saw less discretion, lower pay and a narrower understanding.

Such separations also had the virtue of providing a career ladder needed to grade workers for salary purposes and give an ostensibly empirical and standard route by which increased responsibility and more skilled work led to promotion and higher pay. The labor market for people with computer experience was tight early on, and remained so almost continually to the present day. Wages for experienced computer staff tended to increase faster than those for most other workers at the same company, and dramatic raises early in the careers of programmers and analysts were needed to prevent them from seeking opportunities elsewhere. Personnel departments preferred job classifications based on narrow salary bands and clearly defined skills and responsibilities to those with broad salary ranges and fuzzy descriptions.

How did companies hire programmers and other computer staff? Around the turn of the decade, as the first corporations ordered their Univacs and IBM 700 series machines, there could have been no more than a few hundred programmers working in America. Pioneering scientific and university computing installations supplied a trickle of intelligent and experienced programmers to industry, including many of those who headed application development efforts for the computer manufacturers themselves. The vast majority of business application programmers, however, had no previous programming experience or formal training other than a short course from the computer manufacturer. As Wallace reported in 1956, "Usually, the computer team should be made up for the most part of men who know the company and its

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operations. Their backgrounds might be in tabulating, procedures work, accounting systems development, or industrial engineering...." In 1957 alone, IBM trained more than 14,000 people to prepare them for work as programmers. According to Business Week, most had no more than a high school diploma.[337]

Some experts with practical experience counseled that the benefits of having at least a department head or a chief programmer with computer experience were sufficient to outweigh the cost of hiring such people. But a consensus soon developed that it was easier to take somebody who knew something about business and teach them the fundamentals of programming than to take someone with programming experience in an unrelated area and teach them the culture of business. The Harvard team examining computer acquisition polices reported that, "Several executives said that... it was easier to train an accountant to program than to train a programming expert in accounting..." – and it seems likely that these executives were parroting what they had heard from computer salesmen. This idea was easy for IBM to sell to managers, because it fitted their own assumptions that managerial knowledge of business is more valuable and harder to replicate than technical knowledge or skills. The idea also benefited IBM, since it assured potential customers that the terrible lack of programmers was not a problem. Instead, IBM supplied a "programmer aptitude test" (basically a standard verbal reasoning and mathematical examination ) and a short training course. Some companies offered all their white collar employees a chance to take this test, while others recruited more narrowly from the accounting, systems and punched card departments. [338]

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[337] Wallace, Appraising the Economics of Electronic Computers, 24.

[338] The quote is from Laubach, Company Investigations of Automatic Data Processing, 146. Similar sentiments are expressed by the manager responsible for General Electric's seminal Univac installation in G. M. Sheehan, "An Application to Payroll", in Automatic Data Processing Conference, ed. Robert N. Anthony (Boston: Graduate School of Business Administration, Harvard University, 1955), 155 The figure comes from Anonymous, "Business Week Reports To Readers On: Computers", page 87. See also Brown, Office Automation -- Selecting, Training, and Organizing Computer Personnel for a discussion of programmer training, and Conway, Gibbons, and Watts, Business Experience With Electronic

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Historians have also given much less attention to the historical importance of analysts, supervisors or operators than to that of programmers. Sometimes, the term programmer has sometimes been used to encompass the whole of the data processing staff. This may in part reflect the interests of early computer scientists, and more recent historians of science, in the scientific or theoretical aspects of computing. From these perspectives, analysts, operators and supervisors were irrelevant and even applications programmers did little work of note. However, as we have seen, programming was neither the most common data processing job, nor the best paid, nor the one held by managers and supervisors in the highest esteem. The development of programming as a corporate occupation had much more to do with what the corporation was already like than it did with the scientists and mathematicians who programmed the first experimental computers. Across America, thousands of punched card supervisors like McCaffrey were retraining as programmers.

Application programming evolved at the fuzzy interface between punched card machine operation (a predominantly masculine activity) and systems and procedures analysis (an almost exclusively masculine one). The male domination of corporate computer programming should not, in this context, be a surprise. Jennifer S. Light has recently argued that, "the job of programmer, perceived in recent years as masculine work, originated as feminized clerical labor." Despite the merits of this argument with respect to ENIAC, the focus of her paper, it is clearly not viable in the context of corporate application programming – the dominant programming activity from the mid-1950s onward. The clerical job was that of keypunch operator – feminized in the

Computers, 83-93. For an earlier statement of the theme, see Laubach and Thompson, "Electronic Computers: A Progress Report", page 127. On programmer testing, see T. C. Rowan, "The Recruiting and Training of Programmers", Datamation 4, no. 3 (May-June 1958):16-18. Those with more intimate experience of computing, such as Canning, Electronic Data Processing and McCracken, Weiss, and Lee, Programming Business Computers tended to put more emphasis on the need for at least some experienced programmers to be included in the new department. Hedstrom too concluded that administrative programming was a masculine task from the beginning, and that the work of women on early scientific systems had no influence in the office. See Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970", 247-55.

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punched card era, feminized after the computer arrived and (as data entry clerk) feminized to this day. Given that few corporations hired mathematicians as business programmers, the influence of human scientific "computers," whether male or female, on the culture of rank and file administrative application programmers was marginal at best. The worlds of data processing and scientific computing had very little do to with each other during the 1950s, and moved only a little closer together in the 1960s and 1970s.[339]

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[339] Jennifer S. Light, "When Computers Were Women", Technology and Culture 40, no. 3 (July 1999):455-83. A similar argument is made in Ensmenger, "From Black Art to Industrial Discipline", 18-22. Ensmenger shows that the programmer/coder split was discussed in a draft UNIVAC programming manual as early as 1949, though it was removed from the published version of the same manual. ENIAC has, however, been documented as the linguistic source of this new sense of the verb "to program" in David Alan Grier, "The ENIAC, the Verb "to program" and the Emergence of Digital Computers", IEEE Annals of the History of Computing 18, no. 1 (January 1996):51-55. To judge from W Barkley Fritz, "The Women of ENIAC", IEEE Annals of the History of Computing 18, no. 3 (Fall 1996):13-28, an oral history of female ENIAC programmers, the term "code" was also current at the time. Ensmenger also argues, less convincingly, that the presence of this attempted division between programming and coding was an extension of earlier attempts by Herman Goldstein and John von Neumann to separate the work of "coding" a scientific problem from the more skilled work of the scientist "planner" would provide the algorithm and the numerical analysis work required. This, he suggests, was in turn an extension of work practices imposed on early ENIAC programming. (A similar argument is made in Ensmenger and Aspray, "Software as Labor Process", 158-59). Ensmenger, "From Black Art to Industrial Discipline", 18-22 lists a six stage programming process attributed, without specific citation, to Goldstein and von Neumann. Ensmenger claims that, "coding was regarded as a 'static' process by Goldstein and von Neumann" and that, "the first five of these tasks were to be done by the 'planner' who was typically the scientific user and overwhelmingly often was male; the sixth task was to be carried out by coders." Neither of these claims can be reconciled with the characterization given in Herman H Goldstein and John von Neumann, "Planning and Coding Problems for an Electronic Computing Instrument. Part II, Volume 1", in Papers of John von Neumann on Computing and Computer Theory, ed. William Aspray and Arthur Bucks (Cambridge, MA: MIT Press, 1987), 170-74 (originally issued in April 1947), which presents an explicitly numbered four stage model of "the actual process of coding" in which the first stage is mathematical analysis of the kind that would be performed regardless of the method of calculation, the second was the drawing of flow diagrams and modeling of the overall dynamic structure of the program, the third the static coding of instructions for each box on the chart, and the fourth the assigning of final memory locations. All but the first stage, including the "dynamic" work of charting with which the paper was chiefly concerned, were clearly viewed as intrinsic parts of "coding proper." Goldstein and von Neumann (here at least) did not distinguish between coding, planning and programming (despite using all three terms) or propose any distribution of labor. (Ensmenger's six stage model seems to have been produced by altering the original to turn stage one into four stages – which is in accordance with the sense of the original if not the numbering – and dropping the original step four entirely. Of course, it given the lack of attribution it is possible that this model is derived from some other work of Goldstein and von Neumann).

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## The Craft of Programming

To understand the development of data processing it is necessary to have some idea of what programmers were actually doing. Without this knowledge, it is hard to appreciate the tensions and contradictions that have continued to plague corporate programming work over the following decades. First, an appreciation of the very machine-oriented and complex nature of early application programming helps to explain why programming remained a separate job, developing a culture that remained more focused on technical internals than business problems. Whatever their backgrounds, programmers needed to develop a particular craft sensibility in order to succeed. Programmers have often, to outsiders, appeared antisocial, unmanageable and perversely focused on minutiae – to understand this perception we must examine the content of their work.

Second, this attention to early computer technology, and in particular to the role of corporate programmers in producing the basic software tools used in their work, illuminates the emerge of "systems" programming as a separate specialty. Systems programmers were generally the most technically accomplished, and earned the respect of their colleagues, but their specialization took them closer to the machine and further from business analysis and specific applications. Future generations of corporate programmers were caught between a technical culture in which elegant systems programming seemed more worthwhile than producing a payroll reporting routine, and a business culture in which the role of craft knowledge was downplayed and rewards flowed from steering one's career in the direction of business analysis or management.

Third, hardware and software technologies were constantly changing. To remain competent, a programmer had to work with the latest machines and practice the latest techniques. To develop skills in management or business analysis while maintaining currency as a programmer was virtually impossible – yet the effectiveness of data processing relied on finding a

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way to produce programs that were both technically efficient and organizationally effective. The data processing career ladder was intended to provide one solution to this; later developments in software engineering tools and programming technologies can be seen as alternative solutions to the same problem.

What was it like to be a corporate programmer during the 1950s? That is an easy question to ask, and a good one, but a hard question to answer. The rank and file corporate programmers of the 1950s had no trade association, no union, no journal and no conferences. They did not write many articles for Datamation, though they may have read it – which is more than they did with publications of the machine accountants or the systems men. Data processing managers had their conferences and publications, but corporate application programmers did not. While it is relatively easy to find what data processing managers and supervisors thought of programmers, it is much harder to find what programmers thought of supervisors.

Even the categories of programming and programmer are potentially misleading. On the one hand, neither has ever been clearly demarcated. The boundaries between programming and coding, analysis and management have shifted over time and between companies. As one 1957 report said, "There are as many definitions of 'programmer' as there are data processing installations."[340] Neither is it clear how much time one has to spend programming, or what one has to program, before one becomes a programmer. As more people use computers, this problem has only become more acute. The term "program" was controversial during the 1950s, and the newer phrase "software" was highly ambiguous throughout the 1960s. Among those people who could safely be called programmers, there were enormous differences between business application programmers and scientific programmers, and as time went by systems programming work was increasingly handled by specialist teams or organizations. These people all wrote

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[340] Brown, Office Automation -- Selecting, Training, and Organizing Computer Personnel, IH5.

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programs, but they generally worked for different kinds of organizations and tried to accomplish very different tasks. By the 1960s they were using different programming languages. Almost no generalization is true about all these types of programmer. For most purposes, what divides them is very much more important than what unites them. No unified identity of "programmer" has ever existed, and at least in the United States, few serious attempts have ever been made to create one. Whatever shared consciousness might appear as a result of fundamental similarities in the actually process of programming between these different settings falls far short of creating a single occupation, profession, community or culture of programming.

The problem is exacerbated because so much of what has been written about early programming does not come from the programmers of the 1950s themselves. The most vocal and eloquent characterizations of early programming practices come from outside the corporate community – primarily from the computer scientists and software engineers of later decades. The researchers at places like IBM, the RAND Corporation and universities who accomplished so much fundamental work in the area were, by virtue of their background and concerns, engaged in very different work from that of the corporate application programmer. As computer science developed, its adherents drifted further from the concerns of practicing corporate programmers, instead seeking rigor, theory and fundamental principles. When software engineering developed, a little later, it was explicitly concerned with better methodologies for the production of software. But its supporters have tended to use broadly drawn characterizations of early programming as a shoddy, poorly organized, craft work – the better to contrast with the anticipated professionalism of the true software engineer.

Having said all this, the task is not quite hopeless. The most useful single source on early administrative programming is the book Programming Business Computers by Daniel D. McCracken and two of his colleagues from General Electric's Computer Department. McCracken had been hired by Herb Grosch as part of the programming team to use GE's first computer for

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engineering calculation. In 1956 McCracken accompanied Grosch to Phoenix. While Grosch was supposed to be in charge of finding applications for the forthcoming line of GE computers, McCracken was both head of programming for these applications and in charge of programmer training. At this point he had already published one book on scientific programming and was working on another. Organizational politics within GE kept McCracken distant from the ERMA banking project that GE was then working on for the Bank of America, though he did undertake contract work using the team's IBM 704, including its use to simulate a another computer that NCR was then designing. His growing interest in management led him to a staff job in operations research at GE headquarters, before he quit to become a freelance consultant and author.[341]

McCracken was thus ideally placed to write what was (according to its foreword) the first "book for the person who is interested in applying computers to business problems and may not have a mathematical background" – someone seeking more than just "a skimming of the highlights." He was a highly accomplished member of the first cohort of scientific and technical programmers to work in corporations using commercially available computers. He had an excellent reputation on the strength of his earlier book Programming Digital Computers, he had concerned himself closely with the emerging field of administrative computing and he was interested in managerial problems. One of his co-authors was a certified public accountant, adding extra weight to the coverage of problems in accounting and auditing. The book became a deserved classic, and the first practical guide to which an inexperienced programmer, "a punched card man who wants to know what computers are all about," or an accounting student interested in getting into computing could turn.

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[341] McCracken, Weiss, and Lee, Programming Business Computers. On McCracken's early experience, see Grosch, Computer: Bit Slices from a Life and his own Hughes and McCracken, "IBM 700 Series", page 191.

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Once a computer installation was properly staffed, there was no reason for a programmer[342] ever to touch the computer itself. Program code was written out long-hand on a "coding pad." This was basically a blank piece of paper, ruled as a grid with a few spaces marked in the corner to write the name of the programmer, name of the program, sheet number and other identifying information. Programmers were issued with folding reference cards detailing every instruction available on the machine they were using. For the first twenty years of electronic data processing, the typical programmer needed no special equipment beyond a pencil, a coding pad and the appropriate hardware and software manuals. During the 1950s they did not generally qualify for the plate glass and climate controlled conditions granted to the machine itself, or for the windows and private offices given to managers.

When the program was finished, the programmer conveyed it to a keypunch operator. Just like the data they would one day manipulate, programs were transcribed from coding sheets and onto punched cards by female keypunch operators. In some companies the programmer might carry his or her coding sheets over to the computer room and drop them off personally. In others, a special drop box was used, or a messenger was periodically circulated to take delivery of programs requiring transcription.

Once the program had been punched onto cards, the programmer could then submit it for execution, together with any test data it required and instructions to the operator about how to configure the computer. Some time later, the programmer would receive these cards back, together with the results of the run. These results might include output data, in the shape of

[342] Even the term "program" itself was not entirely uncontroversial. The authors suggested that, "program" was acceptable as a verb, when used strictly to define "the planning that is done between the time the application is started and the time when detailed instructions are written." The writing of these specific instructions they preferred to call coding. What they objected to was the use of "program" as a noun – a usage they abhorred and viewed as "historical." They preferred to call the "collection of functions which carry out some desired function" a routine, rather than a program. Although this usage of "routine" did not gain general acceptance, it is interesting to note that the corresponding "subroutine" triumphed over the more logical "subprogram" to describe part of a program. McCracken, Weiss, and Lee, Programming Business Computers, 47.

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printout, more cards, or even a tape. How long the programmer waited depended on how busy the computer and its operators were and what policies the company had in place. Computers of the 1950s could run only one program at a time. Regularly scheduled "production" jobs generally took precedence over new program development. A programmer might wait longer to receive the results of their test around payroll time or at the end of financial reporting periods. Some companies granted different priority levels to programmers according to their seniority or the urgency of the project they were working on.

It was not uncommon for development jobs to routinely be held until the middle of the night. After submitting a program in the night, the programmer would find the results waiting in his or her mailbox in the morning. The programmer might therefore have only one chance to correct previous mistakes and resubmit their job in every twenty-four hour cycle. Computer time was also expensive. As a result, programmers devoted considerable effort to making sure that their programs appeared to be correct before submitting them to be run. At its simplest, this involved reading it carefully and pretending to be the computer – checking the validity of each instruction and making sure that their aggregate effect matched that intended. This could be done with a pencil, and perhaps a simple mechanical desk calculator. McCracken suggested that code should, in addition, routinely be checked by a second person before running it – on the grounds that another person was far more likely to see the code one actually wrote rather than the code one intended to write. As code was so hard to read, McCracken also suggested spending the time to turn the code as written back into a detailed program flowchart and seeing if it corresponded to the chart it was originally based on.

As work on the program continued, programmers were more likely to be able to run their programs to completion with their test data. Attention turned to other kinds of mistakes, often more insidious and harder to diagnose. A program that ran perfectly with one set of test data might spew garbage when given another. Any real task, such as payroll, was likely to involve a

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large number of runs, each with a separate program. If rules for input and output of each run had not been precisely specified for all situations, and adhered to religiously, then problems were guaranteed when the time came to integrate these programs. A problem with the output of one run could be caused by an undetected error in the transfer of data between two previous runs.

Early computer users invariably discovered that programming took longer than expected, and that debugging was a much more involved process than they had credited. Most programs still contained bugs when they were put into operation. In 1957, a programmer in Ford's payroll team wrote what may have be the first article devoted to the subject of "maintenance" programming for business applications. He was one of two programmers employed full time just to keep the payroll programs functioning. Ford had been using a 702, one of IBM's largest computers, to run payroll for 70,000 people. This required several programs, with a combined total of 13,000 instructions. Unlike machines, computer programs do not depend on oiling or periodic replacement of moving parts. Maintenance, a term that is still widely used today, is really a euphemism for two activities: continued debugging, and the tweaking of the program to reflect changing requirements. With respect to the former, the author noted that "during production runs on the computer, intermittent errors periodically came to light as inadequate output was generated by the 702. In many instances, the error was so subtle that several days were spent in isolating the trouble." Problems involving files shared between several programs were particularly difficult to pin down. In addition, programs sometimes reacted badly to improper input data instead of politely rejecting it and continuing with their other work. While this was not exactly a bug, since the data failed to met specifications, it was still a problem that needed fixing.[343]

[343] John Boccomino, "The Importance of Program Maintenance", Systems and Procedures 8, no. 3 (August 1957):9-14

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The author mentioned "numerous changes in Company policies, new union contracts, Government regulations, etc." as examples of the second kind of maintenance work. In these cases, external changes dictate modifications to the program so that it can continue to do its original job. By the 1960s, programmers had discovered a lot of design tools and techniques that made it easier to build flexibility into programs. Quantities prone to change, such as pension contribution rates, could be encoded as constants for easy modification without changes to the main program. Or, using a more advanced technique, the logic for working out deductions could be stored as rules in a decision table rather than spread over hundreds of lines of program code. But these techniques relied on tools and skills that were not available to the first corporate programmers, and indeed were devised only when the scale of the maintenance task became apparent.

Data processing managers found that maintenance work had a tendency to expand until it occupied all the available programmers. Each new application installed was an open ended commitment of programming manpower. Unless the number of programmers could be increased, this would eventually prevent the development of new programs altogether. The problem of maintenance was not simply one of labor supply. When the time came to make changes to a program, there might be nobody around who fully understood how it worked. As McCracken reported, there was a good deal of job hopping among programmers, especially good ones. Even if the programmer was still available, and could be spared from whatever new project he or she was working on, there was still no guarantee that the programmer could remember how his or her code worked. While the original flowcharts were supposed to provide documentation, it was very common for changes to be made during programming, debugging and maintenance without corresponding modifications to the charts. Still worse, programmers had a tendency to make small changes to their programs by directly modifying the punched cards on which the executable code was stored. These so-called "patches" were a serious problem when a program had been

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compiled (from a higher level language, or – more commonly in the 1950s -- by using a symbolic version of machine language). They got the job done in the short term, but could cause serious problems later on. Only by referring back to the original source code could a maintenance programmer read the program as written (including comments, macros, or constants) – but the program actually being run was a different one.

To this end, McCracken called on programmers to eschew excessive cleverness. "One rule, which some of best programmers find difficult to follow, is easiest to express in the negative: do not program so ingeniously that no one else can understand what you have done. Some programmers find great delight in writing in nine steps what everyone else thought would take ten. The trouble is that they often do it by some fiendishly clever trick which cannot be understood without intensive study."[344]

Almost all business programmers of the 1950s and early 1960s worked in what would later be called a "low level" language – where each instruction they wrote corresponded to one instruction to be run by the computer itself. Such languages are today called low level to distinguish them from "high level" languages such as COBOL and FORTRAN. High level languages are generally regarded as being easier to learn than low level languages. A given program can usually be written faster in one, and the program is generally easier to understand and update than one written in a low level language. A special program, known as a complier, is used to translate the high level language into the low level instruction set that the computer hardware itself is capable of running. The language is "higher" because each instruction generally does the work of several in the "lower" level language, and because it is conceptually closer to the concerns of the user and abstracted from the details of the underlying hardware.

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[344] McCracken, Weiss, and Lee, Programming Business Computers, 40.

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The very first programs for administrative purposes were often entered into the computer as a string of numbers in octal – the numerical base 8. Each instruction consisted of the operation required and an option, for example the memory address to perform it on.[345] These instructions were not easy to write, since each level of translation ("hmm, let's see. I want to do an "ADD" instruction, and that is code number 6600 in octal, and I want to add the contents of memory location 352") introduces the possibility of error. They were almost impossible to read, making debugging and maintenance a nightmare. Furthermore, any useful computer program relied heavily on a technique known as conditional branching. Imagine, for example, that a payroll program needs to figure out whether pay is over $200, in order to trigger a particular payroll deduction. If the computer discovered that the record being processed met this condition then it jumped out of its normal sequence of instructions to process the deduction. Even the act of comparison would take several instructions. One instruction would load the previously calculated pay into a special area of memory known as a "register" (the name was a holdover from punched card machines and mechanical calculators). Another would subtract from this the figure of 200. A third instruction would, if the contents of the register remained positive, jump to a specified memory location elsewhere in the program.

To program any branch or loop of this kind, the programmer needed to know the exact memory location where the code to process the deduction would start. The addition or removal of a single instruction elsewhere in the program would push this subroutine up or down a few locations in memory – upon which all such jumps would function incorrectly. Likewise, variables (current pay, days worked this week, hourly rate and so on) were also stored in memory locations,

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[345] Many early computers used six bits (100110 for example) to represent a character. Humans find binary an inconvenient notation, but fortunately any 6 bits can be conveniently represented by two octal numbers (for example 46). Early computers required a lot of individual instructions to do the simplest tasks. Each instruction filled one memory location, and after executing it the computer moved on to the next one. (The complete collection of instructions understood by a computer was referred to as its "instruction set").

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so any change to the program organization could cause terrible problems here. And of course, there was little point in upgrading the computer's memory because programs would ignore the additional storage space unless they were completely rewritten.

This style of programming was called "octal absolute." Octal absolute was neither a programming language nor a vodka, but a notation. Octal because the programmer entered instruction codes directly in octal, absolute because all memory locations for variable locations, jumps and branches were specified in terms of their exact (absolute) location in the computer's memory. The code punched from the programmer's pad was ready to be loaded straight into the computer's memory and executed as it stood. The approach had directness on its side, but little else to recommend it.

Even in 1954, this represented a failure to adopt the latest techniques from the better established field of scientific programming. It was, however, used for a number of early projects – including the famous GE Louisville payroll program finished in 1954 – the first of its kind to be run in the US. Never one for modesty, Grosch recalled the efforts of his administratively focused colleagues with some contempt. "[A] huge mass of stupids from GE Louisville GE New York, Arthur Andersen and Remington Rand were trying to make the Appliance Park payroll run on the Number Three UNIVAC. They tried to write and check out a 80,000-word program written in one piece in absolute. I wanted to send help or give advice, and was very rudely turned away; [Roddy Osborn] who had published his plans in advance in the Harvard Business Review, was banished after two years to GE Realty, where he probably brought swampland." By the end of the decade this practice seemed positively antediluvian. But entrenched practices change slowly, and as late as 1961 a Datamation editorial could still report, albeit with disbelief, that, "one major

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installation… persists in octal absolute coding despite the pleas of an embarrassed manufacturer."[346]

By the late 1950s, a number of what would later be called software tools were available to help programmers in their work. McCracken referred to them under the umbrella term of "machine aided coding." This was a more honest variation on another phrase current in the literature of the day: "automatic programming." Among the tools he identified were "relative address coding," "symbolic coding and compiling," and the high level language. Using each of these techniques, a programmer would not directly write the code that the machine would run. Instead, they wrote code using a different notation, and perhaps an entirely different set of commands. This was then fed into another program, where it was translated into the code the computer could run.

The alternative to "absolute" addressing was "relative" addressing. The General Electric payroll programs contained a total of about 80,000 instructions. As there was no way to know in advance exactly how large each subroutine would be, no one could tell in advance exactly what area of memory each would eventually occupy. It was therefore impossible for the authors of each part of the program to know the addresses that each of their variables and instructions would eventually occupy. When shifted in memory, even slightly, an otherwise flawless routine would suddenly fail in unpredictable ways. Relative addressing allowed a programmer to refer to memory addresses relative to the beginning of a particular subroutine. When it was time to knit these different subroutines together to form the entire program the code for each was fed through a simple program known as an "assembler." This program substituted absolute addresses for regular ones. When subroutines were reshuffled in memory, another trip through the assembler

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[346] Anonymous, "Software on the Couch", Datamation 7, no. 11 (November 1961):23-24, Grosch, Computer: Bit Slices from a Life, 186

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was all it took to see them running happily in their new locations. (A simpler utility, known as a relocation routine, could be use to move subroutines one at a time).[347]

Although McCracken defined the provision of relative addressing as the core task of the assembler, he mentioned an optional but desirable feature – the automatic translation of mnemonic operation codes into the underlying numerical codes used by the computer. For example, while the Univac I itself used 2400 to represent one kind of addition and 6500 to represent subtraction, it was more convenient as for a human to use standardized mnemonic codes such as A and S respectively. (Though later schemes were somewhat clearer, the Univac mnemonics themselves were cryptic -- for example, 50 was the mnemonic to print on the console printer). As the assembler had to go through the original code anyway, it might as well make itself useful by performing this translation. Because code in this form was ready to be fed into the assembler, it has often been referred to as "assembly language." (Today this translation is generally thought of as the primary job of the assembler).[348]

As mentioned earlier, the very first commercial computers, such as the IBM 701 and the Univac I, did not always arrive with an assembler or with any other programming aids. IBM did distribute two assembly programs and a number of smaller utility programs for tape copying, data conversion and other chores to its customers as early as 1952, but these were intended as tutorials and templates rather than fixed products. As an exhaustively researched history written by IBM insiders noted, "Nobody at the meeting expected that the IBM programs would be used

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[347] According to Bashe et al., IBM's Early Computers, 319-27 the basic need to renumber routines when assembling them into a program had been apparent to Alan Turing as early as 1945, a few years before a computer requiring such techniques had actually been constructed. The need for a careful numbering convention had been apparent to the IBM team working on the 701 from the beginning, and it was Nathan Rochester who came up with the concept of relative addressing. In May 1951, Rochester produced what Bashe et al. claims was the first symbolic assembler.

[348] McCracken, Weiss, and Lee, Programming Business Computers. See Bashe et al., IBM's Early Computers, 319-63 for the best discussion to date of IBM's involvement in the production of assemblers and other early programming tools for its first generation machines.

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unchanged at 701 installations. Their purpose was to serve as models that might be used in developing basic operational tools..."[349]

Companies had ordered their computers because they wanted to run particular tasks – to print payroll checks, simulate nuclear explosions or design gas turbines. Yet, as their programming teams began to tackle these tasks, their best programmers often found their interests shifting towards the more general challenges represented by such software tools. Another result was the gradual emergence of a class of programmers who spent more time working on utilities than on the application programs themselves. As Canning noted in 1957, "In any EDP installation based on a general purpose computer, there is always need for a fair number of programs which are of a 'utility' or 'housekeeping' nature." This was not a bad thing – a small amount of time spent writing programs such as assemblers would be repaid many times over by savings later on. But it did have the unanticipated result that companies whose interests lay in other fields entirely were obliged to support what was, in effect, basic research in computer science. These specialists were called "systems programmers" – a confusing term since it has nothing to do with the systems men, or with systems analysis.[350]

A social norm soon developed whereby companies made tools of this kind freely available to each other. This maximized the common good, since utilities (unlike application programs themselves) were often useful for many different kinds of companies and included little of proprietary interest to the firm. North American Aviation, for example, was an early user of the IBM 701. The firm was a pioneer in the field of coding standards, setting out strict guidelines for the development of application programs. It was involved in a cooperative Los Angeles effort to produce an assembler, leading in 1955 to PACT (Project for the Advancement of Coding Techniques). The computing staff of North American, and of other Southern Californian

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[349] Bashe et al., IBM's Early Computers, 322.
[350] Canning, Installing EDP, 83.

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aerospace firms, formed close ties with the RAND Corporation and with the local chapter of the ACM (Association for Computing Machinery). As we shall see in a later chapter, many of the most vocal proponents of data processing within the ACM, and of the creation of a general professional identity uniting different kinds of computer work, emerged from this distinctive regional culture.[351]

From the assembler, the logical next step was to what McCracken called "symbolic coding." Symbolic coding allowed the programmer to assign labels, for example "PAY", to particular memory locations – to mark the spot where a variable was stored, a loop began or a jump should terminate. All future references within the code would use this label, rather than the memory address itself. This made code more readable, but its biggest advantage was that the labels moved up and down within the program along with the instructions they labeled. Whereas the addition of a few extra lines might push an instruction from location 1029 to 1033, if the programmer had used a label rather than an address number then the program would still work. Thus, while the assembler made it easy to move entire subroutines around in memory, symbolic coding made it easy to add and remove lines of code within subroutines.

The importance of such utilities was not lost on IBM and the other computer manufacturers. They made increasingly strident efforts to produce assemblers for their computers, and to have a suite of utilities ready for their new computers as soon as the hardware itself was ready to slip. By the mid-1950s, IBM was teaching "Symbolic" as the main programming techniques in its standard programming courses offered to companies when they ordered a 705 computer. Even on its smaller 650, it eventually moved away from the initial exclusive reliance on direct coding expressed in its manuals and early training courses. In 1955 it produced SOAP,

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[351] For North American Aviation and PACT see Florence R. Anderson Papers (CBI 101), Charles Babbage Institute, University of Minnesota, Minneapolis and Anonymous, "Los Angeles Cooperative Compiler Project Policy Committee Minutes", Annals of the History of Computing 5, no. 2 (April-June 1983):139-41.

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the Symbolic Optimal Assembly Program. This was another area where technical innovation was driven by data processing staff rather than machine suppliers. IBM had not originally intended to produce an assembler for the 650, but had been inspired to do so by reports presented at a conference on "automatic programming," where its representatives discovered that several users had already written their own. One by the John Hancock Mutual Life Insurance Company, the recipient of the very first machine, included provision for the automatic optimization of instructions.[352]

Useful as SOAP was, it did not spell the end for grass roots efforts, many of them stemming from the most unexpected corners. A full six years later, Business Automation profiled Helene Curtis Industries, a supplier of beauty industry products. The firm's 22,000 point installation boasted two 650 computers, and a staff of forty people. Its head had twenty-seven years of experience with punched cards, and the machines were used primarily for invoicing. From this description of a small, administratively focused installation with strong punched card roots, one would not expect a particular commitment to innovation. Yet two of its programmers claimed to have reduced programming 50 percent with their own "ingenious computer routine." After "much frustration with the routines supplied by the manufacturer," they cleaned out SOAP and installed their own replacement, including improved debugging capabilities. The improved assembler had been used to write payroll, order processing, billing, accounting and sales analysis programs.[353]

Did the Helene Curtis group really write an assembler so much better than IBM's that it substantially boosted the productivity of their programmers? We may never know. It was,

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[352] Because the 650 stored the program it was running on a slow-moving drum, the optimal placement of instructions could greatly improve performance. For its importance to IBM see Bashe et al., IBM's Early Computers, 351-52. On SOAP, and other recollections of 650 programming, see Haefner, "The 650 at Savannah River".

[353] For the Helene Curtis case, see Anonymous, "Programming For Cosmetics", Business Automation 6, no. 6 (December 1961):30-33.

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however, generally recognized that programming groups much preferred to write their own routines rather than rely on those provided by outsiders. As the Price Waterhouse team reported in their 1959 study, "many programming groups feel strongly that they can produce better work than the manufacturer and feel that the use of automatic coding routines casts doubt on their own abilities."[354]

Extension of symbolic translation techniques made it much easier to write code in which code in one subroutine triggered the execution of (or "called") another. This provided a standard mechanism for transferring the sequence of execution to the subroutine, allowing it to run, and then restoring control to the original routine. Programmers could effectively extend the instruction set of the computer they were using – mixing and matching instructions that the computer could execute directly with other "pseudo-instructions" that were in reality calls to standard subroutines. The program that translated these instructions into the more verbose machine code that the computer could actually run was called a "compiler".

The first compiler was produced in 1951-2, by legendary programmer Grace Hopper of Univac. It did not do much that was useful, but the concept behind it galvanized programming researchers. An improved version was actually used by some Univac customers as early as 1953. Adoption of compilers proved to be a turning point in the history of software. In principle, a compiler of sufficient sophistication could translate programs written in any reasonable notation and using any instruction set into code that a computer could execute. It was this prospect that prompted terms like "automatic programming" – as enthusiasts dreamt of the day when programs written in plain English could be converted to executable code without human intervention. (During these years, machine translation between different human languages was a well funded

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[354] Conway, Gibbons, and Watts, Business Experience With Electronic Computers.

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field where immediate and dramatic results were expected – the enormous gulf separating mathematical notation from natural language was widely ignored).[355]

The immediately attainable results proved, however, to be much more modest.[356] In 1959, when McCracken's book appeared, COBOL had not yet been designed. The only language of this type mentioned by McCracken was Univac's FLOW-MATIC – so called because it was supposed to allow automatic translation from a programmer's flowchart to finished code, removing all together the need for human coding and thus making programmers more like systems analysts. FLOW-MATIC also made it much easier to work with information stored in files, and separated the definition of file content from the details of the program that used it. Somewhat optimistically, the FLOW-MATIC routine was described as "ordinary English." However, the "high/low level" categorization of languages was not yet current, and McCracken devoted only a few pages to what he called "nonmachine-language coding." As we shall see in the next chapter, despite a flurry of activity and widespread publicity during the early 1960s, it was only during the second part of that decade that high level languages came to predominate in data processing. Even then, the relationship of programmers to analysts and managers did not change

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[355] For a summary of Univac's early work on automatic programming see Mary K Hawes, Automatic Programming for Commercial Installations, 1955, contained in Sperry-Univac Company Records, Hagley Museum and Library, Wilmington, Delaware.

[356] McCraken also identified a fourth major tool, "interpretative coding" – essentially the same thing as a compiler, except that the instructions are translated one at a time when the program is run. The first widespread use of these techniques was to provide what would now be called "virtual" machines, with instruction sets that were more extensive, more powerful or more convenient than those of the computer actually being used. Instructions written for this imaginary computer were translated by the compiler or interpreter into the corresponding series of instructions for the real computer. Such an instruction set might include the ability to multiply two numbers stored in memory, without having to write several instructions to load them into special registers and return the results. Or it might extend the computer's capabilities in more profound ways, for example adding the ability to work with convenient and accurate representations of very large or very small numbers ("floating point").This was the main advantage of the widely used Speedcoder system for the IBM 701, plugging a major gap in the hardware of the machine. Speedcoder was useful only for scientific computations, and did not include assembly capabilities or the translation of mnemonic programming codes. On Speedcoder, see Bashe et al., IBM's Early Computers, 336-40

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substantially. Administrative programming remained a demanding job performed by specialists, whose culture and concerns often diverged from that of their supervisors.

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# SECTION III: FROM DATA TO INFORMATION 1959-1975

## 7. DATA PROCESSING EVOLVES

The first generation of electronic computers, installed by thousands for firms during the 1950s, were profoundly unfamiliar technologies applied to the furtherance of conspicuously conservative ends. The promise of business revolution was never renounced, however, merely deferred. During the 1960s it was stripped from routine clerical data processing and reapplied to a number of new technologies and approaches, among them the high-level programming language, random-access storage, real-time operation, and (above all) the management information system. Each of these was offered to redeem the airy dream of the computer revolution from the excessively mundane world of data processing into which it had fallen.

The dazzling pace of technological advance may have served to distract from the slower process of organizational change. By 1958, computer technology was launched upon its now-familiar upward trajectory, followed without deviation through the 1960s and early 1970s. New models appeared every year. They were invariably more powerful and less expensive than those they replaced. In less than a decade, the first generation, vacuum-tube machines were replaced by a second generation, and then a third. Memories expanded, access times diminished, the number of calculations performed per second climbed from the thousands into the millions. As costs fell, smaller and more conservative companies ordered their first systems, while larger firms installed ever more hardware. One could not hope to find a more clear cut case of spectacular technological progress than that of computer hardware. Computer people spent their entire careers scrambling to keep up with waves of innovation, and the enthusiasts of the 1970s were as awed by the magnitude of these developments as any giddy commentator of the late 1990s. By 1973, Carl Hammer, chief computer scientist for Univac, could boast that the work accomplished

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by computers in America alone would take 400 billion people to accomplish manually – a situation he claimed was multiplying the power of each mind in America by a factor of two thousand. According to Hammer, his firm's largest machine then put the power of ten million clerks at the disposal of its programmers.[357]

Everything about computers was invariably bigger and better (or where appropriate, smaller and faster). Neither were these advances confined to hardware. The burgeoning software field delivered new programming languages, real-time operation, powerful operating systems, data base management systems, and time-sharing operation all promised to open up the computer to new kinds of applications and new kinds of user. High-level languages were supposed to remove the need for specialist application programmers. Operating systems were supposed to make computer operation virtually automatic, eliminating the need for constant skilled attention that characterized the use of early computers. Large, random-access storage devices and interactive terminals were supposed to spread direct access to computer systems throughout the firm.. Massive centralized computers, accessed through telephone lines and special "time-sharing" software, were supposed to pipe computer power to the desktops of scientists, executives and engineers. With such a "computer utility", the theory went, corporations would no more have to maintain their own computer than their own water filtration system. Packaged software was supposed to cut a swathe through the ranks of programmers. Meanwhile, the old idea that the true purpose of the computer was a revolution in managerial techniques rather than the automation of clerical procedures was revived, and was very widely disseminated during the period.

Yet data processing went stubbornly on, through the 1960s and into 1970s, without diverging in any fundamental way from the template established during the 1950s. The applications performed by computers changed slowly, the internal structure of the data processing

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[357] Helen M Milecki, "DPMA's Computer Sciences Man of the Year", Data Management 11, no. 6 (June 1973):14-20.

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department altered very little, and its culture and organizational mandate were essentially unchanged. Data processing departments multiplied in numbers, grew in size and influence, and inched their way up the charts of many corporations. This scaling up and proliferation did not, however, result in any sudden sloughing off of the traditions they inherited from punched card and systems and procedures groups. Computers remained under the control of specialist managers, analysts, programmers and operators in the data processing department. Throughout the period, most computers were used for purposes of routine administration – though emphasis shifted slowly from accounting to operational support. Despite enormous attention given to the use of terminals to operate computers interactively, the vast majority of data was still punched onto cards and run through the computer in large batches. Most companies continued to rely almost exclusively on application programs constructed by their own programming groups. The tension between the managerially-oriented dreams of the systems men and the machine-oriented craft of data processing remained the central paradox of corporate computing, even as the existing systems groups of large corporations were increasingly assimilated by the ever growing reach of their data processing departments. Operations research remained much discussed but little practiced, and was joined at the fringes of administrative computing by the equally distant academic discipline of computer science.

This continuity defied contemporary expectations that new generations of computer technology, the transistorized "second generation" of the early 1960s and the more powerful and versatile hardware-software systems of the third generation in the late 1960s, would result in a fundamental shift in the function of computer applications. The relatively slow pace at which the second and third-generation computer technologies were adopted, and the much slower pace at which data processing practice and business processes were reorganized around them, provide us with a novel perspective on the development of corporate computing. The existing literature, focused more on technological capabilities than organizational practices, implicitly overstates the

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immediate impact of these new technologies. In Computer, the most important synthetic history of computer technology written to date, authors Martin Campbell-Kelly and William Aspray suggest that it was with real-time operation that, for the first time, "computers made a crucial difference" to business practices. Whereas most computers of the 1950s and 1960s were used as simple replacements for punched card systems, real-time systems opened up entirely new areas of application. One cannot, in the long view, argue with this assertion. Real-time operation is central to the personal computer, the Internet, and contemporary business application architectures. Yet only in the mid-1970s, twenty years after their introduction, did real-time systems move beyond a few tiny niches within data processing. In as much as a general shift in computer applications shift took place, it was toward more direct administrative support for operational management, and away from early focus on the simple replacement of clerical workers performing financially oriented work such as payroll.[358]

What little historical attention has been paid to the application of computer technology has been oriented primarily toward the celebration of a handful of exceptional cases in which companies pushed well beyond the limits of existing technology to produce dazzling results. This approach is then held up as an example of convergence between corporate strategy and information technology that less visionary firms would be well advised to emulate. While case studies of the pioneering SABRE air-line reservation and ERMA banking automation system are valuable, a focus on the exceptional will, by definition, tell us very little about the ordinary. The

[358] Campbell-Kelly and Aspray, Computer, 157. Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970" suggests that from 1960 onward, the use of computers shifted decisively in the direction of "blue sky' applications. Cortada is more cautious, suggesting that the entire 1954-1965 period was one of exploration rather than the "major adoption" that characterized the post-1965 period. Cortada, Information Technology as Business History: Issues in the History and Management of Computers, 161.

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question is not why a few companies successfully spent a fortune to push the state of the art. It is why so many more did not.[359]

The three chapters in this section begin to answer this question. The first focuses primarily on the apparently revolutionary technologies of the 1960s (high-level languages, operating systems, random-access storage and on-line operation) and explores their actual usage. These new technologies did not have a major impact on data processing practices of the first half of the 1960s: subtle but vital technological factors prevented all but a handful of firms from building new types of application around them, and in practice even apparently radical departures such as random access storage were generally integrated into earlier systems without substantial disruption. Indeed, technological flux may even have strengthened organizational conservatism by creating an atmosphere of instability. The second (chapter eight) looks in more detail at the most important corporate computing concept of the 1960s, that of the management information system – a huge, all-encompassing on-line system providing every piece of information needed by every manager in real-time. While impossible to construct, these systems dominated discussion of the managerial applications of computers for many years. The third (chapter nine) explores the institutional and theoretical evolution of the data processing department in the early 1970s, examining attempts to improve the accountability and effectiveness of data processing departments, attempts to re-conceptualize the place and role of the data processing department, the early role of minicomputers in data processing, and the influence of the growing availability of packaged software on the organization of data processing groups.

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[359] Case studies of groundbreaking systems were assembled in McKenney, Copeland, and Mason, Waves of Change : Business Evolution through Information Technology. James Cortada has made a similar plea for more attention to be paid to the representative systems, in Cortada, "Using Textual Demographics to Understand Computer Use: 1950-1990", 34-35.

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## The Second Generation Machines

All the mainstream, commercially available computers of the 1950s used vacuum tubes as the basis for their electronic logic circuits. Despite great ingenuity on the part of their engineers, this technology ensured that machines such as the Univac I, IBM 700 series and the IBM 650 were expensive, large, heavy, hot, and highly unreliable. Between 1959 and 1960, however, all the major manufacturers of computers began to use transistors as the main component used to create the electronic logic of their most important products. Transistors were much smaller than vacuum tubes and produced much less heat – dramatically reducing the expense and complexity of constructing a computer room. They could also be operated at much higher computational speeds than vacuum tubes. Their primary advantage, however, was their reliability – only with the production of transistorized models could one reasonably expect to operate a computer for several days without needing to replace any of its components.

The benefits of transistorization were so great that IBM and the other computer manufacturers moved rapidly to replace their entire range of computers with transistorized models. As we saw earlier, the speed and extent at which early computers would become obsolete was widely disputed during the 1950s. Within a few years, however, the almost total replacement of vacuum tube machines in the product lineups of computer manufacturers had dispelled such illusions. Neither was this a one-time transition – transistor technology has been shrinking and accelerating ever since. Indeed, the most remarkable characteristic of computer hardware over the past half century has arguably been the speed with which it becomes obsolete. The constant arrival of cheaper, faster, more reliable and smaller machines means that even the most impressively capable piece of equipment will soon be embarrassingly outmoded.

Exploiting this, hardware manufacturers were keen to advertise their products as belonging to a new "generation." With the transition to transistorized machines, the early vacuum tube models were dubbed the first generation, while the new models were recognized as a second

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generation. Suppliers of second generation machines also began to stress the programming tools and utilities provided with the new computers as another decisive break with the limited or non-existent nature of those provided previously.[360]

The second generation, transistorized computers of the early 1960s were the first to displace appreciable numbers of electro-mechanical punched card machines. With them, the computer moved closer to the heart of data processing. Their most important result was therefore to spread existing patterns of organization developed around the earlier, first generation machines of the 1950s. By mid-1958, the data processing department was well established in America's largest corporations. More than 1,200 computers were installed and approximately three thousand more were on order. But the spread of computers and data processing departments over the next few years was to be nothing short of phenomenal – as shown in the graph below.

[360] While the "generation" concept has been widely used in computing, the characteristics and dates assigned to each generation have differed sharply depending on the priorities of the person doing the defining. Most definitions have focused primarily on hardware – but even here, some early writers split the machines of the 1950s into two generations, making the first transistorized machines into a third generation. See, for example, Richard E. Sprague, "Automatic Management Reporting and On Line Real Time Systems", in Ideas for Management: Papers and Case Histories presented at the 1962 International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1962). Taxonomies based on software or applications are very different. In addition, while definitions of the first three generations are broadly recognized, the nature of fourth and subsequent generations remained murky. See Friedman and Cornford, Computer Systems Development: History, Organization and Implementation, 16-21 for an insightful discussion of different versions of the generation concept.

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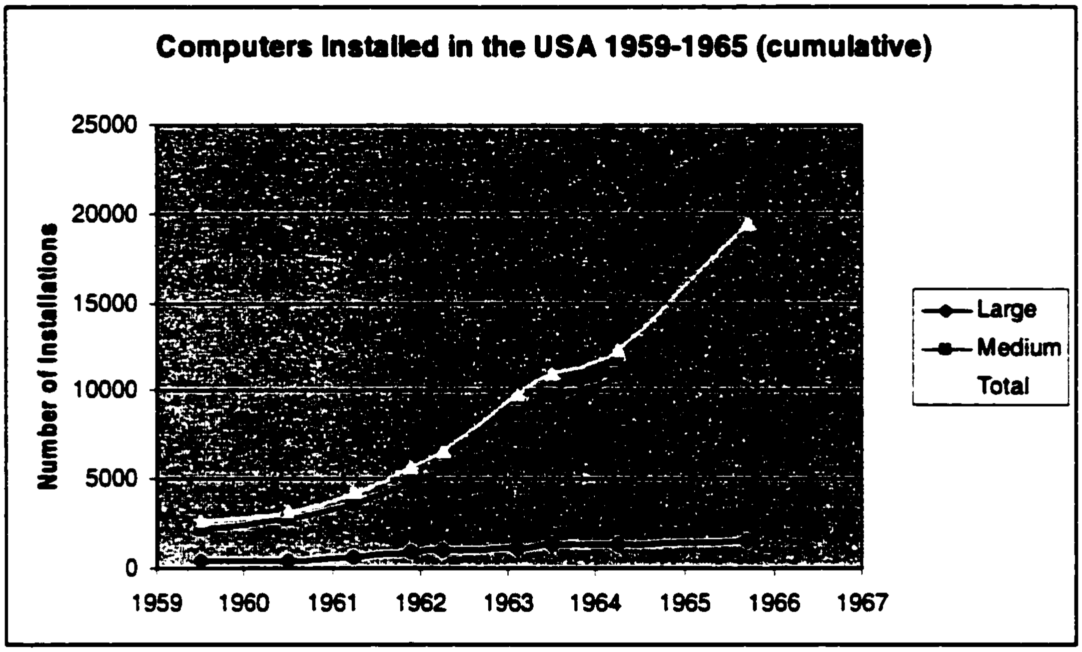


**Figure 19: Large and medium digital electronic computers installed in the USA, 1959-1965 (cumulative).**[361]

Six years later, by mid-1965, almost twenty thousand computers had been established. Following the pattern established in the 1950s, large million-dollar computers continued to get

[361] The graph is taken from the computer census data produced by R. Hunt Brown and his company Automation Consultants, Inc. With the exception of the 1959 data, taken from Brown, Office Automation: A Handbook on Automatic Data Processing, II L 2 the remaining data points come from versions of the census published in Business Automation magazine. Dates used are those given in Business Automation, and may not reflect the actual points at which data was gathered. Some of the individual figures given in the census and totaled here are estimates rather than exact data – while the census includes this disclaimer it does not always specify which figures are estimated. In 1959 and 1960, "medium sized" computers are those with an estimated purchase price of more than $50,000 and less than $500,000. From 1961 onward, these thresholds were raised from $75,000 to $750,000. However, no installed computers moved from one group to another as a result, and so figures are comparable over the whole period. The census included machines which were in-use but no longer produced, and these are included in my totals here. However, its creators removed obsolete machines from their list. For example, the IBM 650 was by far the most common computer through December 1961. By March, 1962 it had been overtaken by the IBM 1401, and the July 1963 census showed a drop in the number installed. By 1964 it had vanished from the census altogether – though some were probably still in use. While these numbers cannot capture the exact number of computers in use, they are likely to be the most accurate figures available across the entire spread of computer manufacturers. As well as IBM, they include computers from Addressograph Multigraph, Burroughs, Control Data, GE, General Precision, Honeywell, NCR, Philco, RCA, Scientific Data Systems, Teleregister, Univac. Small machines from vendors such as Clary, Monroe and Royal Precision were included in the census, but the entire "small computer" category was excluded here – eligibility criteria varied from year to year, and few machines in this category were used for data processing.

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the attention, even though smaller computers made up the bulk of the market by both number installed and by value.

Despite this enormous proliferation, very little of importance changed in the ways in which computers were used during the period. The data processing department remained the dominant institution of corporate computing, and data processing remained the dominant occupational identity of corporate computer staff. Former tabulating staff continued to dominate data processing organizations, and computers continued to be used primarily for administrative purposes. If anything, the most popular computing technologies of the period strengthened the existing ties between tabulating and data processing.

IBM demarcated its second generation, transistorized machines by using adding an additional digit to the model number. The first transistorized computer offered by IBM was the 7090 – a design based on its earlier 709 model. Although flexible enough that they were sometimes used for business applications, both the 709 and the 7090 were used primarily for technical purposes. There was, however, no shortage of second generation IBM machines designed expressly for administrative purposes. The firm fielded no less than three distinct and incompatible lines of second generation computers designed specifically for business data processing. The 650 was replaced as the workhorse of data processing by the transistorized 1401. The larger 702/705 machines were succeeded by two distinct lines of larger transistorized computers -- the 7070 and 7080 families. All these lines received periodic upgrades – the 1401 was supplement by the 1410 (faster, more expensive, designed to work with disk packs), 1440 (smaller, cheaper, not very successful) and 1460 (much faster). The 7070, though generally considered a flop, was nevertheless followed by the 7072 and 7074.[362]

[362] This additional bifurcation between the 7070 and 7080, both large computers for administrative use, occurred as a result of misunderstandings and internal struggles between different groups within IBM (in part along lines of fracture between its large computer and punched card oriented factions). The 7070

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If the reader's eyes have glazed over at this point, this reaction is probably not unlike those of contemporary managers trying to understand the computing field. Computer technology was so complex, so full of buzzwords and promising new approaches, and so rapidly changing that it remained hard for a non-specialist to understand what was going on. Whether through participation in a formal feasibility study, or through a more individual investigation, anybody who could put in enough time to grasp the relative merits of a 1440 and a 7072 was probably already well on the path toward socialization into the new culture of data processing.

Of this mass of second generation IBM machines, the 1401 series was by far the most successful, whether one measures success in terms of numbers installed or by revenue generated. The machine was launched in 1959 and first installed late the following year. About 12,000 were produced over the next five years– a population that dwarfed that of any previous computer model. Given that there were a total of about 45,000 punched card installations at this point, it is apparent that the 1401 was the first computer to really challenge existing punched card technology in mainstream data processing. As a result of its success, in 1962 IBM's revenues from its computer products finally overtook those from its punched card products. By July 1963

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was designed for easy transition from existing 650 programs and data. It boasted a modular design – in its cheapest configuration its cost was similar to that of a 650, but with the addition of disc drives, tape drives and memory it was expected to handle the largest of data processing jobs. With the use of special translator software, it could run programs written for the 650. Unfortunately, its place as a replacement for existing 702 or 705 computer was limited by its inability to read files from these machines, let alone run their programs. IBM was therefore forced to offer the 7080, an alternative design with greater 705 compatibility, as an upgrade path for its other customers. The 7070 series failed to meet IBM's internal expectations – though a far from negligible total of around 550 machines were eventually installed according to the Business Automation computer census. The 7080 line did even less well – shipping a total of just 43 computers. Anonymous, "Computer Census -- August 1965", Business Automation 12, no. 8 (1965):42-44. One of the best short guides to IBM's product ranges is Bob O. Evans, "System/360: A Retrospective View", Annals of the History of Computing 8, no. 2 (April-June 1986):155-79. For an anecdotal account of the origins of the 7070 see Bob Bemer, Birth of an Unwanted IBM Computer (bobbemer.com, [cited 26-APR-01 2001]); available from http://www.bobbemer.com/BIRTH.HTM. For a user's account of working with a 7070 see Tom Van Vleck, The IBM 7070 (24 Mar 1996 [cited 06 June 2001]); available from http://www.multicians.org/thvv/7070.html.

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over 4,800 had been already been installed – at which point this single model made up around 40 percent of America's entire population of medium and large electronic computers.[363]

The 1401's success stemmed in large part from the ease with which it could be integrated into existing punched card installations – it did not demand any substantive shifts in management techniques, corporate structure, or even in the organizational role of the data processing department. Although this success was made possible by the reduced costs and increased speed and reliability associated with by transistorization, analysts agree that its enormous success can be explained primarily by the remarkable new printer (the 1403) that accompanied it. The 650's reliance on existing printing technology had limited the practical usefulness of its computational capabilities, but the new printer greatly alleviated this output bottleneck. As Campbell-Kelly and Aspray put it, "for the cost of a couple of [electro-mechanical tabulators], the 1401 provided the printing capacity of four standard accounting machines; and the flexibility of a stored-program computer came, as it were, for free."[364]

The obvious benefits of cost, reliability, speed and size were not the only claims made for the second generation. It was sometimes associated with new applications that would move the computer beyond its roots in routine clerical activity. Enthusiasts continued to hope that optical

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[363] Figures on the 1401, including the first installation date, are taken from Anonymous, "Computer Count Mounts to 13,500; Will Reach 20,000 By Next Year", Business Automation 9, no. 1 (January 1963):42-43.

[364] Campbell-Kelly and Aspray, Computer, 134, drawing heavily on Bashe et al., IBM's Early Computers, 471, 180-495. User experiences with the 1401 are reported in Anonymous, "EDP Makes Sense, Means Profit to Bergen Drug", Business Automation 9, no. 5 (May 1963):36-37, R. C. Cheek, "A System for General Management Control", in Control Through Information: A Report on Management Information Systems (AMA Management Bulletin 24), ed. Alex W. Rathe (New York: 1963), Hans A. Lustig, "At Gibraltar, On-Line Money Spells Profits", Business Automation 12, no. 4 (April 1965):44-47, Donald Young, "Reyerson Turns Paperwork into Working Paper", Business Automation 6, no. 4 (October 1961):22-27. For a personal account of the 1401, see Roger Louis Sinasohn, "Programming the 1401: An Interview with Leo Damarodas", The Analytical Engine 1, no. 1 (1993):3-8. Not only was the 1401 an excellent choice for a medium sized punched card installation looking for a first computer, but it was often pressed into service as an auxiliary machine to larger computers – taking up the printing, data formatting and sorting chores that had previously required even the largest data processing departments to keep around some conventional tabulating machines.

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character recognition, or some other form of "automatic data entry" would be a defining characteristic of the second generation. One consultant insisted that the consensus at a 1961 American Management Association meeting had been that no second generation of computers worthy of the name could rely on keypunching since, "[t]he cost of data collection is equal to at least three times the computer cost."[365]

Despite these claims for the second generation as a fundamental break with the first, in practice administrative users of these machines employed them primarily for the same kinds of application that first generation computers had been used for. They were faster, cheaper, more reliable, and far more widely adopted – but their mainstay remained payroll, inventory management, accounting of various kinds and customer billing. A survey of data processing installations, conducted in 1963 on behalf of Business Automation magazine, suggests that the pattern of applications performed on these machines differed little from those pioneered five years earlier by users of first generation computers.[366]

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[365] Charles F. Winter, "Second Generation Computers", in Total Systems, ed. Alan D. Meacham and Van B. Thompson (Detroit, MI: American Data Processing, Inc., 1962).

[366] The survey included 340 firms, most of which were manufacturing firms of one kind or another, though insurance (fifty-one firms) and banking (thirty-four firms) and electrical and gas utilities (twenty-seven firms) provided the largest specific industrial groups. Anonymous, "Annual Survey of Data Processing Salaries (part II)", Business Automation 10, no. 1 (July 1963):18-23. As one would expect, given this broadly based sample, generally applicable tasks such as accounting and payroll continued to dominate administrative computing. Industry-specific tasks such as loan processing or premium billing, while common in banking and insurance respectively, do not therefore figure in the table below. Results were also revealing with respect to the computers used. 36 percent of the Business Automation sample were using the IBM 1401 – by far the largest group. 19 percent of the sample had no computer at all –an underestimate of the continuing prevalence of punched card data processing, but a powerful reminder of the gradual nature of the shift. 12 percent used one of the larger IBM second generation machines – primarily those in the 7070 series. First generation IBM computers (the 650 and the entire 700 series) made up just 5 percent of the sample – confirming that the enormous investmens made in these machines had been rendered obsolete in just a few years. Univac models trailed – making up just 4 percent of those reported, though this was still more than share claimed by the Bendix, Burroughs, Honeywell, RCA, NCR, GE and Philco machines that brought up the rear.

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| Application | Percentage of data processing departments performing |
|---|---|
| Payroll and Wage Records | 90 |
| Accounts Receivable | 74 |
| Accounts Payable | 66 |
| Cost Account, Gen. Expense Distribution | 63 |
| Inventory Control | 59 |
| Personnel Records | 58 |
| Sales and Market Analysis | 57 |
| Budgetary Control | 56 |
| Invoice and Order Writing | 42 |
| Fixed Asset Accounting | 41 |

**Table 3: Leading data processing applications in 1963.**

## Applications, Staffing and Practice

A number of significant studies were reported of data processing practices and applications during the 1960s and 1970s, the results of which are discussed here whenever appropriate. Unfortunately, no longitudinal studies were performed to examine changes with identical or directly comparable groups of companies, making it hard to speak with confidence about trends over time. The closest we can come to this is annual data processing salary survey performed by Business Automation magazine. As well as showing the extent to which data processing salaries as a whole rose during these decades, any changes in relative pay between particular data processing occupations, such as programming and analysis, can be read as a surrogate for the changing status accorded to these specialties.[367]

[367] From 1960 onward, Business Automation magazine published an annual survey of data processing salaries commissioned from a specialist human resources consulting firm. While the published version of the survey is not ideal (it does not consistently distinguish between large and small firms, and some job categories are missing for some years), the survey does provide comparable data for a long time period, gathered using consistent description of job categories and a consistent survey methodology.

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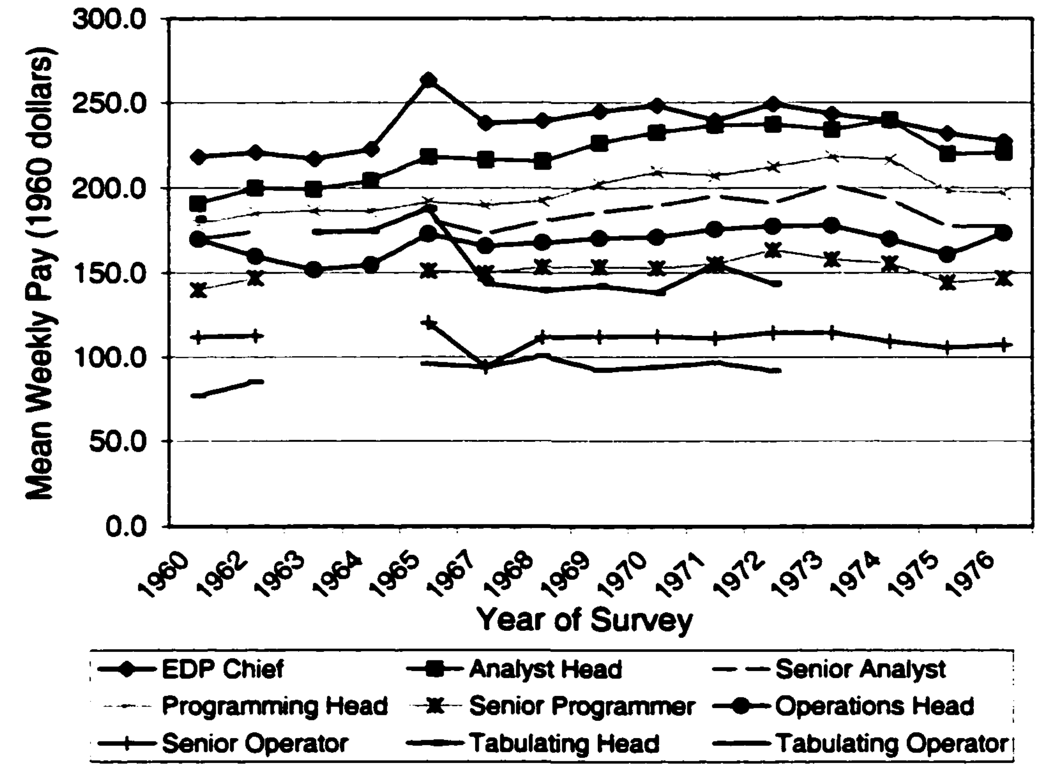


**Figure 20: Mean real weekly wages for data processing occupations, 1960-1976.**

One of the most striking discoveries from the survey is that the basic hierarchy of data processing – manager, analyst, programmer, operator – did not appreciably alter during the first two decades of administrative computing. For the most part, the pay differentials between these different jobs remained constant. The differentials held up at all ranks: heads of analysis earned more than heads of programming, senior analysts earned more than senior programmers, junior analysts earned more than junior programmers, trainee analysts earned more than trainee programmers, and so on. Salaries of the different groups usually rose and fell in tandem.

Having said this, there are a few interesting divergences. One is the weakening position of the operator. Pay for senior operators was essentially flat for the entire period. Operations heads started out in 1960 with almost the same pay as heads of programming, but by the late 1960s the differential had grown appreciably. The biggest drop, however, came for tabulating

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staff. Tabulating machine operators were consistently the worst paid of the groups shown here (though the almost exclusively female keypunch operators continued to earn considerably less and lacked the same hope of moving into computer operations or programming). The pay of the tabulating head, however, was roughly equivalent to that of a senior analyst until 1967, at which point it dropped sharply. The reason for this is most likely that larger companies were by then either removing or downgrading their tabulating operations – so that remaining salary reports came from smaller operations.

Based on her personal experience as a programmer and community college teacher, Joan Greenbaum reported that the data processing hierarchy of the mid-1970s offered diminishing opportunities for personal advancement. Data processing job distinctions, she argued, were now reflected in the ethnic, gender and class positions of those recruited to fill each job. According to Greenbaum,

> In general, computer operators are men and the set-up and support functions are performed by women. Both kinds of output support titles—operators and the more clerical input/output support functions—are filled by recruitment procedures that usually draw young working-class people, often from immigrant and minority populations. Applications programming titles are divided by rungs in the ladder. Today the lower rungs within the applications ladders are increasingly being filled by women; the higher one goes up the ladder, the more the positions are held by college educated males. Systems programmers, the 'elite' among programming ranks, are most often men from middle-class and professional families. Systems analysts generally are selected from the same backgrounds.[368]

Greenbaum also suggested that these distinctions were reflected in the backgrounds of recruits. This pattern was reinforced by changing methods of recruitment and training. In 1969, IBM "unbundled" its hardware products from its software and services. As a result, data processing managers could no longer count on its free programming training, and as a result were forced to reconsider the long established practice of hiring programmers and operators with no

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[368] Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work, 99.

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previous computer experience. Independently operated for-profit data processing schools had been growing during the 1960s, and were happy to assume some of the training burden in return for fees from would-be data processing workers. Another result was a substantial increase in enrollments for vocational data processing training in two-year colleges, whose graduates were likely to work as operations programmers or on simple applications programming work. The trickle of graduates from four year computer science programs (established from the mid-1960s on) were more likely to find work as systems programmers.[369]

Perhaps the most striking observation from the pay chart is the general flatness of real salaries in data processing. It was not just operators who failed to receive substantial increases in mean pay. Most of the other data processing occupations saw a slow real increase from 1960 to 1973, followed by a sharp drop with the economic shock of the mid-1970s. This increase was quite tiny for senior programmers, more substantial for senior analysts, and reasonably generous for heads of analysis, programming and the department as a whole. But even for head analysts – the position with the biggest pay growth – real wages rose only a total of 30 percent over the 14 years between 1960 and their peak in 1974 (significantly slower than productivity growth in the US economy as a whole.) Between 1973 and 1976, all the data processing occupations gave up many of these modest gains, with mean wages for the posts of senior programmer, senior analyst and head of programming finishing up pretty much where they had been in 1960.[370]

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[369] Ibid, 92-96. On private EDP schools, see Edward Markham, "Selecting a Private EDP School", Datamation 14, no. 5 (May 1968):33-40 and Edward J. Menkhaus, "EDP: Nice Work If You Can Get It", Business Automation 16, no. 3 (March 1969):41-45, 74. According the Business Automation surveys, use of private EDP schools as a source of recruits actually fell during the early 1970s, from 57.1% of firms in 1972 to 25.3% in 1972. This may be related to the growing availability of experienced staff.

[370] Even this may overstate the real growth in pay for heads of analysis. By the end of the period, most firms had abandoned the practice of running analysis as a separate unit within the DP department. Those firms retaining a separate analysis function were disproportionately large – and it appears likely that an growing proportion of large installations among those reporting data for the head of analysis position would trigger a corresponding increase in the mean pay reported, thus overstating the underlying growth rate.

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This picture is even clearer in the version of the chart shown below, which uses changes in averaged unskilled hourly wages rather than changes in the consumer price index as the basis on which to adjust the salaries reported in later years to make them comparable with those reported for 1960. This gives a better idea of how the earning power of data processing employees was altering compared to that of other workers.

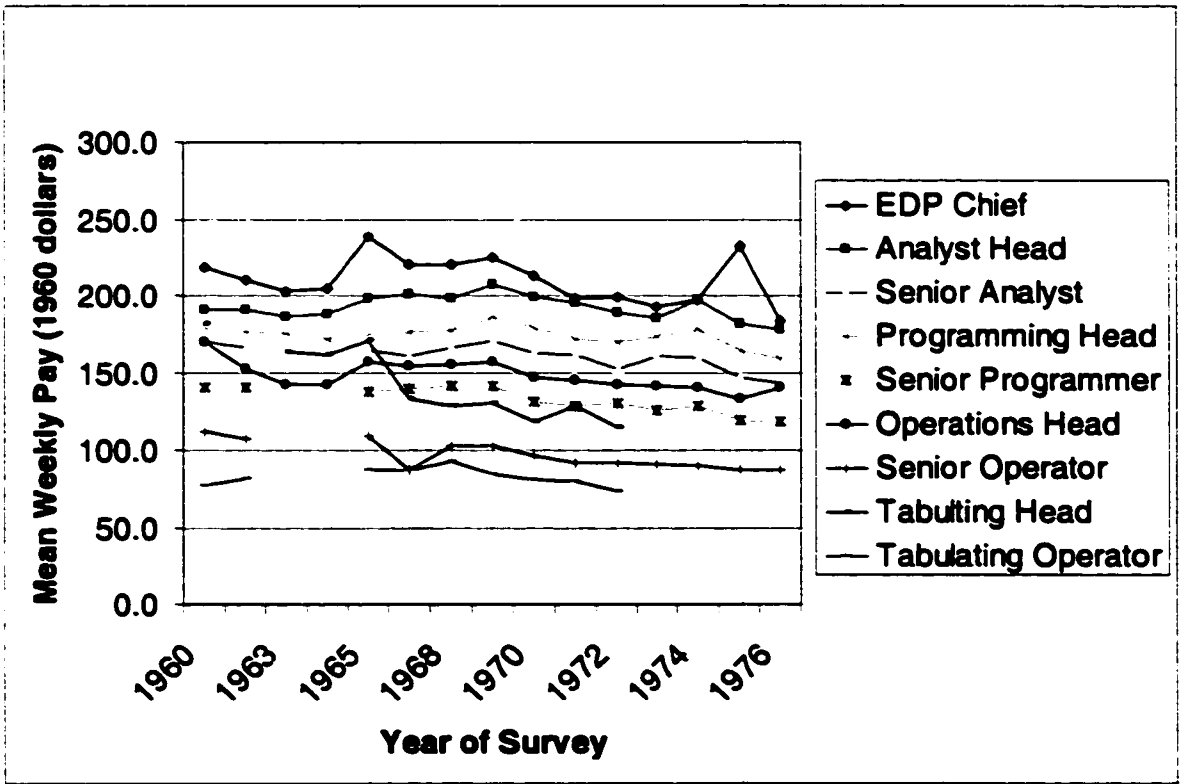


**Figure 21: Mean real weekly wages for data processing occupations, 1960-1976 (using unskilled hourly wage as the deflator).**[371]

This hardly fits with the picture presented, in the specialist computing magazines and general business press, of data processing as a field plagued by ever-rising salaries, driven up by a perpetual shortage of qualified staff. In 1967, for example, Fortune magazine claimed that around 100,000 programmers were already working in the US, and an additional 50,000 posts languished

[371] Unskilled wage data used here as a deflator is taken from Samuel H. Williamson, "What is the Relative Value?" Economic History Services, April 2002, URL : http://www.eh.net/hmit/compare/.

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unfilled. (Such numbers were little more than guesswork, derived by multiplying the better documented estimates of the number of computers being installed by a guess at the number of programmers employed to serve each machine). This number was widely quoted at the time, and has been used by historians. Whatever the exact figures, there can be little doubt that exponential growth of computing installations did create a huge demand for data processing staff.[372]

These results do not mean that data processing was no a financially attractive field for many individuals. Rapid growth created an environment in which experience was prized and ambitious staff found it easy to switch between jobs and to rise rapidly through the ranks – and so the average salaries of experienced and capable individuals often rose rapidly. Staff turnover remained high even though mean salaries were largely stagnant, suggesting that computer staff were prompted to move between firms because of an unwillingness to raise salaries across the board. According to the 1971 Business Automation survey EDP managers had worked for a median of more five years for their current employer, systems analysts for more than four years, and programmers for more than three years.[373] In an era of long tenure for many white collar jobs, this may support characterizations of data processing as a hotbed of job swapping. In 1969, according to the survey, 29 percent of firms reported turnover of more than 20 percent among systems analysts, and 43 percent among programmers.[374]

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[372] Gene Bylinsky, "Help Wanted: 50,000 Programmers", Fortune (March 1967):140-43, 68, 71-3, 76. Joan Greenbaum, looking at pay data from the Bureau of Labor Statistics and Computerworld likewise concluded that data processing salaries showed no real growth during the early 1970s. Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work, 19-21.

[373] Anonymous, "Data Processing Salaries Report-1971", Business Automation 18, no. 8 (June 1 1971):18-29.

[374] Anonymous, "EDP Salary Survey--1969", Business Automation 16, no. 6 (June 1969):48-59. Very few computer staff benefited from incentive pay, and most firms did not extend overtime payments to any of their data processing staff. In 1969, at the height of a stock market boom in computer related and technology companies, only 0.3 percent were eligible for stock options. 1 percent were covered by some form of profit related plan, and just 4.2 percent were considered for performance related bonuses.

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It is also likely that pay rises within the data processing installations of the large firms that pioneered data processing are obscured in these averages by the spread of data processing into smaller firms where pay might be generally lower. Yet the evidence seems clear that the average salaries assigned to data processing jobs across the workforce as a whole did not show significant real increase during the 1960s or 1970s, reflecting the constant influx of new staff into this rapidly growing field.

There was, then, little change in the relative prestige of different data processing occupations as measured by salary. Neither did the importance of these jobs change substantially in terms of their share of the overall data processing staff at a typical computer installation. As we saw earlier, experts of the mid-1950s suggested that keypunch operators should form the largest single group, while programmers, systems analysts and machine operators would each account for something like 20 percent of the total. A 1962 survey of thirty large data processing and scientific computation departments found the mix of data processing personnel to be very little changed from the 1950s. Twenty-eight percent of their combined personnel were computer or punched card machine operators, 24 percent programmers, and 23 percent keypunch operators.[375] The 1971 Business Automation survey included a breakdown of the number of personnel falling into each job category, as well as the pay ranges found there. This provides the opportunity to compare the makeup of the mature data processing department of the early 1970s with the pioneering installations of the late 1950s.

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[375] Charles M. Lawson, "A Survey of Computer Facility Management", Datamation 8, no. 7 (July 1962):29-32. The slightly lower number of keypunch operators and higher number of programmers may be cause by the presence of scientific installations, which relied less on high volume data entry than their data processing counterparts.

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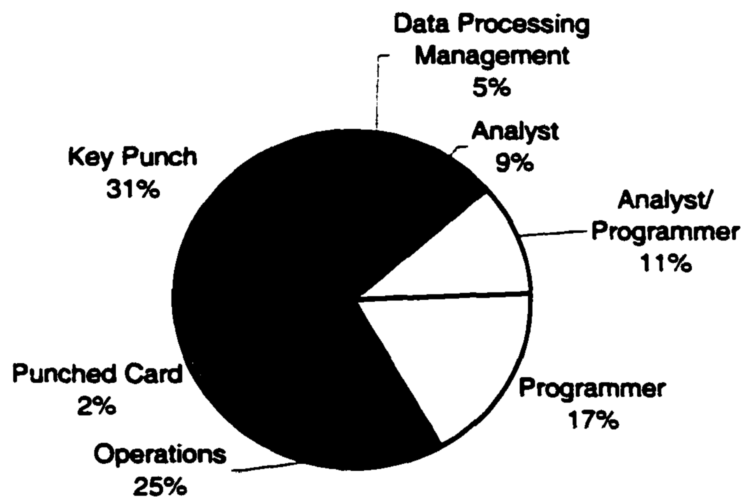


**Figure 22: Data Processing Personnel by Job Category, 1971.**[376]

The most striking observation is, once again, the degree of continuity exhibited in the structure of the data processing department. Operations staff continued to make up a full quarter of all data processing staff – roughly equal to the number of programmers and programmer/analysts combined. Despite the prevalence of third generation equipment, and the attendant spread of sophisticated operating systems, the relative decline in numbers of the operations staff was quite modest. Given the rapid increase in the overall number of electronic data processing departments, the total number of computer operators must have been increasing rapidly throughout the 1960s.

One change is the virtual disappearance of punched card machine operators and supervisors. By 1971 they made up just 2 percent of data processing staff in the installations

[376] Anonymous, "Data Processing Salaries Report-1971". Personnel of different ranks have been collapsed here according to their functional groups, including both junior staff, their supervisors, and the heads of specialized groups. Thus senior operators, junior operators, trainee operators, lead operators, operations supervisors and heads of operations have all been grouped together as "operations". The same has been done with analysts, analyst/programmers and programmers. Keypunch supervisors and keypunch operators are grouped together. Only the overall heads of data processing and their assistants have been categorized as "data processing management." The survey included almost 28,000 data processing staff.

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surveyed. (This was a rapid drop off – as recently as the 1963 survey, 95 percent of the firms questioned still had tabulating departments). Key punch operators, in contrast, remained the largest single group of data processing staff. Almost all administrative data processed by computers was still punched onto cards before being processed by the computer – though by the early 1970s this was finally beginning to shift. Firms remained keenly interested in efficiency with which jobs could be fed through the computer. Two thirds of firms continued to operate their computers through more than one shift during the period.[377]

According to Greenbaum, firms enforced increasing separation between programmers, analysts, and operators during the late 1960s and early 1970s – culminating in the establishment of "programmer pools". Yet in retrospect it is clear that at least one trend in the other direction was also at work. The role of "Programmer/Analyst" was first included in the Business Automation survey as a distinct occupation in 1969. Its spread during the early 1970s represented the final merging of the old systems and procedures department with the new and less managerially-oriented work of programming. Since the 1950s, an increasing number of companies had experimented with the use of project teams in which programmers and analysts worked side by side. This, however, was a cross-disciplinary collaboration. The individuals involved were still either programmers or analysts, and might still expect to follow different career structures and report to different managers. The formal creation of a programmer/analyst career track, reflected a more fundamental combination of roles, and involved the creation of a career ladder in which programming and analysis tasks were more closely intertwined than

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[377] In 1969, 67% of firms ran their computer(s) for more than one shift. More than a third offered no pay differential for the second shift. Anonymous, "EDP Salary Survey--1969". Even in 1976, the survey reported that only 27% of firms used less than 40 "meter hours" a week on their mainframes, representing one full shift. The median firm used between 51 and 60 hours, while 18% used more than 120 hours. In most of these companies, a minor salary differential was awarded to staff on the second and third shifts – though seldom more than a 10 percent bonus. See also Robert B. White, "A Case Against Large-Scale Computers", Infosystems 22, no. 8 (August 1975):34.

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before. By 1970, the number of programmer/analyst positions reported equaled the number of systems analysts, and accounted for 40% of the total reported population of programming staff. By 1975, the survey reported more than three times as many "Computer Systems Analysis and Programming" positions as "Computer Systems Analyst" positions.[378]

One cause of the shift to combine programming and systems analysis was the increased use of high level languages, coupled with a general awareness that rigid segregation of computer knowledge and business procedures knowledge did not contribute to effective computer use. Another was probably the spread of the computer into smaller firms, less likely to have housed a separate systems and procedures group eager to maintain its status. The shift may also reflect the gradual dissociation of the term "systems analysis" from expertise in managerial techniques and its increasingly close ties to the computer. As analyst became more and more a title bestowed on a relatively senior member of the computer department, and analyst positions were increasingly filled with promoted programmers, its exclusivity diminished and the efforts made to keep it separate dwindled.

## COBOL: "A Step In the Right Direction"

Computerization forced managers to rely on the efforts of programmers in order to make the slightest change to their administrative procedures. Modifying a report or changing a tax

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[378] Greenbaum, In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work. Greenbaum herself later acknowledged this trend in Andrew Friedman and Joan Greenbaum, "Wanted: Renaissance People; A New Survey of DP Managers Reveals a More Relaxed Management Style and a Desire to Hire Some "Know-It-Alls"", Datamation 30(1984):134(6). Survey figures from Anonymous, "EDP Salary Survey--1969", Anonymous, "EDP Salaries Report-1970", Business Automation 17, no. 6 (June 1970):38-49, page 49, and Anonymous, "1975 Salary Survey: Recession Holds EDP Wages to an Overall Average Gain of 4.9%", Infosystems 22, no. 6 (June 1975):34-43. (The 1975 figure is produced on totaling figures given in both category for all grades: manager, lead, senior, junior). The 1969 survey also found that separate systems groups were increasingly rare but still by no means unknown – in 19 percent of firms the systems analysis group was managed separately from the data processing department itself. Although systems analysis and programming became much less distinct areas during the 1960s they had by no means blurred together entirely.

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regulation became a major undertaking. As we have seen, shortages of experienced programmers plagued early electronic data processing efforts, and companies found themselves forced to retrain large numbers of staff and keep them as full-time programmers. As costs mounted and the long-term burdens of program maintenance and development became apparent, programming emerged as the main bottleneck in the computerization process. As a result, computer manufacturers were keen to support the development of so-called "automatic programming tools" – such as the assemblers we have already considered.

During the early 1960s, however, data processing circles were abuzz with discussion of COBOL, the first widely promoted high-level language for business data processing. According to its most enthusiastic backers, COBOL was as easy to understand as English, so that analysts could write computer code directly and managers could read it to verify its accuracy. The mystery would be stripped from computer programming and the narrowly specialized business application programmer would turn out to have been a transitional role. Needless to say, this did not happen – though COBOL did eventually serve as the standard language of data processing from the late-1960s to the early-1990s. The story of COBOL therefore provides an important example of how a technology expected, by some, to fundamentally transform the social structure of data processing and shift the balance of power between managers and specialists was instead assimilated into an almost unchanged social system. (As we shall see, the same pattern was repeated many times over subsequent decades).

Almost all the applications programs of the 1950s were written in some variant of assembly language. The instructions that the programmer wrote were, subject to some automatic translation of notation, the same instructions that the computer would run. Administrative computing was slower than scientific computing to adopt the use of compilers, and in particular to adopt standardized high level languages. The first high level language compiler to receive widespread usage was developed by John Backus of IBM. Work on FORTRAN (FORmular

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TRANSlator) began in 1954 to accompany IBM's forthcoming 704 computer. Its construction took longer and needed more programmers than originally expected, but on its release in 1957 users of the large, scientifically oriented IBM 704 and its successor the 709 rapidly adopted it. New and improved versions of FORTRAN followed, and the language remained the main choice of scientific and engineering users into the 1980s. FORTAN compilers were produced for smaller machines, and the language was rapidly adopted by other computer manufacturers. There is no need to dwell on the story of FORTRAN here. Its history has been well documented, and it was never widely used administrative purposes.[379]

It is startling, however, to realize the extent to which FORTRAN and other systems programs supplied by computer manufacturers like IBM were often heavily modified by computer users. As Fred Gruenberger of RAND lamented in 1962, "From time to time FORTRAN gets to be a little bit frozen. A new tape comes out from IBM; we all get a copy of the tape and we all have the same language for about five minutes. Then everyone goes off in different directions again. It's no longer common in any sense except that a certain amount of training can be transferred from person to person. But our FORTRAN codes can't be run anywhere else."[380]

FORTRAN allowed the direct expression and evaluation of mathematical expressions – removing from the programmer the need to apply rules of mathematical precedence, to carefully reorder operations, to worry about the storage of intermediate results, or to devise subroutines to calculate mathematical functions (such as trigometic operations) that were not directly supported

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[379] For first-hand accounts of early FORTRAN use, see Anonymous, "FORTRAN Comes to Westinghouse-Bettis, 1957", Annals of the History of Computing 1, no. 1 (July 1979):72-74, John Backus, "The History of Fortran I, II, and III", IEEE Annals of the History of Computing 20, no. 4 (October 1998):68-78, Herbert S Bright, "Early FORTRAN User Experience", Annals of the History of Computing 6, no. 1 (January-March 1984):28-30 and other articles in the same issue. The classic Fortran manual is Daniel D. McCracken, A guide to FORTRAN programming (New York,: Wiley, 1961).

[380] Anonymous, "The RAND Symposium: 1962. Part One - On Programming Languages", Datamation 8, no. 11 (October 1962):25-32

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by the hardware of the computer. This greatly reduced the time needed for a specialist programmer to turn a mathematical algorithm into a program, and it made it possible for technically minded but non-computer specialist scientists and engineers to learn enough programming to tackle some of their own problems. The success of FORTRAN sparked a flurry of interest in the production of a similar system for business, and planted the somewhat misleading idea that it might be possible to make the transition from a manager's statement of business requirements to an administrative program as rapid and direct as the transition from an engineer's mathematical equations to a computational program.

But FORTRAN, like earlier interpreters such as Speedcoder, represented an approach far more applicable to the laboratory than to the office – a fact that historians have rarely acknowledged. There were several main reasons for this. Firstly, the code produced by compilation was likely to be larger and take longer to execute than code produced manually. While many scientific and engineering calculations had to be performed only a few times, most administrative jobs would be run again and again. Each time the job was run, the amount of precious computer time lost to inefficiency was magnified – and in those days, many jobs of practical size took hours to run. The time saved in development, in contrast, was the same whether the program was run once or a thousand times. Even FORTRAN turned out to exact a substantial price in terms of performance and size of the programs produced, leading at least one expert user to conclude that it was "quite unsatisfactory" for, "users who are experienced coders with really big problems, in which machine storage and machine time must be considered seriously."[381]

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[381] John M Blatt, "Comments from a FORTRAN User", Communications of the ACM 3, no. 9 (1960):501-05. Recent commentators such as Ensmenger, "From Black Art to Industrial Discipline", 58-65 and Lohr, Go To, 11-34 have tended to accept Backus' own assertion that Fortran delivered code as efficient and compact as that produced by an expert human coder. While not all its users appear to have believed this assertion, it is true that the FORTRAN were far more effective than any other compiler

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Secondly, many scientific installations were run on an "open shop" basis. As picked up by the computing community, this term meant that programming was not the exclusive domain of a single centralized computer group. It usually meant that programming was done by the non-specialist scientists and engineers for whom it was being undertaken. In some technical groups, operation too was in the hands of non-specialists as scientists signed up for a time slot on the computer in much the same way they would for any other expensive and bulky piece of laboratory equipment. The compiler could provide instruction sets that were more convenient for mathematical work and easier to learn. In contrast, few accountants and managers were inclined to write their own programs, and even if they had been, their needs were less mathematical and so harder to assist with the compiler techniques of the 1950s. Because almost all administrative programs were written by full-time programmers, it followed that the speed with which a mathematically inclined novice could become productive was a less compelling factor for administrative programmers.[382]

Thirdly, the technical and human resources available at scientific installations were different from those available at business installations. On the technical side, compilers needed powerful computers to run well, and business installations of the 1950s were disproportionately likely to be using a more modest computer such at the 650 rather than a larger, 700 series machine. On the human side, we must remember that many of the compilers and assemblers in use during the 1950s were either created or heavily modified by the companies using them. They

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designers of the era in optimizing the efficiency of the output code, and that for most mathematical applications the tradeoff was well worth making.

[382] A survey conducted by the System Development Corporation in 1962 included an investigation of the then-burning question of open-shop programming. The survey included only 30 firms, most of them using large computers such as the IBM 7090 and split roughly equally between administrative and technical installations. It found that 39 percent of the technical computing installations had adopted open shop programming, but that it was not practiced in any of the administrative data processing centers. This definition of "open shop" included the use of full-time programmers outside the central computing organization, as well as non-specialist programmers. Lawson, "A Survey of Computer Facility Management".

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were exchanged from company to company through user groups like SHARE. Writing a compiler was a difficult and highly abstract programming task. It demanded a certain level of comfort with systems of abstract notation and symbolic transformation that was more likely to be found in someone with a scientific background than a punched card operator or accountant who had been sent on a training course to become a business programmer. Indeed, the design of compilers and programming languages was a central concern around which computer science began to establish itself as a theoretical discipline.

In 1960, however, a standard high-level language for business was announced, just in time for the arrival of the second generation machines. The COmmon Business Oriented Language, or COBOL, was designed by a computer industry group known as CODASYL. This body represented computer manufacturers and large corporate and military computer users. COBOL was the first standardized language for administrative computer programmer. Agreement on COBOL led to the almost immediate abandonment of other proprietary high-level programming languages for general data processing purposes, such as Univac's pioneering FLOWMATIC and IBM's promising COMTRAN.[383]

As a high level language, COBOL differed greatly from assembler. One of its great advantages was that a program written in COBOL could theoretically be complied to run on any other computer with a COBOL compiler. This characteristic was particular attractive to users wishing to share programs between multiple computer centers using different machines. This was particularly appealing to the Department of Defense, one of the original sponsors of the standardization effort. Assembly language, in contrast, was at this point tied quite specifically to individual computers, allowing transfer of programs only between very closely related models. In

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[383] For the recollections of the COBOL pioneers, see Virginia C. Walker, "COBOL - A Monument to Cooperation", Annals of the History of Computing 2, no. 1 (January 1980):79-83 and Jean E. Sammet, "Brief Summary of the Early History of COBOL", Annals of the History of Computing 7, no. 4 (October-December 1985):288-303.

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1959, when efforts to design the language started, the DOD already had 225 computers in use for administrative purposes.[384]

COBOL was not a single product but a standard – a set of rules that a compiler had to comply with in order to correctly translate any given COBOL program. Translation from COBOL to executable instructions was a complex process, making the construction of a COBOL compiler one of the most difficult tasks yet undertaken by many computer manufacturers. But during the first few years of the 1960s, every major manufacturer of business computers rushed to provide compilers. This was due in part to the prodding of the DOD, which within a year of the completion of the COBOL standard had distributed 16,000 copies of an elaborate procedures manual giving guidelines for the functioning of a COBOL compiler. Its policy that COBOL should be the language for all administrative projects unless a case could be made to the contrary was a considerable incentive to computer manufacturers to hurry the development of their compilers. In addition, anything that made it easier for users to transfer their existing programs to a new computer was likely to be good news for the smaller computer firms attempting to erode IBM's market dominance, giving these companies a further incentive to support COBOL.[385]

COBOL stirred up the passions of computer users during the early 1960s, as testified to by the transcripts of discussion at Fred Gruenberger's RAND Symposium meeting of 1962. (The symposia were an annual series of informal, invitation only meetings between some of the most prominent computer experts of the day). By this point, a backlash against COBOL was in full swing. RAND computer expert Robert L. Patrick, believed that, "the requiring of COBOL in its present state of development could be a hell of a big mistake." Ascher Opler, of the ACM and the

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[384] Charles A. Phillips, Joseph F. Cunningham, and John L. Jones, "Recollections on the Early Days of COBOL and CODASYL", Annals of the History of Computing 7, no. 4 (October-December 1985).

[385] For the role of a common language in facilitating shifts between computer suppliers see Dan McCracken's comments in Anonymous, "The RAND Symposium: 1962. Part One - On Programming Languages".

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Computer Usage Company, argued that any standardization was premature and would tie users to an inefficient, overly generalized language just as new and more promising techniques were appearing. Even its "commonness" was disputed. Barry Gordon of IBM suggested that, "the name is the only thing that is standard" about COBOL as implemented. That same year, the manager of a major General Electric computer installation wrote in Datamation that COBOL was, "considerably harder to use effectively than simpler languages," and accused it of being an exercise in complexity for its own sake. As he put it, "when slow compilers, producing inefficient object programs come out a year or two late, the user begins to suspect that he would have been better off without all the frills."[386]

Others defended the language as a significant, if incomplete, step toward some important goals. Howard Bromberg, one of its designers, was in charge of compiler development for RCA. According to Bromberg, the debate, though full of "passion, vehemence and gusto," tended to focus more on the abstract desirability of COBOL as a universal language than its practical utility. For example, while admitting that it was, "almost certainly not the case that a program written in COBOL for computer X can be compiled by computer Y without alteration," Bromberg still argued that COBOL served to compartmentalize the machine specific aspects of the program, making translation a much easier task. [387]

The other major advantage claimed for COBOL was its similarity to the English language. Unlike the purely numerical format of absolute octal, the cryptic RETs and NOPs of symbolic assembler, or the elegant algebraic formulations favored by scientific language

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[386] For the comments by Gordon see Anonymous, "The RAND Symposium: 1962. Part Two- On Programming Languages", Datamation 8, no. 11 (November 1962):23-30, 23-24; for Patrick's see Anonymous, "The RAND Symposium: 1962. Part One - On Programming Languages", page 28. The GE manager was Harry N. Cantrell, "Where are Compiler Languages Going?" Datamation 8, no. 7 (August 1962):25-28.

[387] Howard Bromberg, "What COBOL Isn't: A Temperate Evaluation for Implementation", Datamation 7, no. 9 (September 1961):27-29. For the comments by Opler see Anonymous, "The RAND Symposium: 1962. Part Two- On Programming Languages", 23-24.

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developers, COBOL was written with an emphasis on comprehensibility rather than terseness. Every instruction in COBOL was a real English word, and its nouns and verbs fitted together to make something like a sentence – such as "READ CHARGE-ACCOUNT-FILE IN AT END MOVE "YES" TO WS-END-OF-FILE-SWITCH" or "MULTIPLY OLD-BALANCE BY INTEREST-RATE GIVING NEW-BALANCE." Mathematical notation was reassuringly absent.

Of course, this similarity with human language was only skin deep – a thin wrapping of lexical familiarity around fundamentally alien syntactic and semantic worlds. Claims were sometimes made that with the right language, anyone who could write in English could program, entirely obviating the need for application programmers. In 1958, for example, Robert Bosak of SDC reported on the progress of the firm's work with compilers and suggested that the, "ultimate goal is to remove the programmer entirely from the process of writing operational programs. In effect, the manager would write and modify his own programs." While such hopes were sometimes pinned on COBOL, the idea does not seem to have been taken seriously by anyone actually involved with its development, or with first-hand experience of administrative programming.[388]

On the other hand, the corresponding claim that someone who knew English could read a program through and get some idea of what it did – allowing managers and customers to inspect the programs that were written for them – was more intuitively plausible. While only a tiny subset of English was in COBOL (making it hard to write), all COBOL was theoretically in English (which should make it easy to read). One of the language's most active promoters was Stanley M. Naftaly, who went on to organize a popular "COBOL Seminar" for members of the Data

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[388] Robert Bosak, "Implications of Computer Programming Research for Management Controls", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).

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Processing Management Association (DPMA) in 1965 and to serve as Chair of a U.S. Standards Institute group working on a standard for the language. In 1963, he wrote that, "COBOL can be taught readily, on a communications rather than a programming level, to customer areas within the company. Twenty hours is normally more than enough for this instruction."[389]

Even this more modest claim did not hold up. As a critic observed, "[t]hree lines of COBOL are, of course, easier for the layman to read than would be an equivalent formulation in [a scientific programming language]. However, ten pages of COBOL are no more readily understandable to him than they would be if they were written in Urdu."[390] This verbosity was the source of much disdain for the language (although, as it was stripped out during translation to machine language, it should have made little real difference to the quality of the code produced). But criticism of the "English narrative form" of COBOL was mixed with the more substantive criticism that its loosely defined syntax included a number of formulations that were needlessly hard to translate, potentially ambiguous, or both. By making apparent naturalness in English a design criteria, the creators of the language may have compromised its efficiency and precision. Programming textbook writer Daniel D. McCracken pointed out in this context that, "It is time a fundamental fact was accepted: production programming is done by programmers, not by stock clerks or vice presidents. This axiom, if universally accepted, could have a profound influence on the publicity for new languages, and, in the usefulness of time, might even influence their design."[391] (Slowness to recognize this represented the unwillingness of general managers to

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[389] Stanley M. Naftaly, "Correcting Obfustications By Ordained Linguists", Datamation 9, no. 5 (May 1963):24-28. In what may well have been a jibe at the Rand Symposium group, he observed that, "One of the newest parlor games seems to consist of sitting around in a circle (inner of course) and debunking COBOL... My intent is to break the spell of 'I've never used it, but I have a feeling that it won't work' syndrome...".

[390] Frederick Kirch, "The Computer Language Myth", Data and Control 1(July 1963):28-30.

[391] Daniel D. McCracken, "Source Program Efficiency", Datamation 9, no. 2 (Februrary 1963):31-33, page 33.

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realize, and the reluctance of computer manufacturers to admit, that ever greater swathes of corporate administration were, and would remain, utterly dependent of the work of technical specialists.)

COBOL was supposed to be little more than a stop-gap. Its specification had been rushed through by a "Short Range" committee, while separate "intermediate" and "long range" committees were chartered to take their time in producing more satisfactory languages. (The efforts of the other committees ultimately failed to bear fruit.) A 1963 report noted that, "Enthusiastic advocacy of COBOL as a statement-level programming language appropriate for business data processing is becoming rare. The most favorable comment heard is that, while it is not perhaps a very good language, it is a step in the right direction." After all, as Naftaly noted the same year, "COBOL is an evolutionary language. Nobody expects it to be around in ten years time."[392]

Enough, then, of the debates that seemed so important at the time. COBOL did not make programming appreciably more accessible to managers, and it did make programs somewhat easier to transfer between different models of computer. But what did the language mean for the work of the data processing department? Despite the widespread availability of compilers, and considerable coverage in the computing and general business press, adoption of COBOL was quite slow. Few other computer using organizations had quite the same profusion of different computer models as the Department of Defense, and so the relative ease with which COBOL programs could be moved between different computer families did not have the same appeal to them. By 1963, however, a number of huge companies such as U.S. Steel, Westinghouse, and

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[392] The first quotation is from Kirch, "The Computer Language Myth", the second from Naftaly, "Correcting Obfustications By Ordained Linguists". See also Anonymous, Sammet, "Brief Summary of the Early History of COBOL".

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Standard Oil of New Jersey had standardized on COBOL for their administrative application programming.

EDP Analyzer reported the experiences of Naftaly's employer Space Technology Laboratories, one of the first companies to use the COBOL compiler for RCA's large 501 computer. Having just set up its computer installation, the firm was keen to have it performing useful work as soon as possible. It found that the new language did indeed allow inexperienced programmers to produce greater number of programs in a short time. The group converted a large number of tabulating jobs to its computer on an aggressive schedule, producing 230 programs (each one of 700 to 7,800 machine instructions) with a staff of 12 in one year. Like many prominent data processing figures, Naftaly did not stay around long after the accomplishments he boasted of in print. He went on from this to a job at Lockheed, and within two years had founded his own consulting company.[393]

The first COBOL compilers were spectacularly slow (sometimes taking more than an hour to process a single program) and could only run on the newest and largest computers. [394]

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[393] Richard G. Canning, "Time to Switch to COBOL?" EDP Analyzer 1, no. 11 (December 1963).

[394] Recall that programmers wrote out programs longhand onto coding sheets. Their instructions were transcribed onto punched cards by keypunch operators. These punched cards were submitted to the computer room, together with input data. If an assembler was being used (almost universal by the end of the 1950s) then the operator loaded the assembler code into the computer and followed it with the "source code" of the program to be assembled. The computer then output (onto tape or cards) the "object code" – a version of the program ready to be executed by the computer. This object code was fed back into the computer, together with the test data. Once the program was fully debugged, the object code could be run again and again by the operators, with no need to refer to the source code or use the assembler again. Use of the compiler added another step. The programmer did not write source code in the language required by the assembler, but in COBOL. The COBOL compiler translated this source code into assembly language, which was then run through the assembler as usual. Space Technology Laboratories found that their RCA compiler took between forty minutes and two hours to compile a single program! Each program needed to be compiled many times during development – consuming a lot of valuable computer time.

COBOL compilation ran even more slowly on the IBM 1401 and 1410 models, the workhorses of data processing during the early 1960s. Indeed, lack of memory ruled out the use of sophisticated programming tools altogether on many 1401 machines. In its minimum configuration, the 1401 had only 1,200 characters of memory and relied exclusively on punched cards to store programs and data – limiting its programmers to a basic assembler called SPS or Symbolic Programming System. A more expensive system with 4,000 character memory and four tape drives could run Autocoder, a more powerful assembler with better support for debugging and subroutines. While this intermediate configuration also supported a

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Programs produced by the COBOL compiler were also likely to be less efficient than those crafted by hand, or even those produced by less ambitious tools such as IBM's Autocoder. This amplified the problem with the use of earlier high level languages – the compiled program continued to waste valuable computer time every time it was run.[395]

Did COBOL really lower skill requirements for programmers? Its supporters had few doubts. According to Naftaly, the language would remove the need for specialized programmers altogether, allowing analysts to turn their high level flowcharts directly into COBOL statements.

> Use of experienced analysts as programmers is encouraged by the format of the language and its notation. This approach eliminates the communications problem inherent in passing a program from the analyst to the programmer and permits one man to nurture a job from inception, through analysis of existing procedures, design of the proposed system, selling of the system to the customer (who works closely with the programmer-analyst), flow charting, coding, compiling, debugging and production documentation.[396]

However, if efficiency was of the slightest concern then even this could be hard to realize. Firstly, the COBOL language was more complex than the instructions used by the computer itself – including more that 250 command words and many more options on how to arrange them. Although the language might make it easier for an experienced programmer to translate business requirements into complex programs, its syntax and principles were no easier to

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stripped down version of COBOL, only the relatively few 1401s equipped with the maximum 16,000 character memory were able to run the full version of COBOL. On 1401 programming systems see Bashe et al., IBM's Early Computers, 363-67. For first hand accounts of 1401 programming, see Tom Van Vleck, 1401s I Have Known (14 Jan 1997 1993 [cited 06 June 2001]), Sinasohn, "Programming the 1401: An Interview with Leo Damarodas", Roger Louis Sinasohn, "Programming the 1401: An Interview with Leo Damarodas, part II", The Analytical Engine 1, no. 2 (1993):26-32. In reality, not all compilers produce assembly language programs. Some early compilers translated directly to executable code. One of the most successful early compilers, a version of FORTRAN for the IBM 1401 called GOTRAN, used a novel scheme by which the program to be compiled was held in memory and converted gradually to executable code.

[395] When one company tried writing the same program in both Autocoder and in Cobol on an IBM 1410 computer, it found that the Cobol version took twice the time to run and used almost 50 percent more memory. Comparisons with efficiently written assembler programs were still less flattering. However, the language's defenders suggested that the such comparisons were misleading – because it was precisely the shortage of capable programmers able to produce efficient code in other languages that made COBOL attractive.

[396] Naftaly, "Correcting Obfustications By Ordained Linguists".

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grasp than those of assembler. FORTRAN's popularity with non-specialists rested on the fact that scientists and engineers already understood the algebraic logic it used. Because there was no existing and widely understood formal language in which analysts and business men were conversant, it was impossible for the designers of COBOL to produce a language with similar appeal.

Secondly, while the compiler could be used by skilled programmers to generate good programs more rapidly, in practice a good knowledge of COBOL could not fully substitute for knowledge of the underlying instruction set of the computer. While the language specification included some very complex and powerful commands, these were liable to prove so inefficient that a successful programmer would need to understand which commands might execute efficiently using their particular computer and compiler. As manufacturers were slow to document the details of translation, this required a great deal of trial and error coupled with manual examination of the code produced by the compiler.

Thirdly, while a compiler could report syntax errors from compilation, any debugging information produced during an unsuccessful run of a program would refer to the instructions actually being executed by the machine, not to the COBOL they were translated from. Because modifying the COBOL program to try a possible fix would involve another hour of compilation, in addition to the time spent waiting for a turn on the computer, most debugging was performed by directly modifying the already compiled code. This resulted in the source code and the program actually being run getting further and further out of synchronization as more fixes were made.[397]

The reality of COBOL was therefore of a set of tradeoffs. As EDP Analyzer reported, "We concluded that large corporation that have standardized on COBOL have done so primarily

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[397] Canning, "Time to Switch to COBOL?" 7-9, Cantrell, "Where are Compiler Languages Going?" page 27.

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because it provides a good communication method between installations." For companies without a need to exchange programs between computers, or to upgrade from one computer to another, its advantages were less straightforward. It made skilled programmers more productive, by swapping machine time (both when programs were compiled and whenever they were run) for the additional programmer time that would otherwise be consumed by the development of programs is assembly language. At the same time, its long compile times and loss of control over the final code might frustrate them. Indeed, the report mentioned that, "many experienced programmers are resisting it strenuously." It did, however, suggest that COBOL would indeed make it somewhat easier for analysts to write programs, and that COBOL programs were indeed somewhat easier for humans to read – making it easier to transfer work between programmers and thus leaving a company somewhat less vulnerable to programmer turnover.[398]

The shift to COBOL was thus a gradual and incomplete one for many companies. The new language was not a panacea, but an addition to the existing range of system software that allowed a different set of tradeoffs to be made between flexibility, speed of program development, program efficiency, amount of computer time tied up by development, size and training of programming staff, and so on. As late as 1967, Richard F. Clippinger could claim in a review of current trends in computing that, "[o]nly 5 percent of all commercial work is currently programmed in COBOL."[399] Clippinger presented no evidence in support of this observation, but he was at that point employed by computer manufacturer Honeywell, and had been managing computer installations since the 1940s, so his estimate should not be dismissed lightly. A data processing textbook published in 1971 contained the claim that, "for the career-minded college

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[398] Canning, "Time to Switch to COBOL?". By the late 1960s, COBOL's place was secure and efforts shifted towards attempts to standardize it. See Howard Bromberg, "The COBOL Conclusion: End of the Beginning", Datamation 13, no. 4 (March 1967):45-50.

[399] R F Clippinger, "Systems Implications of Hardware Trends", Systems & Procedures Journal 18, no. 3 (May-June 1967):10-17.

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student who looks to computer programming as an occupation in the field of data processing, the most valuable programming language to study is System/360 Assembly Language."[400]

In addition, many companies demonstrated an understandable reluctance to throw away functional programs just because a new programming language had come along. New machines were invariably accompanied by translator or emulator programs, and often hardware features, designed to make it easy to transfer existing programs – and so assembler and Autocoder programs were sometimes updated and debugged for decades to come.

Meanwhile, one of the most important programming systems of the 1960s occurred at the other end of the computer language spectrum from the complex and sprawling COBOL. With its new 1401 computer, the successor to the humble 650 and the workhorse of second-generation data processing, IBM supplied a new programming system called Report Program Generator (RPG). As we have seen, some of the things that were easy to accomplish on the specialized hardware of punched card machines, such as sorting and tabulating, required elaborate programming to accomplish on a computer. As the first computer marketed as a viable alternative to conventional punched card technology for mainstream punched card installations, the 1401 had to be easy to use for these simple tasks. RPG was thus designed to translate a simple programming notation for input formats, output formats and simple calculations – the kinds of task formerly handled by wiring the control boards of punched card machines. RPG was an

[400] Richard W. Brightman, Bernard J. Luskin, and Theodore Tilton, Data Processing for Decision-Making: An Introduction to Third Generation Information Systems (New York: The Macmillan Company, 1971), vi.

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enormous success, and was soon offered for other machines including the larger 7070 computer.[401]

## On-Line Systems and Random-Access Storage

Through the whole of the 1950s and 1960s, the vast majority of corporate data processing applications were either run manually (one at a time) or queued serially using a simple operating system to allow the scheduling of a batch of jobs. As we have seen, almost all data to be processed by the computer was first entered onto punched cards by specialist key-punch operators. The only people to issue instructions to the computer were the specialist computer operators who manned the machine room. The computer was used in a manner similar to that of a punched card machine, and its effectiveness was sometimes measured by the rate at which jobs could be pushed through it, or the number of hours each month it spent running useful work.

While this was the dominant way of using a computer, it was far from the only technologically feasible one. Indeed, some of the very first computers had worked differently – in a way that was usually called "real-time" (and which we would now refer to as interactive). When used as part of a real-time system, the computer would respond directly and immediately to signals it received, or requests that were fed into it. Such systems were often also referred to as being "on-line", giving the phrase "real-time, on-line." This meant that the computer was connected to some set of special sensors or input devices, allowing it to respond directly to signals from the environment.

The first real-time computer, MIT's Whirlwind, was used by IBM as the technological prototype for its special AN-FSQ-7 computer, the heart of the famous SAGE air-defense network

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[401] Because of its apparently mundane nature, RPG has received a lot less historical attention than its usage would justify. The information here is drawn primarily from Campbell-Kelly and Aspray, Computer, 133 and Bashe et al., IBM's Early Computers, 479-80.

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deployed during the 1960s. Whirlwind was a long and, by the standards of its day, tremendously expensive project that culminated in 1953 with the production of the world's fastest and most reliable computer. The SAGE network used twenty-three computer installations spread across the USA to gather together information from hundreds of radar stations and other input devices, updating it in "real-time" as enemy bombers flooded into American airspace and fighters were scrambled to intercept them. Information from this computer model was displayed on screens, and system operators used keyboards and light pens (conceptually similar to the mouse) to issue commands and request clarification. SAGE was the most important single project in the history of computing. Its technological contributions include the first uses of computer networking, interactive computer graphics, real-time operation and techniques of high reliability.[402]

This was not the only profound impact of the new military systems. Among a host of other technical firsts, SAGE was the first project to directly connect computers to each other and to external sensors. The computers responded in "real time," updating their memories and displays as information came in. Despite its enormous cost, and its unfortunate strategic irrelevance, SAGE was cited as a model of technological possibility by dozens of corporate systems men. Its influence on the technical community was even more direct. Construction of SAGE also demanded a programming effort on an unprecedented scale. SDC (the System Development Corporation) was spun-off from the RAND Corporation in order to tackle this task. By 1959, more than 800 programmers were working on the project. SAGE exposed a generation of data processing personnel to the potentials and techniques of large scale, real-time computer

[402] For a brief overview of SAGE, see Campbell-Kelly and Aspray, Computer, 165-69. On its political and cultural significance see Paul Edwards, The Closed World: Computers and the Politics of Discourse in Cold War America (Cambridge, MA: MIT Press, 1996).

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projects.[403] By 1960 around 4,000 programmers had already left System Development Corp, making it by far the biggest single training ground for advanced systems programmers and real-time application specialists during the 1950s.[404]

Everything about SAGE, however, was essentially a custom development – from the SAGE computers themselves, through the display screens and light pens used to operate them, to the programming tools and project management methodologies used to program them. The enormous scale of the system gave its designers the latitude to fit programs and hardware together to accomplish a particular task. This was an enormously costly approach, but the only one that could deliver a system so far beyond the general state of the art. While no corporation could contemplate an investment on anything like the scale necessary to produce SAGE, as an apparent proof of technological feasibility and a source of new technologies and approaches it was profoundly influential. In 1961, for example, the director of Systems Planning at Raytheon invoked SAGE to suggest that, "the validity of the real-time concept has been amply demonstrated in scientific and military applications"[405]

Early administrative real-time systems followed the same pattern, although on a much smaller scale. Early discussion of "electronics for the office" implicitly included real-time control systems as well as batch-oriented data processing systems. Indeed, the first specific system to be

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[403] The stream of personnel out of SDC was exacerbated by the pay scales enforced on it as a non-profit Air Force contractor – the firm lost about 20 percent of its employees each year, and by 1960 its growing legion of former employees already outnumbered its current employees. On the programming of SAGE see Rowan, "The Recruiting and Training of Programmers" and, for a secondary account, Claude Baum, The System Builders: The Story of SDC (Santa Monica: System Development Corporation, 1981).

[404] Baum, The System Builders: The Story of SDC. For a contemporary account of programmer recruitment for SAGE, see Rowan, "The Recruiting and Training of Programmers".

[405] Norman J. Ream, "Advances in Data Communications (Transmission and Reception)", in Advances in EDP and Information Systems: AMA Management Report Number 62, ed. Administrative Services Division American Management Association (New York: American Management Association, 1961), 45. SAGE provided bragging rights to companies such as SDC and Burroughs that were involved in its construction. See, for example, Mary Hawes, "Burroughs' Future in Electronics" (paper presented at the Data Processing, St Louis, Missouri, 1959) and Donald G. Malcolm and Alan J. Rowe, eds., Management Control Systems (New York: John Wiley & Sons, 1960).

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profiled as "electronic data processing" in Systems and Procedures Quarterly was an integrated electronic system for toll recording and accounting built for the Port Authorities of New York and New Jersey. Like other such systems, this demanded custom designed hardware, in this case including the ten key keyboard used by toll collectors to enter information. Companies undertaking feasibility studies during the mid-1950s were advised to consider carefully the possibilities of such "special purpose" hardware. Not only could it accomplish some things, most particularly real-time operation, not yet possible with general-purpose administrative computers, but it also held out the possibility of reduced hardware costs through the elimination of computer circuits not required for a particular job.[406]

The Harvard Business School team, whose investigation of computer acquisition was discussed earlier, published a book-length study of a shoe company's purchase, during the mid-1950s, of a small computer intended for just such an application. The company had invited detailed proposals from manufacturers for the hardware needed to implement an inventory control system. This involved a combination of a special-purpose computer and an array of conventional punched card machines. The punched card machines were used for all analysis purposes – output from the computer was actually converted from paper tape to punched cards and then used as the basis for reports and order processing. The computer was employed for its ability to handle the simplest part of the job very fast. It used a small magnetic drum to store information on inventory levels of different products and currently unfulfilled sales orders. A few simple programs to update and query this information were "wired into" the computer. No programming was undertaken by shoe company personnel, who instead turned a switch to select the program they

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[406] McCall, "Electronic Data Processing". Odd as this idea now seems, we must recall that the manufacturers of earlier office equipment such as bookkeeping machines produced a vast number of closely related models, each one minutely adjusted to a particular task, and sometimes to a particular customer. It was not immediately apparent that there was anything inherent in electronic technology to change this situation. (It is also worth pointing out that, even today, most computers are special purpose electronic controllers embedded in things like cars, compact disk players and washing machines).

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required. The advantage of the computer was its instant accessibility: it was supplied with a "keyset" (what would later be called a terminal) including ten numeric keys, a cancel button, a space button, one switch, and three lights. The clerk assigned this job could enter product numbers and quantities, flick the switch to enter the order, and see immediately from the lights whether stocks were sufficient to cover the order. An additional "visual inventory indicator" showed available stocks of specified products, while a "Flexowriter" (essentially a typewriter that punched onto paper tape) was used for other input purposes.[407]

The "Magnetronic Reservisor," one of the earliest such systems, was developed to perform a similar task for airline reservations clerks. This specially designed computer went into operation in 1952, and used duplicate magnetic drums to reliably store seat availability information for more than one thousand flights. Operators using specially constructed terminals answered telephone queries from reservation agents. The firm behind the system, Teleregister, had been founded during the 1920s to produce display boards for the stock exchange, but moved quickly into this new market for the automatic presentation of information. Other early systems were produced by American Totalisator, which used experience in racing display systems to build things like cash registers that automatically transmitted sales data to a control unit in central office. Such systems spread slowly though the 1950s and the early 1960s. For example, in 1962, Howard Savings (a six branch bank in Newark) could claim to have used Teleregister to construct the "first on-line banking system" in the country – using five magnetic drums and two duplicate computers to store balance and recent transaction information on 270,000 accounts. Although by this point the computers were physically smaller, more powerful and more reliable, and the drums

[407] Wallace, Management Influence on the Design of Data Processing Systems, 129-37.

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could store more information, the fundamentals of real-time administrative computing did not change much during its first decade.[408]

These system illustrates the constraints faced by companies eager to build real-time systems during the 1950s. Crucial parts of the system had to be custom designed. Another problem was the lack of flexibility in the resulting hardware and programs. For the shoe company, for example, any significant change to its paperwork procedures would demand the replacement of its computer. We also see that real-time operation demanded some form of random-access storage, so that the computer could retrieve the desired information immediately. But perhaps the most important characteristic was that on-line operation required the commitment of an entire computer to a single task. The only way that a clerk could expect to receive an immediate response to an inventory level request was for the computer on the other end to be running the appropriate program and to be monitoring the keys and waiting for one to be pushed. It would hardly be practical for operators to rush to insert the appropriate punched cards or tapes into the machine. As a result, the use of custom designed hardware – the other hallmark of real-time projects in the 1950s – was not as restrictive as it might appear. The computer would not be able to do anything else, anyway.

Random-access storage was not entirely unknown in the production machines of the 1950s. Only one standard, mass-produced and successful data processing system of the 1950s provided any kind of interactive capability, though it was at the other end of the computing spectrum from the mighty processors of SAGE and SABRE. The RAMAC 305 (Random Access Method of ACCounting) had been offered by IBM since 1957. The RAMAC provided five million characters of storage (roughly equivalent to three standard floppy disks of the late-1990s)

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[408] Anonymous, "Ring Up a Sales Report", Business Automation, November 1962, William Carr, "No Waiting at Howard Savings", Business Automation 7, no. 3 (March 1962):30-32, Jon Eklund, "The Reservisor Automated Airline Reservation System: Combining Communications and Computing", IEEE Annals of the History of Computing 16, no. 1 (Spring 1994):62-69.

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– spread over fifty discs spun at 1,200 revolutions per minute. This was the first time IBM offered disk storage.[409]

The RAMAC itself was a freestanding product, with simple programming capabilities and an old-fashioned control panel that was rewired to configure the machine. It could be integrated into existing punched card operations, and while it was not particularly fast, it could process an transactions about as quickly as its printer could produce the resulting output (1.5 seconds per query). Square D, of Milwaukee, used a prototype model to store stock levels for each item in a 24,000 inventory in its Industrial Controller division. Different decks of cards represented changes in desired stock levels and order quantities, as well as bills of materials to alert the system of new orders received. Another user of RAMAC technology, American Bosch, had switched to "continuous flow" accounting for its production and inventory control, in which transactions were posted as they arrived in the accounting office. Its operators could request special reports at any time by punching special codes onto a "trigger deck" of cards and feeding it into the system.[410]

RAMAC was real-time (if the term is interpreted broadly), but decidedly not on-line. Like the on-line systems it harnessed an entire computer, but unlike those systems it could perform more than one function, as long as all the data required came to less than its five million

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[409] The RAMAC has not received the historical attention it deserves. Not only did it remove the Achilles heel of sorting, but it opened the door to systems in which data from punched cards was inserted or retrieved from computerized storage as needed, rather than stored on tape and run daily, weekly, or monthly through the system. Its discs were much slower to retrieve information than the drums used for high-speed random access memory in the real-time systems of the 1950s (and with many larger computers in the 700 series, as well as the main memory device on the 650). But they stored a lot more information at a much lower cost. IBM offered the same technology for its larger computers as the 1405 Disc Storage Unit.

[410] Willard L Jerome and Loretta Hartford, "RAMAC at Work", Systems and Procedures 8, no. 4 (November 1957):30-38 and Anonymous, "New Accounting Concept Based on 'Assembly-line' Processing", Management and Business Automation, February 1961. Use of the RAMAC is also discussed in Robert H. Gregory, "Preparation for Logic -- An Orderly Approach to Automation", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960) and Anonymous, "Programming An Information Explosion", Business Automation 14, no. 5 (May 1967):47-50.

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character capacity. RAMAC was queried by feeding special trigger cards into it, not by flicking switches on a custom keyset. Although it could keep totals continually up to date, it still required all transactions to be punched onto cards. RAMAC's production run, around a thousand machines, was much larger than the number of special-purpose on-line administrative systems produced during the same 1957-1962 period.

By 1961, the new disc systems, from IBM, Telex and the specialist firm Bryant had moved far beyond the capabilities of the RAMAC.[411] This dramatically lowered the cost per character stored of random access storage, and increased the applicability of the technology beyond RAMAC's niche of accounting operations with a need for instant balances of accounts or stock levels. The new drives were still not as fast as the magnetic drums often used with large computers of the 1950s, but they stored far more data. Whereas drum storage had been used primarily for temporary storage of data and programs, disc storage could be used as a permanent repository for large data files. Consultants were soon predicting the acceptance of disks as a general-purpose replacement for tapes for all but the very largest collections of data. They also forecast explosive growth in the "real time" and "on-line" applications for which capacious and rapid random access storage was a prerequisite.[412]

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[411] The heads floated on a cushion of air created by the motion of the disk itself. As a result, these drives stored data at a higher density and span the discs faster. In addition, they provided a read/write "head" for each disc platter rather than requiring a single mechanism to move up and down between the different platters. IBM's first drive using this technology stored 28 million characters of data, and up to ten of them could be connected to a large computer at once. An improved model the next year quadrupled this capacity. On the early disc systems, see Edward Webster and Norman Statland, "Instant Data Processing", Business Automation 7, no. 6 (June 1962):34-36, 38, Norman Statland and John R. Hillegass, "Random Access Storage Devices", Datamation 9, no. 12 (December 1963):34-45 and Bashe et al., IBM's Early Computers, 300-10.

[412] At the other end of the spectrum, IBM introduced interchangeable disk packs holding 3 million characters each, and intended for use by smaller installations. These devices were often paired with the smaller computers of the 1400 series. One model, the 1410, was originally conceived as a replacement for the RAMAC. NCR pioneered a hybrid of card and magnetic tape technology as the cost effective means of providing random access – its CRAM system stored data on cards made of the same magnetic material as tapes. 5.5 million characters of information were spread over 256 of these cards, and in the space of a quarter of a second the device would drop a specified card into a drum and supply the requested

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Most of the new equipment installed during the 1960s was not used for real-time, on-line operation. Instead, disk drives typically served as a means of making the computer a more effective tools to tackle administrative and accounting operations. Random access was a boon to programmers of many kinds of application. As well as the rapid lookup of a particular piece of information it made it possible to shunt pieces of program and chunks of data in and out of the computer's memory as needed. Together with the larger memories of the newer computers it heralded a gradual shift away from the need for dozens of separate "runs" through master files to perform routine updates. But random access storage also demanded a whole new set of programming techniques, analysis methods and conventions.[413]

This provided one crucial part of the on-line puzzle – relatively large random access storage as a standard piece of equipment. But although the second generation hardware of the early 1960s required less modification to work on-line, development costs remained very high. The largest and best known of these systems, SABRE, supported reservations for American Airlines. It paired two of IBM's largest mainstream computers – the 7090 model – avoiding the need for specially designed computers. The system was still not cheap though. Its computers were

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information to the computer. IBM's interchangeable disk packs are discussed in C.M. Hester and G. V. Harris, "Interchangeable Random Access Discs: The IBM 1311", Datamation 9, no. 12 (December 1963):25-26 and Bashe et al., IBM's Early Computers, 312-13. For NCR's CRAM see Herbert L. Gross, "Card Random Access Memory: Interchangeable Decks in Random Sequential Systems", Datamation 9, no. 12 (December 1963):27-30. IBM storage products are also discussed in Emerson W Pugh, Memories That Shaped an Industry: Decision Leading to IBM System/360 (Cambridge, MA: MIT Press, 1984).

[413] For example, although a programmer could now retrieve the contents of any of the millions of storage locations on a disk, this was of little use if it was still necessary to comb through every one of those locations to find the record she was after. Some kind of index or table of contents was required – so that the program could first determine where the specific record was stored and then find the data. But nobody had experience producing such a system, and any method adopted would add substantially to the complexity of the program, the storage space needed on the disk and the work required to insert, delete or update particular records. New headaches arose when it was necessary to make a backup copy of the disc system, alter the format in which records were stored, or to change (expand, shrink, or move) portion of the disk system allocated to a particular program. McCracken devoted some consideration to the problems of random access programming in McCracken, Weiss, and Lee, Programming Business Computers. For its evolution see Robert H. Buegler, "Random Access File System Design", Datamation 9, no. 12 (December 1963):31-33 and Richard G. Canning, "New Views on Mass Storage", EDP Analyzer 4, no. 2 (February 1966).

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fitted with every option then available. The first full version relied on six of IBM's fastest drum units (an expensive niche product then used largely in military systems) and thirteen of its larger but slower 1301 disk units. The control units for operators were still specially built (at a cost of $19,000 each). In 1963 a typical 7090 configuration was worth about $2 million, whereas SABRE cost American $30 million and committed IBM to an undisclosed loss on its own contribution.[414]

More importantly, all this expensive – if largely standard – hardware was committed to SABRE and SABRE alone. Most computers still did only one thing at a time. Real-time operation demanded that the computer constantly monitor its attached terminals and other input devices, and be prepared to deal rapidly with whatever requests it received. (The provision of a hardware feature known as an "interrupt", found in large second generation computers, made this monitoring process much more efficient). Unlike batch operation, where a variety of different jobs were scheduled and run in succession, real-time operation demanded the commitment of an entire computer on a full-time basis. While such systems were not usually available around the clock, the night-shift was occupied with backups, the loading and unloading of data, report generation, compression, upgrades, and testing.[415]

Real-time programming work was enormously complex and, unlike the new hardware, continued to demand a great deal of custom design activity. Such systems were inherently more intricate and harder to program than the batch operations that dominated data processing practice. For projects like SABRE, the program logic itself still had to be written in assembly language, and closely integrated with specially written input/output and system control code (functions that

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[414] Duncan G. Copeland, Richard O. Mason, and James L. McKenney, "SABRE: The Development of Information-Based Competence and Execution of Information-Based Competition", IEEE Annals of the History of Computing 17, no. 3 (Fall 1995):30-57.

[415] On the programming of real-time systems in this period, and its relationship to hardware features, see W. L. Frank, W.H. Gardener, and G.L. Stock, "Programming On-Line Systems. Part Two: A Study of Hardware Features", Datamation 9, no. 6 (June 1963):28-32.

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were increasingly standardized in operating systems in mainstream data processing). The new languages and operating systems that were gradually simplifying the production of mainstream data processing systems were essentially useless for real-time systems. This combination of the inherent complexity of real-time control routines with the one-off nature of the task made the programming of SABRE into an epic struggle. American had to hire dozens of programmers and consultants, while IBM committed its own team to write the special purpose control system. The final program came to half a million lines of assembly language. At one point in development, each change made to the code for the main control routine took thirty hours of uninterrupted processing to reassemble, and it ran so slowly that substantial improvements and restructuring were required before the original programs could be used. Even so, United found its computer memory to be saturated after only 30 percent of the flights had been transferred to the new system – requiring an expensive doubling of its core memory capacity in 1963.[416]

This state of affairs was summarized by Robert V. Head, a veteran of SABRE, in his 1964 text Real-Time Business Systems. Such systems demanded hundreds of thousands of machine instructions and tens of millions of dollars of computer hardware. Their production was plagued with difficulties, because the project team was learning the new programming techniques required for real-time operation at the same time they were coming to grips with new hardware. In addition, operational support applications such as SABRE were much harder to test and plan than traditional batch based accounting applications, because temporary failure was far more serious and reservation clerks rather than computer operators determined the pace and makeup of

[416] For a thorough contemporary account of SABRE, see R. W. Parker, "The SABRE System", Datamation 11, no. 9 (September 1965):49-52. For a more recent and longer term secondary account, see Copeland, Mason, and McKenney, "SABRE: The Development of Information-Based Competence and Execution of Information-Based Competition".

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the input the system had to deal with. A minor computer system error could cause substantial financial losses.[417]

Knowing what we now do of the path of computer technology over subsequent decades, we may be inclined to laud such pioneering and "visionary" use of the computer as an example of strategic brilliance, in which an early adopter transformed its business through the infusion of cutting-edge technology. Indeed, as shown later, even before the system was finished it has established itself as a textbook example of the potential of corporate computing. If SABRE was in large part a technological advertisement on the part of IBM then it was a spectacularly successful one. As Head admitted a little later, during the early 1960s SABRE was one of those projects, like General Electric's installation of a Univac to do payroll a few years earlier, in which a firm's dedication to push the limits of technology led it to shoulder a much bigger challenge than it realized. "Though company PR men may deny it," wrote Head, "both vendor and company typically 'took a bath' in producing such new systems, in the sense that more resources had to be expended than originally envisioned, or more calendar time elapsed before completion, or both."[418]

Yet it is by no means clear that American Airlines knew what it was getting into, or that there were many other economic sectors in which the costs of such a system could be justified. As the backers of Priceline.com discovered more recently when the firm tried to expand from air travel to groceries, airline seats are essential unique commodities. They are expensive but utterly generic, and lose their value in a dramatic but entirely predictable manner if not filled. Any reservation system capable of filling a few extra seats on each plane could pay for itself easily.

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[417] Robert V. Head, Real-Time Business Systems (New York: Holt, Rinehart and Winston, Inc., 1964), 18-23. Similar sentiments are expressed by consultant Robert Patrick in Fred Gruenberger, RAND Symposium 6, 1963, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

[418] Robert V. Head, "Old Myths and New Realities", Datamation 13, no. 9 (September 1967):26-29.

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Despite this, the initial feasibility study for SABRE, hard as this is to believe, measured its potential savings on the basis of the wages of the 1,100 clerical workers it was expected to replace, rather than on any more general benefits to the airline's operations.[419]

To move beyond such confining niches, computer manufacturers would have to find a way to provide the capabilities of on-line, real-time systems in a cost-effective manner using standard hardware. Widespread adoption of such systems promised to substantially increase computer sales – as the placement of large volumes of data on-line demanded the deployment of large numbers of disk drives, powerful computers, expensive terminal units, and voluminous core memories.

## The Third Generation

Real-time technology retained its allure. Indeed, many of the technical advantages originally associated with second generation machines were soon being marketed as key features of the new, third-generation computers such as the IBM/360 series installed from 1965 onward. These computers promised to deliver the magic combination of large, random-access storage, standard hardware support for real-time operation, and an operating system including full support for multi-programming – allowing one general-purpose computer to run a mixture of real-time and batch jobs and so dramatically reducing the investments in hardware and programming needed to support a real-time application.

In practice, it is hard to distinguish between definitions offered for the second and third generations. It was not until the late-1960s that random access storage and high level languages truly achieved general usage in most data processing installations, by which time the second generation machines they initially accompanied were themselves obsolete. Many of the (often

[419] Copeland, Mason, and McKenney, "SABRE: The Development of Information-Based Competence and Execution of Information-Based Competition", page 35.

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unrealized) advantages previously claimed for second generation computers were transferred over to become hallmarks of the third generation models. Manufactures were eager to claim that their newest machines represented a third generation, and once a competitor was making that claim, nobody wanted to be the last one still marketing the second generation.[420]

It was, however, the IBM System /360 range, announced in 1964 and delivered gradually over the next few years, that had the most profound impact on the computer industry. Its dominance of the industry under threat from cheaper and faster competitors, IBM replaced its entire range of computers and peripheral equipment. In doing so it introduced the idea of a range of compatible machines sharing the same "architecture," so that programs and equipment could be switched between them. The concept of a family of compatible machines was not a new one – the 1400 series eventually included four machines of differing capacity and design. Neither was the idea of producing a replacement machine compatible with its predecessor. What made the 360 series novel was its scope: the simultaneous redesign of IBM's entire range of administrative and technical computer lines around a single instruction set and design philosophy.[421]

Despite initial delays in hardware production, and more fundamental problems with software support, the commercial success of the 360 series was rapid and spectacular. Faced with a full range of compatible machines, IBM's competitors were largely unable to mount an effective challenge for the mainstream data processing market. So successful did this concept

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[420] At least one contemporary author assigned the "third generation" tag to computers announced between 1959 and 1960. Sprague, "Automatic Management Reporting and On Line Real Time Systems". Many features promoted by IBM with its third generation machines originated with the groundbreaking Burroughs 5000, the first computer designed from scratch to exploit multiprogramming, operating systems, and high level languages. See Robert F Rosin, "Prologue: The Burroughs B 5000", Annals of the History of Computing 9, no. 1 (January 1987):6-7 and the other papers in this special issue.

[421] A great deal has been written about the development of the 360 series. The fullest account remains Emerson W. Pugh, Lyle R. Johnson, and John H. Palmer, IBM's 360 and Early 370 Systems (Cambridge, MA: MIT Press, 1991). An insightful summary of the architectural issues is given in Evans, "System/360: A Retrospective View". The 360 series is featured prominently in the standard histories of the computer, including Campbell-Kelly and Aspray, Computer, 137-47 and Ceruzzi, A History of Modern Computing, 144-54.

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ultimately prove that IBM itself was never able to replace the 360 architecture. All its future mainstream administrative mainframes were based on a gradual evolution of the 360 family, retaining backward compatibility with earlier models.

The shared architecture tackled a fundamental problem in the business use of computers. In computing as in nature, nothing makes sense except in the light of evolution. Because programs could now be shared more easily between computers of different sizes, and could be expected to work on a computer purchased in the future, investment in software appeared less risky. From IBM's point of view anything that made it easier for their customers to install a bigger computer was a good thing. Any given computer model was current for only a few years, and obsolete not long after that. Data processing staff would lobby ceaselessly for the latest model, while computer salesmen presented it as the solution to whatever problems of operation, storage capacity, reliability, timeliness of results, or constraints on applications were being experienced with current data processing operations. But a three or five year cycle of computer replacement was much faster than the speed at which most businesses reorganized their administrative and operational practices. If the shift to a new computer required throwing away existing programs and redesigning them from scratch, then the cost and disruption caused to the operation of business by this could dwarf the cost of the machine itself. Managers outside the computer department saw little reason to abandon application programs and the associated administrative procedures that might well have only recently emerged frustrating periods of debugging. When one adds to this the cost of training programmers and operators in the use of an entirely new system, and of discarding peripheral devices such as printers and tape drives, the data processing manager was trapped between the Scylla of pointless disruption and the

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Charybdis of obsolescence. Compatibility and standardization, of the kind claimed by the 360 series, promised to mitigate this.[422]

The third generation computers were the first to use integrated circuits (soon to be known colloquially as silicon chips), providing the fundamental shift in hardware necessary to justify the "new generation" tag. The machines of the 1960s continued to use the intricately threaded ferrous loops of "core memory" for their main internal memories, but shifted to miniaturized devices holding more than one electronic component as the building blocks of their logic units. While IBM selected a quite conservative technology, integrating only a handful of components into each module, semiconductor firms were able to squeeze ever-larger numbers of components onto each chip. As with the earlier transition to transistors, this was in itself enough to ensure the new generation machines would be faster, cheaper and more reliable than those they replaced. Although the shift to chips would eventually shift the economics of computing away from large, centralized computers and toward minicomputers and microcomputers, this technical change was actually the least disruptive element of the transition from the viewpoint of data processing managers. Thus, while the shared architecture and integrated circuits of the System /360

[422] Of course, at least some of these problems were simultaneously being addressed by an alternative route: the adoption of publicly agreed standards shared between computer manufacturers. While the easier transfer of programs between different computers had been the original motivation behind the development of COBOL, differences between the features actually supported by different versions of the language led to a renewed push to improve and tighten the specifications. Standards efforts were underway in many different arenas during the 1960s, including IEEE committees, the US national body ANSI and the international ISO. The many subcommittees, task groups and panels produced by these efforts were populated in disproportionately large numbers by IBM's competitors. Indeed, along with the 360 came a new IBM designed programming language, PL/I, which the firm expected to supersede both COBOL, the technically oriented FORTRAN and the international standard scientific language ALGOL. For IBM, the imposition of its own systems as a de-facto standard held considerable appeal – on the one hand, it would be much easier to move from smaller IBM machines to bigger ones, and from older ones to newer ones. On the other hand, it would be just as hard as before to move from an IBM machine to a non-IBM machine. In the end, compatibility came though the imposition of the 360 architecture, rather than a more rigorously defined version of COBOL, a universally agreed set of pseudo-instructions, or any of the other ideas banded around within the computer industry.

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machines were of vital importance to the development of the computer business, they were not the changes with the greatest immediate impact.

Two technologies originally promoted for second generation machines assumed center stage. The new computers were the first to be designed to be programmed in high level languages such as COBOL and IBM's new PL/I. Their larger core memories and new features in their architectures and instruction sets helped to make compilation and execution of programs written in COBOL far more efficient than previously. Most of the larger 360 machines installed were accompanied by disk storage units able to keep substantial volumes of information ready for immediate retrieval. Disk drives continued to increase their capacity and became far more common during the mid 1960s. The transition from tape to disk also helped make compilation far more efficient, since compilers and other programs could be loaded in and out of memory rapidly. In addition, the new machines often came with better designed compilers, and could run several programs simultaneously, allowing compilation to continue with spare resources while the computer was used for production work.[423]

The third generation machines represented a fundamental departure from earlier practice in two additional areas: the introduction of the operating system as an integral part of the computer installation, and the addition of standard hardware for interactive, real-time operation. A cluster of capabilities built into new hardware and operating systems made it much easier to use computers interactively. These technologies included video terminals, support and (somewhat later) "time-sharing" capabilities so that several users could work with the computer

[423] There was, however, an irony here. These same features that made the new computers far more suitable for COBOL were accompanied by the idea that their true purpose should be running sophisticated real-time, interactive applications. COBOL was useless for real-time applications, and was focused entirely on batch-mode, sequential storage (tapes, rather than disks). While it went some way to support for the establishment of files that were shared between applications and could be queried independently of the applications that created them, it did not allow direct specification of the relationships between records in different files. Given its original status as a disposable language, it is no wonder that, by the time it was generally adopted during the late-1960s, COBOL was fighting the last war with its solutions to the data processing problems of the decade before.

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simultaneously as if they all had machines of their own. Thus the new communication capabilities and operating systems were intended to take the achievements that had required so much carefully crafted assembly language and specially built hardware to accomplish for a system like SABRE and make them into a standard capability of the hardware and software installed in a typical large data processing center.[424]

## Operators and Operating Systems

Modern operating systems, such as Microsoft Windows XP, are creations of enormous complexity, in which millions of lines of code grouped into thousands of different routines are layered on top of and around each other. Operating systems isolate users, and application programs, from any contact with the underlying workings of the computer hardware. They assign memory blocks, control access to stored files, and start and stop programs.

In these respects at least, the operating system on your personal computer is living up to its name. Just as automatic programming systems promised to automate the work of the programmer, the operating system got its (otherwise rather mysterious) name through the promise that it would automate the work performed by human operators. Armed with a suitable operating system, a computer might automatically execute a string of jobs, reconfiguring itself as needed between them, assigning suitable tape drives as needed, and logging the information needed for performance monitoring and debugging. The dream of unattended computer operation, touted by Richard L. Sprague and others as in the early-1950s key departure from punched card machinery, might finally be realized.

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[424] Communications generally, and timesharing in particular, were an area of weakness for IBM's original 360 series computers compared with competing models from RCA and General Electric. Fortunately for IBM, although these capabilities were much discussed during the 1960s they were not much user until the 1970s, by which time the deficit had been remedied with the 370 series.

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As the staffing figures presented above made clear, human operators made up almost the same proportion of the total data processing workforce in the early 1970s as in the 1950s. From this we may immediately conclude that the operating system did not replace them. It is, instead, another example of a technology expected to transform the social order of data processing that was instead assimilated into the existing order. Operating systems did, however, exert an increasingly important influence on the kind of work performed by operators, and an equally profound influence on the work of programmers. They also provided a technological underpinning for a new idea of computing use, in which a computer would run several programs at the same time instead of waiting for one to finish before beginning another.

During the early and mid-1960s, however, the influence of the operating system was quite marginal in data processing circles. The emergence of the operating system concept was a gradual process, and the term operating system was applied to some very different packages. As we have seen, the very first commercially available computers arrived with almost no programs. User organizations wrote their own assemblers, loaders, monitor utilities, and other basic tools for programming, debugging and operation. They also began to exchange and standardize these tools through user groups such as SHARE (for users of IBM's large technically oriented computers) and GUIDE (for users of its large administrative machines). By the late 1950s, computer manufacturers aimed to supply a basic suite of programming tools along with each new machine. While the handful of technically oriented users of the first large machines might be able to fend for themselves, any attempt to expand the base of computer using organizations and interest smaller firms in the technology demanded that firms like IBM be prepared to supply and support these tools themselves. Meanwhile, the increasingly ambitious scope of such projects strained the capabilities of voluntarism.

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This came to a head with the attempts of SHARE to develop its own "operating system" – an integrated collection of programming tools and control programs.[425] The project was termed the "SHARE Operating System" or, in a term that foreshadowed the difficulties that were to plague the production of system software, SOS. Building on top of SHARE's previous work in standardizing computer configurations, subroutine libraries, coding conventions and operating practices, SOS was to integrate a new and improved assembler (or compiler-assembler-translator as it was then called) with a debugging system, standardized input and output routines and a job control system. Collectively these components formed an "operating system" – so called because it was intended to automate much of the work formerly performed by human operators. The operating system could schedule a "batch" of jobs, reconfigure the system for each one, and perform much of the loading and unloading of programs, and the transfer of data files from one to another, that otherwise occupied so much operator time. This was expected to boost productivity of the computer, by increasing the amount of time that it spent performing useful work. Close integration of operating system and programming tools allowed the automatic compilation, assembly and execution of a program to be scheduled as a single task.

SOS was not a great success. Despite SHARE's attempts to coordinate the work of user organizations and a few programmers contributed by IBM itself, the system arrived late and was referred to by SHARE pioneer Herb Grosch as a "fiasco." By the time it limped into the world in

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[425] SHARE's origins lay in an earlier project between Southern Californian aerospace engineering firms to develop a powerful assembler for their IBM 701 computers – a project known as PACT. When word reached these firms of its looming replacement by the forthcoming IBM 704 they organized a broader and more formal user group. This was intended to give users a stronger voice in IBM's design process and to standardize configurations, programming practices, assemblers and the like between the different installations to permit the exchange of utility programs and technical expertise. Although these firms did not exchange their proprietary applications programs (things like aerodynamic modeling systems), the ready acceptance of technical collaboration in the utilities area demonstrates the extent to which the staff of technical computing centers were already identifying more strongly with their machines and with the new field of computing than with their employers. Fascinating as the story of SHARE is, its importance in this context is as the developer of the first operating system for a large IBM computer. The story of SHARE has been told in Atsushi Akera, "Voluntarism and the Fruits of Collaboration", Technology and Culture 42, no. 4 (October 2001):710-36.

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1960, its close ties to assembly language programming seemed outdated to a scientific computing community increasingly turning toward FORTRAN and other high level languages. Like other computer suppliers, IBM was forced to assume primary responsibility for the production of operating systems and other systems tools for its hardware. But the importance of operating systems only grew during the 1960s.[426]

Operating systems for business data processing came still later. As we have seen, administrative computer installations were closer to the traditions of punched card work and tended to run the same set of large, input/output heavy jobs on a regular basis. GUIDE, the user group established for users of the large administrative IBM computers, was less active than SHARE in the development of advanced programming tools. Neither did IBM devote enormous resources to the matter. The 702, the firm's first large administrative model, was accompanied by examples of symbolic assembler and a sample sort program. The code for both was presented in its programming manual, "for study and actual application if desired." In 1956 there were still only nine IBM programmers working on programming issues for its successor, the 705.[427]

New computers offered during the first half of the 1960s added a number of hardware features with the potential to boost efficiency considerably. Exploitation of these features greatly increased the complexity of input and output programming, which in turn drove an increasing separation of input and output from the direct control of applications programs.[428] Various job

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[426] H.R.J. Grosch, "Software in Sickness and Health", Datamation 7, no. 7 (July 1961):32-33. Both SOS and IBM's internal efforts are discussed in Bashe et al., IBM's Early Computers, 359-63. During the early 1960s, it produced systems such as SBSYS and IBJOB to help users of its scientific 709 and 7090 computers reduce the amount of manual intervention needed to run a series of jobs.

[427] The contributions of this group included a version of the powerful Autocoder assembler. As befitted the importance of data storage and retrieval for administrative tasks, one of the main concerns of GUIDE was the establishment of standard methods of structuring, labeling and accessing data files. Standards were more effective when paired with "libraries" of subroutines or blocks of prefabricated code. A programmer could specify the appropriate parameters and trigger the "macro" feature of the assembler to insert the actual code required. Bashe et al., IBM's Early Computers, 345-47, 55-56.

[428] We have already seen that the direct control of hardware such as printers or tape drives by applications programs massively complicated the amount of programming work required to write the

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control programs, input-output routines, debugging aids, programming tools and miscellaneous utilities offered by computer suppliers were increasingly widely used during the early 1960s. They provided a valuable complement to the on-going efforts of individual installations to set programming standards and to build up re-usable libraries of programming routines and utility programs. But they did not form a single, unified and standard operating system, of the kind developed later in the decade. Indeed, the term "operating system" was rarely encountered in the general administrative computer literature of the era. IBM was actually using it, as part of the phrase "management operating system", to promote an entirely different concept.[429]

The focus during these years was on programming tools, including the high-level languages discussed earlier. Such tools made it easier to produce efficient programs using standard routines, but once these programs had been compiled they still ran one at a time, took over all the memory and resources of the computer directly, and relied on the intercession of human operators to sequence them and prepare the system for them. Complex control programs, of the kind produced for SAGE and SABRE, were inextricably tied to particular application

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simplest of tasks. This was alleviated by the use of standard subroutines. The problem remained, however, that a computer was wasting vast amounts of processing power while it waited for a tape drive to write a record or a printer to print a line. Hardware features including "buffers", "channels" and "interrupts" made it possible for the main processing unit to perform other work while peripheral equipment caught up. Exploitation of this power required the insertion of an additional layer of operating system software between the application program itself and the hardware. In its simplest form, this added a capability known as SPOOLing – so that a new job could be started before the results of the last one had been printed. IBM offered a "Data Synchronizer Input-Output Package" to simplify the operation of the complicated new tape controller it supplied with its 705 Model III in 1959. Its successor, IOCS (the Input-Output Control System) was offered across its range of large computers during the early-1960s, further insulating the creators of individual application programs from the intricacies of tape configuration.

[429] On IBM's use of the term "management operating system" (MOS) see Frank P. Kovach, Joseph F. Charlow, and Oliver W. Wight, "Totally Integrated Management Operating System: Part I", in Data Processing Vol 5: International Data Processing Conference of the Data Processing Management Association (New York City: National Machine Accountants Association, 1962) and H. C. Hartmann, "Totally Integrated Management Operating System: Part II", in Data Processing Vol 5: International Data Processing Conference of the Data Processing Management Association (New York City: National Machine Accountants Association, 1962).

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programs and hardware configurations. Only in 1964, with the launch of the IBM System /360, did the operating system concept achieve widespread recognition in data processing circles.

As contemporary observers instantly recognized, and historians have since confirmed, development of the 360 series was a milestone in the history of software. During the 1960s the delivery of high-level language compilers, particularly COBOL, had proved increasingly expensive. Failure to produce a good quality compiler on a reasonable timeframe had embarrassed many computer manufacturers. Within firms like IBM, software development teams began to achieve a higher organization status and a more appreciable share of the budget. The complexity of the new 360 series hardware required a standardized and omnipresent set of control programs: individual applications would no longer take over the entire machine, but would be assigned a particular area of memory and access to tape drives, disk storage and printers by the operating system. The operating system would load programs in and out of memory without direct human intervention. IBM originally planned to provide a single main operating system, OS/360, that could be run in different configurations on all the machines in the 360 range.

A few months after the launch, IBM manager John H. Worthington explained the concept to the readers of Business Automation. He had little doubt of the importance, or novelty, of the operating system. "A major milestone in the history of programming has passed almost unheralded. Not since the development of program languages, which so simplified the job of preparing computer instructions, has anything as significant as the "operating system" been developed." While the operating system included dozens of individual utility programs, compilers and programming tools, Worthington wrote that its heart was, "essentially a monitor or supervisory program which forms a bridge within the computer between succeeding jobs." This, he predicted, could double productivity since this supervisory program would reassume control of

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the machine at the conclusion of one job and load whatever other modules were needed to ready it for the job to follow.[430]

Worthington also stressed the flexibility that the new operating systems would bring to programming. Requests from programs to use resources such as tape drives would only be assigned to particular drives by the operating system, when the program was actually run. It would no longer be necessary to rewrite a program to have it use drive-8 for its temporary storage rather than drive-12. In addition, a program could be interrupted in the middle of its run if the computer was needed for something more urgent, such as a special report. As he admitted, current application programs would have to be rewritten to coexist with the control program, and the other new features. From this point forward, application programs came to depend upon the presence of a particular version of a particular operating system, as well as (or even instead of) a particular computer model and a particular hardware configuration. Transition to a new operating system could be more painful than transition to a new computer. Indeed, the /360 range was eventually served by no less than four different types of official operating system, despite its adoption of a single instruction set and architecture.

One of the most important new hardware capabilities of the larger third generation machines was "multi-programming" (the technical equivalent of the multi-tasking capability that was added to mainstream personal computers during the 1990s). The idea behind this was to get more work out of a computer system by processing of more than one task at a time – analogous to the idea of "load balancing" pursued by electrical power companies to spread use of their generators throughout the day by broadening the range of uses. Many data processing jobs failed to tax the full capabilities of the central processing unit of the new computers, or (as memory sizes increased) to occupy their entire core memories. But these job could still take a long time to

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[430] John H. Worthington, "Operating Systems Cut Processing Time", Business Automation 11, no. 7 (July 1964):27-29.

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run because of their reliance on intensive input and output activity, and hence on the speed with which tapes could be read and disks spun. If another program could be loaded into the computer at the same time, then the spare memory and processor capacity could be more fully utilized. As long as the operating system could cut backwards and forwards between execution of the two programs fast enough then the first program would still keep up with the arrival of data from the tape drive, while the second program would receive the lion's share of the processor's attentions and so run almost as quickly as if it had the computer to itself. One early user of multiprogramming, Southern California Edison, claimed in 1965 that by performing several operations at the same time (such as printing bills, updating customer accounts, and preparing statistical reports) it could complete its daily schedule in fourteen hours instead of forty.[431]

These techniques promised to boost the effectiveness of larger computers, whose capabilities were unlikely to be cost effective when applied to smaller programs. It was widely believed during the 1960s that larger computers were inherently more cost effective than small ones – so if a way to harness their power effectively could be found then huge economies of scale would be reaped as companies traded many smaller second generation computers for a handful of larger third generation ones. This assumption was codified by the publicity-hungry Herb Grosch as Grosch's law. It stated that the performance of a computer grew as the square of its price, meaning that larger computers were inherently more efficient than small ones – so much more efficient that the additional hardware, software and complexity involved in multiprogramming (and later timesharing) could easily be justified.[432]

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[431] Anonymous, "Power in Parallel", Business Automation 12, no. 12 (December 1965):42-46.

[432] Grosch first published his "law" in H A Grosch, "The Digital Computer as a Research Tool", Journal of the Optical Society of America 43, no. 4 (April 1953). For a summary of its subsequent fate, see Enin-Dor Phillip, "Grosch's Law Re-Revisted: CPU Power and the Cost of Computation", Communications of the ACM 28, no. 2 (February 1985):142-51.

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But the challenges involved in the production of such an operating system were formidable. It had to juggle multiple applications programs simultaneously, giving each one the illusion that it had command of the computer itself. Two programs might both attempt to use the same disk drive or printer simultaneously. Each program had to run in the specific chunk of memory assigned to it, without reading or writing from memory assigned to other programs or to the operating system itself. Efforts to deliver such operating systems pushed computer manufacturers into uncharted territory, in which they were prone to fall off cliffs or, as Fred Brooks, the leader of IBM's biggest effort in this area famously put it, find themselves thrashing around hopelessly while sinking ever deeper into a tar pit. His own project, OS/360, was finally delivered in 1967 – three years after the announcement of the computers it was supposed to run on. It was a year late, cost half a billion dollars to produce (which in the 1960s was a lot of money), was plagued with bugs, and imposed such a substantial overhead of its own that the original aim of more efficient machine utilization was badly compromised.[433]

Such debacles did not inspire confidence in the new systems. As consultant and real-time systems expert Robert V. Head wrote in 1967, "To say that the systems software being delivered with third-generation gear falls short of being an unqualified success would perhaps be the understatement of the decade. The manufacturers' difficulties in providing flexible and efficient operating systems, file management systems, and other software aids are causing users to ponder whether software that purports to be 'all things to all men' can ever be truly satisfactory for anyone."[434]

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[433] OS/360 is a famous story, and as told by Brooks himself in Frederick P Brooks, Jr, "The Mythical Man-Month", Datamation 20, no. 12 (December 1974):1974 and Frederick P Brooks, Jr, The Mythical Man Month: Essays on Software Engineering (Reading, MA: Addison-Wesley, 1975) it serves as the most important creation myth of software engineering. It is discussed in Campbell-Kelly and Aspray, Computer, 196-200.

[434] Head, "Old Myths and New Realities".

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What little historical attention has been devoted to operating systems has addressed their production, and in particular the difficulties faced by IBM and its competitors in producing such elaborate software systems. Little or nothing has been written on their usage. Surprising as this may seem, the arrival of the operating system did not spell disaster for the computer operator. This had been expected in some quarters – for example the 1964 Business Automation salary survey suggested that an apparent fall in the pay of computer operators was caused "by the fact that console operation is becoming less complex with the advent of new EDP gear." But the additional complexity of third generation machines and sophisticated operating systems may actually have increased the skill and status demanded of the machine room staff. The same survey in 1965 found a rise in operator pay – and predicted further rises with "more job duties due to heavier and more varied work throughout..." The work of peripheral operators, one area where one might expect operating systems to result in particular simplification, was instead predicted to "grow in complexity as peripheral devices are integrated more into on-line data processing schemes."[435]

In addition, scheduling actually became more complex when the additional demands of multi-programming were considered. If a number of essentially unconnected jobs must be run one at a time then it makes very little difference to the total execution time what order they are tackled in – though clever supervisors of operations could sequence jobs so that a minimum of manual reconfiguration was needed between them. Tasks could also be "batched" together for more efficient processing – for example by loading the assembler program into memory and then running more than one piece of source code through it before unloading it and moving on to the next job. The ability of the job scheduling systems built into the new operating systems was

[435] Richard D Kornblum, "Annual Survey of Data Processing Salaries", Business Automation 11, no. 6 (June 1964):26-35. Anonymous, "Annual Survey of Data Processing Salaries", Business Automation 12, no. 6 (June 1965):38-49.

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unlikely to encompass even this kind of automatic operation. Meanwhile, the scheduling was complicated enormously by the need to load the computer with a set of tasks that would complement each other – raising the overall utilization of the machine by stressing different resources, rather than overloading it and slowing to a crawl by trying to do too many similar things at the same time. This required the operator to have a good understanding of the computer, the operating system and the programs to be executed – and thus created entirely new kinds of craft knowledge.

While operators survived the arrival of complex operating systems largely unscathed, the new operating systems did transform the role of the increasing number of systems programmers working within data processing organizations. Firms continued to program their own system utilities, though as the decade wore on these increasingly supplemented rather than replaced standard elements of the manufacturer supplied operating system. Systems programmers were progressively less likely to produce new tools and utilities from scratch, and more likely to work to adapt and integrate those produced by IBM and other external software suppliers. Just keeping on top of the latest bugs, revisions and patches supplied by IBM was a full time job.

The shift was neither as rapid nor as total as one might have thought. Tinkering with the operating system itself continued long after the installation of the new computers. This can be attributed in part to a disposition on the part of data processing staff toward the production of in-house systems. When Systems & Procedures Journal published an article in 1968 called "How Does An Operating System Work?" the author was profiling an operating system created by the Louisville & Nashville Railroad Company. Earlier in the 1960s, it had partially constructed an operating system for an IBM 7000 series computer, as part of a broader effort to produce a "total management information system". At that point, the effort was seen as an experimental learning process. As they put it, the "primary motivation in going to the 7010 operating system was: (1) to obtain experience in the use of operating systems as a preparation for our planned real-time

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processing and management information system and (2) to gain the necessary facility to implement out program interrupt direct inquiry car tracing system." Any time savings in computer and programmer time were merely a "bonus". But rather than abandoning this effort with their upgrade to a /360 computer, they redoubled it. They reported with pride that, "The operating system for the L&N on-line IBM/360 computer was wholly written by L&N people."[436]

## The Third Generation In Practice

Real-time, on-line systems provided powerful publicity for computer salesmen, but remained an exotic novelty in practice. The most pragmatic justification for more powerful computers and multi-programming operating systems was thus the possibility of constraining the rapid profusion of smaller computers taking place in many large corporations during the 1960s. A larger computer system could provide more computing power per dollar. Many data processing managers continued to view the data processing department as a service organization, structured round a large piece of quasi-industrial machinery. The challenge was to utilize this machinery as effectively as possible. This, unfortunately, proved easier said than done.

In theory at least, the shared architecture of the 360 series would make future shifts to newer and larger computers much easier than previously. The more immediate hurdle, however, was moving from existing second generation machines to third generation ones. IBM had factored this into the design of the new computers – most of the 360 models included hardware features designed to assist in the "emulation" of corresponding earlier models. The smallest 360 machines, for example, could mimic the instructions of 1400 series computers as well as running the standardized new instructions. These hardware capabilities were supplemented by software tools designed to fool application programs written for earlier models into running with little or

[436] Louis F. Zaino, "How Does an Operating System Work?" Systems & Procedures Journal 19, no. 1 (January-February 1968):20-23, page 20.

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no modification on the new machines. Since managers were reluctant to authorize the rewriting of perfectly good programs, most 360 users initially relied on emulation for at least some of their programs – reducing programming costs, but also limiting the use made of the new third generation features. Emulation also meant that the additional power of the new computer would largely be soaked up in translation, rather than improving performance of the application. The result was that work practices changed much more slowly than computer hardware – an old program would continue to require just as many tape drives and operator attention when run on an emulated second generation computer as a real one. [437]

The presence of emulation capabilities was not enough to render the shift a painless one. Well into the 1970s, data processing departments that had ordered large systems on the strength of performance gains through advanced operating systems and multiprogramming were continuing to struggle with the technology. Confidential reports written by the Auerbach Corporation, a Philadelphia firm specializing in computer consulting, painted a grim picture of computer installations that struggled to achieve the simplest and most routine of operations. Underlying their criticisms was the assumption that effective utilization of third generation machines required a fundamentally new approach to the management of data processing. In 197X, an Auerbach team visited the First National Bank of Arizona. It found that:

> The Administrator's computer background, based primarily upon first generation General Electric 210 computers and small-scale Burroughs B-300 computers, does not provide sufficient depth of experience for managing a communications-oriented third generation computer facility. In addition, strong knowledge of the concepts of multiprogramming, on-line disk storage, data communication, and the management and organization of software projects is not evident. The lack of these skills has contributed to both an absence of strong technical direction as well as managerial control within the division.[438]

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[437] For the importance of emulation, see Evans, "System/360: A Retrospective View".

[438] Auerbach Associates, An Evaluation of the Electronic Data Processing Division, Report 1848 (for First National Bank of Arizona), 1971, contained in Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis, III-5.

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The bank's operations staff had received little training in the new technologies of their third-generation Burroughs computer, while the department entirely lacked planning and control procedures or statistics on performance. The physical presence of increasingly unreliable, older computers in the same room crowded the powerful new system into a corner, and diverted resources from it. Despite the presence of new capabilities in the hardware and operating system of the computer, the bank's data processing team continued to do things the old way. A review of the progress of individual application projects concluded that most of them were understaffed and all of them were late. Few of its programmers had any experience in COBOL, or in the design of complex systems. Where COBOL was used it was misapplied: the firm's programmers had developed their own generalized file access routine in COBOL, which proved immensely inefficient for this system software work. The bank's application programs continued to tie up computer resources by directly controlling the printer (as was necessary with many first generation machines), meaning that they continued to run until the printer had caught up with their output. Meanwhile the programs had not been written with multiprogramming in mind, and so were not divided up into smaller segments to make more efficient use of memory.[439]

While the company seemed to have been deriving little benefit from the operating system that accompanied its new computer, it did suffer considerably from the overhead it imposed. The computer had 180,000 bytes of core memory, but 100,000 bytes of that was permanently occupied by the operating system control program and various file handling utilities. Some of this precious core memory was perversely gobbled up by custom routines written to perform capabilities that were already present in the operating system. As a result, the computer regularly ran out of core memory and disk space when a full complement of jobs was scheduled – removing the expected performance advantages of the larger processor and memory, while

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[439] Ibid.

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further deterring the use of disk storage to speed up applications. Continued reliance on tape storage, prompted in part by a shortage of disk space, led to additional inefficiencies. While the bank's stock transfer application was supposed to allow the production of special reports, these were produced only as part of the nightly run, during which "a special report request can increase the required computer time to process the system by as much as 100 percent."[440]

Discussion of on-line, real-time operations was noticeable by its absence in this discussion, even as a goal. The bank had hoped that shifting to a powerful new computer and an advanced operating system would speed its existing, batch-oriented routine data processing. Even these comparatively modest ambitions proved hard to attain. When an Auerbach team visited Fieldcrest Mills it found a much happier picture. The only major problems, ironically, had been caused by a short-lived attempt to divert internal resources to the production of an on-line inquiry system for management. "Rug and Carpet Information Services concentrated a large portion of its EDP development resources on the development of CROSS, an on-line order entry/inventory record system. As a result of this concentration, less development capability was available to maintain existing applications than would ordinarily have been the case and the usefulness of many applications has probably deteriorated as a result." Fortunately, the solution to this problem proved simple: "removal of the on-line functions of CROSS have freed up additional computer time which can be devoted to development and production of new and modified applications."[441]

These problems remained a topic of burning interest at the 1973 meeting of Fred Gruenberger's Rand Symposium group. Freelance computer consultant Bob Patrick, a former

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[440] Ibid.

[441] The generally positive review of Fieldcrest is contained in Auerbach Associates, EDP Management Audit. Report 2172 (for Fieldcrest Mills, Incorporated), 1973, contained in Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis. Problems in the Rug and Carpet area are discussed in Auerbach Associates, Supplement. EDP Management Audit. Report 2172-S (for Fieldcrest Mills, Incorporated), 1974, contained in Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis.

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RAND staff member, suggested that data processing departments still had not adjusted to the challenges of complex operating systems:

> True, the total head count goes down. We're getting rid of the type of employee that has high turnover, high error rate, expensive training and is troublesome. We're going to a smaller crew of more sophisticated people. The total hardware costs are, in fact, going down. But the resulting environment is extremely high pressure; the ulcer rate, the divorce rate, and the nerve-jangling rate are taking us right to the edge. We can't handle the new environment intellectually. We have crisis after crisis in which everybody works all weekend to recover from a crash situation....[442]

Patrick suggested that few firms had realized the hoped for economies of scale in multiprogramming systems. "You are suddenly experiencing the complexity shock. It usually happens at the same time your management is making new demands; your applications programmers have not been adequately trained for the new environment -- and all of a sudden you've blundered into it."[443]

Despite the arrival of the new third generation machines, the applications tackled by administrative computing groups did not change enormously with installation. A survey of managers with responsibility for computer purchasing by the Wall Street Journal in 1968 gave a detailed picture of data processing operations among 634 companies. Accounting remained by far the most common application, run by 76 percent of firms and planned by almost all the rest (just 6.8 percent had no plan to introduce it). Inventory control and sales analysis were the two other leading applications, though neither was used by a majority of firms.[444]

The two most managerially-oriented uses of the computer were also the two least popular. 19 percent of firms used computers for market research, 16 percent for decision models.

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[442] Fred Gruenberger, RAND Symposium 14, 1973, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis, 8.

[443] Ibid.

[444] Wall Street Journal, Management and the Computer: A Wall Street Journal Study of the Management Men Responsible for their Companies' Purchases of Computer Equipments and Services, 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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If these applications were not widely performed they were, at least, widely contemplated, also being the mentioned as most likely new kinds of application expected over the next five years – 26 percent of firms expected to add market research and 23.2 percent to add decision modeling. Unfortunately, the Journal did not break these figures out by firm size.

Despite considerable attention given to timesharing and communications during the period, most computing was still performed in batch mode. 91 percent of the large companies surveyed had at least one computer on the premises, most of them leased (almost all the remainder used time-sharing or service bureaus – just 2.4 percent made no use of computers). However, 40.6 percent of the large companies currently had access to some kind of on-line, real-time system via terminals. It appears that most of these were commercial timesharing systems, used by a third of the large companies. Another 27.8 percent claimed to have plans to use such systems in the future.

That same year, the long-running survey of computer installations carried out by Business Automation magazine revealed that the new peripheral devices associated with third generation computing were also spreading quite slowly. The only advanced storage device to have reached most installations was the tape drive – the punched card processing era was finally winding down, as just 28 percent were still without a single tape drive, while the median installation had four. Punched cards retained their supremacy for data input, however, with 85 percent of the departments still reliant on the simple keypunch as the main source of data. Only 12 percent had installed a single optical scanner. Despite its rapid spread, the disc drive had arrived in just 44 percent of data processing installations. The video display, then emerging as the symbol of cutting-edge computer had reached just 13 percent of installations.[445]

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[445] Anonymous, "EDP Salary Survey--1969".

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By the mid-1970s, on-line applications and video terminals were starting to enter the mainstream of data processing. This was, in large part, because of the availability of new software products such as data base management systems (discussed later) on on-line teleprocessing software such as IBM's CICS. Even then, the terminals were often used to provide remote data entry and simple querying functions for data processing applications such as stock control, rather than as portals onto sophisticated management and modeling software. Dominant patterns in data processing practice throughout the 1960s and early 1970s thus ran parallel with, but rarely intersected, a much discussed idea of third-generation hardware as they key to a new managerially oriented approach to the application of corporate computing. This parallel world, the movement for "total systems" and "management information systems," is the topic of the next chapter.

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# 8. INVENTING MANAGEMENT INFORMATION

The early relationship of the systems men to the computer was an ambiguous one: the new technology held both promise and danger for them. Many systems men were no stranger to the computer, having played an important role in administrative computing projects from the first feasibility studies onward. Indeed, we have seen that corporate interest in computers was probably the single most important force behind the creation and expansion of systems and procedures groups during the latter part of the 1950s. Yet many systems men were also uncomfortable at the prospect of finding their systems groups trapped entirely within data processing departments. While systems and procedures specialists aspired to recognition as the expert assistants of top managers, data processing appeared in comparison too technical, too machine focused and too much concerned with means rather than ends. During the late 1950s, data processing attracted increasing criticism in the managerial press for its limited and conservative focus on punched-card style clerical automation. This caused increasing alarm among those systems men whose interest in the computer had been prompted by its promise of a managerial revolution.

These managerially-oriented systems men found salvation in a new and exciting concept that swept through the world of corporate America in the late 1950s and early 1960s: "management information." During these years, the computer's proper role was transformed, rhetorically at least, from a simple clerk-replacing processor of <u>data</u> into a mighty <u>information</u> system sitting at the very heart of management, serving executives with vital intelligence about every aspect of their firm's past, present and future. Its contribution could be evaluated not in terms of administrative cost savings but through the improved performance of the entire business. And, far from coincidentally, the creators of such systems would have to work closely with

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executives, assert broad authority over management of the firm's operations and build up battalions of analysts, programmers, modelers and other experts under their command.

Discussion of information as an area of technical expertise, and of the idea of information systems, first became common in business during the early 1960s with the widespread promotion of the "totally integrated management information system" (MIS) – a comprehensive computerized system intended to span all administrative and managerial activities. While the lower levels of this gargantuan system processed payroll and billed customers, its upper levels would provide executives with constantly updated forecasts and models of their company's position. This promised a new vision of management to a corporate world self-consciously remaking itself around science, high technology, staff experts, and systems. Managerial information itself was essentially defined backwards from the idea of this computerized total MIS – as the input, output and internal contents of such a system. Only then did the idea of managerial information as a commodity or resource, as an entity in its own right that could be piped, stored and processed as needed, really established itself within corporate thought.

By the mid-1960s, total MIS had achieved almost universal recognition as the ultimate purpose of the computer in business. To understand the history of information in business we must therefore explore both how the idea of the total MIS developed and how it spread to achieve such remarkable acceptance. The elite of the administrative systems community – corporate staff specialists in administrative methods, management consultants and business professors – devised the total MIS concept during the late 1950s. Many of its rank and file members in the fast-growing Systems and Procedures Association (SPA) accepted managerial information as their new raison d'etre during the early 1960s. It was soon seized upon by managerially-inclined data processing managers. By the mid-1960s the idea had been spread far beyond this initial

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beachhead and was entrenched in general business literature and ubiquitous in discussion of corporate computing.

The systems men's promulgation of managerial information achieved several things at once. First, by identifying the computer as a tool for the construction of management information systems it established their own jurisdiction over the burgeoning world of corporate computing. Second, this new emphasis on the provision of information and control to top management furthered the long-standing quest of the systems men for recognition by executives as more than just clerical specialists and narrow technicians. Third, the new analytical category of information lumped together some things that the systems men had previously been successful in asserting control over (such as forms, paperwork and clerical procedures) with a host of others that they aspired, as yet unsuccessfully, to control (such as organizational restructuring and strategic planning). Systems men hoped that acceptance of the MIS concept would help them leverage their success with the more mundane aspects of information into a much broader mandate as what Richard Canning (in one of his earliest articles) called "information engineers."[446] They tried to increase their own power by redefining the kinds of knowledge and expertise that were accepted as managerial. The beauty of "management information" was that it tied together a whole set of things that managers already thought were important (such as reporting systems, financial controls and production scheduling) and bound them around the exciting but worrying technology of the computer – thus blurring the distinctions between technical and managerial. The systems men could commandeer the money and prestige accruing to the computer installation without becoming "mere technicians" and betraying their managerial aspirations.[447]

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[446] Howard S. Levin, "Systems Planning for Computer Application", The Controller 25, no. 4 (April 1957):165-67, 86, 165-67, 86. The phrase information engineering was used by Canning a year earlier, in Canning, "Planning for the Arrival of EDP".

[447] For a discussion of the problematic position of systems analysis between engineering and management in US federal government of the 1950s see Atsushi Akera, "Engineers or Managers? The

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## Information and Management

By the late-1990s, almost everything to do with the use of computers in business had been dignified with the word information. Computers and networks were usually called "information technology;" academic and vocational programs to train computer staff were called "information systems" programs; senior computer staff were called "chief information officers," while their junior colleagues had job titles like "information system specialist" and the entire computer department was probably known as something like "information systems" or "information services." The widespread use of computer technology was supposed to have ushered in something called the "information age."

As the reader may have noticed, the conceptualization of these things as being intimately related to information represented a shift. Data processing, operations research, systems and procedures, office management, and the other concepts and identities applied to corporate computing and punched card work prior to the 1960s did not invoke the concept of information. Whereas expertise in science or systems often formed the basis of earlier claims to legitimacy for these groups of managerial technicians, they almost never claimed to be information experts. We are left with the interesting question of how the computer became information technology, and the computer operator an information system support specialist.

The comparatively recent arrival of information in managerial discourse may come as something of a surprise, since information is such a useful and ubiquitous conceit that it is hard to think about many important issues without it. Historians have been happy to talk about the managerial information systems of late nineteenth and early twentieth century firms. In this we have followed the lead of computer scientists, librarians, economists, office managers, geneticists

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Systems Analysis of Electronic Data Processing in the Federal Bureaucracy", in Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, ed. Agatha C Hughes and Thomas P Hughes (Cambridge, MA: MIT Press, 2000).

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and communications engineers, to whom information is an essential and universal property of the universe that exists quite apart from human awareness. According to this view, early managers designed information systems as they tinkered with organizational structures. Whether they knew it or not, their ability to make the hierarchical coordination of managerial capitalism more efficient than traditional market mechanisms hinged on their ability to marshal information. In this scenario, it is no more important that historical actors share the concept of information used by the historical analyst than that a laboratory mouse understand the sophisticated statistical techniques employed to examine its untimely demise.[448]

This approach has very real merit for certain kinds of historical work. The danger is that using the idea of "information" to frame a historical investigation may impede our ability to understand how our historical subjects saw the world, and hence why they did what they did. Only by examining how, why, and for whom "management information", and indeed information itself, emerged as a discrete and meaningful categories can we begin to unpack the very specific associations, assumptions and aspirations that are so neatly folded away inside them. Doing so helps to explain why the idea of information today is so ubiquitous, so culturally powerful, and yet so analytically unsatisfactory.

Of course, neither the word "information" nor many of the things it came to refer to were new – though the use of information to describe a collection of facts was largely novel. The systems men and their contemporaries did not make the word up, but they did give it a distinctly

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[448] For historical investigations deploying information as an analytical tool see Alfred D. Chandler and James W. Cortada, eds., A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present (New York, 2000); Bud-Frierman, ed., Information Acumen: The Understanding and Use of Knowledge in Modern Business, Levenstein, Accounting For Growth: Information Systems and the Creation of the Large Corporation, Temin, Inside the Business Enterprise: Historical Perspectives on the Use of Information; Lamoreaux and Raff, eds., Coordination and Information: Historical Perspectives on the Organization of Enterprise For a synthetic survey of the use made of information in organizational and economic theory see Arthur Stinchcombe, Information and Organizations (Berkley, CA: University of California Press, 1990). Much recent thinking on the role of information in organizations has been influenced by Williamson, The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting.

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new meaning and prominence within business culture. While the word information has a long history, its early usage was closely related to the verb "to inform." Information was originally the act that took place when a specific person or group of persons was informed of something. Although the Oxford English Dictionary shows that its usage as a noun goes back at least to 1450, until quite recently it appears to have referred to the state of enlightenment produced in the informee, rather than the factual material itself. At one time, for example, it was common and natural to speak about getting "information of facts."[449] The phrase makes it clear that facts are not themselves information, but are something of which one might be informed. The same meaning would appear to be at work when Article II, Section 3 of the Constitution of the United States stipulates that the president "shall from time to time give to Congress information of the state of the union...." Even today, such meanings linger in concepts such as the well informed person, the police informer, or the message forwarded "for your information."[450]

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[449] In her introduction to The History of England, for example, Catherine McCauley wrote that individuals "only want a just information of facts to make a proper comment." [449] "Information of facts" sounds terribly odd to our ears, yet it was once a reasonably common expression. It seemed particularly prevalent in legal documents and may also, as linguist Geoff Nunberg has pointed out, be found in Gulliver's Travels). Geoffrey Nunberg, "Farewell to the Information Age", in The Future of the Book, ed. Geoffrey Nunberg (Berkeley: University of California Press, 1997). Because legal language is so slow to change, and is enshrined in statutes, "information of facts" has not yet vanished entirely from the English language. For example, the web page of the Columbia County Florida Sheriff's office includes a list of "Fees for Civil Process, Effective October 1, 1994." Pursuant for status 48.193(3) it includes a twenty dollar charge to "Provide Information of Facts on 'Affidavit of Service'." The phrase may also be found on applications for the Kansas Dental Board and the Oxnard, California police department, and in the statute relating to Louisiana cemetery licensing.

[450] Nunberg has suggested that the dominant meaning of information shifted during the mid-nineteenth century to describe authoritative, objective, publicly communicated factual knowledge of the kind disseminated through newspapers, government publications, and encyclopedias. Ibid. Nunberg refers to this new sense of information as "abstract information" because its authority came from the institution supplying it, and because it was increasingly abstracted from any particular person informing or being informed. Nunberg points out that this newer sense of information is easy to misread into earlier sources, especially 'when the context involves talk of 'having,' 'acquiring' or 'receiving' information...." (A good parallel may be with our current use of "education" or "enlightenment." While we might speak of receiving these, or even of finding them in a book, we would never speak of storing or processing them). As he shows, with reference to a passage from Emerson, the difference is between an older meaning of information as "the instruction derived from books" and a newer meaning of information as "the content of books." Nunberg therefore locates the late-nineteenth century as the true "information age", suggesting that the Internet serves instead to sever the link between form and reliability crucial to acceptance of printed

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My own reading of the business literature of the early- and mid-twentieth century suggests that information was almost always used to refer to the communication of useful facts, rather than to the facts themselves. Although some earlier references undoubtedly exist, the closest I have come to a pre-1950 reference to information storage or processing in the administrative literature is a 1940 article in the Journal of Accounting, which speaks of "information punched in cards."[451] Prior to the 1950s, the only job title likely to include the word information would be that of an "information officer": someone employed to inform other people (often the public). Likewise, the only corporate department incorporating the word in its name would probably be an information bureau responsible for disseminating information externally.

It is never easy to prove a negative, and I realize that many readers might find this claim startling. Let us therefore examine briefly a few of the places in which references to information would later become ubiquitous. One of these is discussion of office technologies and administrative systems. While office management textbooks from the 1910s to the 1940s paid an enormous amount of attention to the concept of systems, and often cast the office as a paper processing machine in need of expert care, they never invoked the concept of clerical work as information processing, or spoke of administrative systems as information systems.[452] Neither did textbooks on filing practices characterize the filing system as a repository of information (though

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reference material as information. (This, he suggests, derived from an earlier, now obscure, sense of information as a kind of moral instruction).

[451] Vannais, "Punched Card Accounting from the Audit Viewpoint". This was some time before Shannon definitively formalized this mechanical sense of information.

[452] Major office management textbooks include Geoffrey S. Childs, Edwin J. Clapp, and Bernard Lichtenberg., Office Management. (New York: Alexander Hamilton Institute, 1919), Lee Galloway, Factory and office administration (New York,: Alexander Hamilton institute, 1918), Galloway, Office Management, Leffingwell, Office Management, Leffingwell, Textbook of Office Management, William Henry Leffingwell and Edwin Marshall Robinson, Textbook of Office Management (New York: McGraw-Hill, 1943), Wylie, Gamber, and Brecht, Practical Office Management. By 1980, however, a leading office management textbook included the claim that, "The office is vital because it deals with one of our greatests resources--information." George R. Terry and John J. Stallard, Office Management and Control: The Administrative Managing of Information (Homewood, Illinois: Richard D. Irwin, Inc., 1980), 3.

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one 1924 book did make the strikingly modern claim that "files now function actively as a kind of composite memory for the organization.")[453]

Advertisements for card file systems promoted them as stores of facts than of information. This held over into the first promotions for business computers. In 1953 the vice president responsible for sales at Remington Rand suggested that, "Modern management needs and demands administrative 'Fact Power' in the form of records and reports – which serve business as a 'Nervous System' in the operation of its economic operations." Rand was a major supplier of office machines, the number two producer of punched card machines, and the first company to offer a computer as part of its product line. Yet its leading salesman still used the clumsy "fact power" when describing the managerial benefits of its machines.[454]

Close examination of the work of individuals now regarded as pioneers in "information age" thinking is particularly revealing. A striking example is found in the celebrated 1945 article "As We May Think" by Vannevar Bush.[455] The article proposed the construction of machine, the "memex," able to store an almost infinite "file and library" in the space of a desk. Users could add their own material, cross-reference entries from different sources, and search automatically. As a result, the memex has been seized upon as a conceptual ancestor of the World Wide Web, and Bush himself is honored as a father of the information age. According to one typical citation, it was "the earliest description of a machine designed to support the building of trails of association through vast stores of information."[456] The article itself, however, includes the word information only four times, and in none of these instances did it describe the mass of text and

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[453] Ethel E. Scholfield, Filing Department Operation and Control (New York: The Ronald Press Company, 1923).

[454] Al. N. Seares, "Advancements in Office Automation", The Hopper 4, no. 2 (February 1953):6-9.

[455] The original article is Vannevar Bush, "As We May Think", The Atlantic Monthly 176, no. 1 (July 1945):101-08.

[456] James M Nyce and Paul Kahn, "A Machine for the Mind: Vannevar Bush's Memex", in From Memex to Hypertext: Vannevar Bush and the Mind's Machine, ed. James M Nyce and Paul Kahn (New York: Academic Press, Inc., 1991), 39.

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pictures stored within the memex. (Instead of using information as a description of the content of his machine, Bush referred to this mass of written material as "the record.") Even where the word was used, the modern reader is struck by the distinction Bush preserved between the data stored within the device, and the information that could be found when it is consulted: "When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down..." (The other three instances of the word information all refer to the transmission of nervous signals within the human body).

Peter Drucker enjoys a deserved reputation as one of the most important theorists of the American corporation. In recent years he too has been widely acknowledged as one of the key originators of the information society concept. Yet while his 1953 classic The Practice of Management included a small section entitled "Information: The Tool of the Manager," this did not describe the need for managers to build up large, formalized collections of facts. Instead, the section was a plea for managers to develop better personal communication skills: "the manager has a specific tool: information.... No matter whether the manager's job is engineering, accounting, or selling, his effectiveness depends on his ability to listen and to read, on his ability to speak and to write. He needs skill in getting his thinking across to other people as well as skill in finding out what other people are after."[457] In 1959, when Drucker coined the term "knowledge workers" to describe the increasing importance of college trained technical and professional staff, he refrained from using the term information to describe what others would later seize on as a key aspect of the "information society."[458] In 1962, the first economist to attempt to quantify the importance of what we would now call information within the American economy made a similar

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[457] Drucker, The Practice of Management, 346.
[458] Peter Drucker, "The Next Decade in Management", Dun's Review and Modern Industry 59(September 1959):52-53, 57-58, 60-61.

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choice when he called his book The Production and Dissemination of Knowledge in the United States.[459]

During the 1950s, however, the idea of information was applied in a number of new ways and gradually took on a variety of new meanings. Its vogue began with the choice of communications engineer Claude Shannon to refer to his generalized mathematical description of digital communication as "information theory." Shannon and his associates introduced the concepts of bits, bandwidth, redundancy and error correction. While some have complained that the use of information to describe this approach was misleading, because it had nothing to do with the factual content of the message sent, this choice was more in line with contemporary usage than is generally realized. Shannon's model described the transmission of a series of encoded symbols between a sender and a receiver – in other words, the process by which the receiver was informed of something.[460]

During the late 1950s "information" seemed scientific, modern and fashionably theoretical. Information theory resonated far beyond its technical niche. In 1953, Fortune magazine lauded it as a great and almost unknown scientific theory whose impact on society was likely to exceed that of nuclear physics.[461] During the 1950s, the word information was adopted in several contexts by groups of technical and scientific librarians. From 1950 onward, the term "information retrieval" was applied to research into the use of mechanical and electronic devices

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[459] Fritz Matchlup, The Production and Distribution of Knowledge in the United States (Princeton: 1962).

[460] On information theory, its relationship to cybernetics, and its use in different scientific fields see William Aspray, "The Scientific Conceptualization of Information: A Survey", Annals of the History of Computing 7, no. 2 (April 1985):117-40. The application of information theory to genetics during this period is explored in Lily E Kay, Who Wrote the Book of Life: A History of the Genetic Code (Stanford: Stanford University Press, 2000).

[461] Many executives received their first exposure to information theory through Francis Bello, "The Information Theory", Fortune, December 1953. This first article focused on the technical and electronic communications aspects of the theory.

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to automate the search and selection of records.[462] The first use of the term "information science" to describe specialized library work has been traced to 1959.[463] While their direct ties to Shannon's work were tenuous, their adoption of the word was motivated in part by the fashionable and scientific aura surrounding information theory. It had gained a resonance lacking in earlier titles such as "special librarian" or "documentationalist."

The 1950s also saw a flurry of interest in the problems of "scientific information." Scientific and technical work was being published in unprecedented quantities, spurring interest in technologies and systems to classify, abstract, distribute and index it. Alarmists warned that an "information explosion" threatened western scientific leadership during the Cold War because America's lack of centralized indexing and abstracting left scientists and engineers doomed to repeat previous published work. All these usages were initially compatible with the idea of information as something produced when someone was informed. They did, however, clearly lend themselves to the subtle redefinition by which information became the factual content of the scientific journal, library shelf, or electronic file rather than the product of its perusal or communication.[464]

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[462] See Hans Wellisch, "From Information Science to Informatics: A Terminological Investigation", Journal of Librarianship 4, no. 3 (July 1972):157-87. This mentions a common idea in the 1950s that information retrieval "could be performed only with the help of sophisticated machinery, primarily computers, and that anything done manually [in libraries] was not to be dignified with the new name."

[463] Ibid mentions that "when the term Information Science was first used, it was clearly implied that it was the same as, or even subordinated to, Computer Science."

[464] Bello updated his audience on the booming field of scientific information retrieval systems in Francis Bello, "How to Cope with Information", Fortune 62, no. 3 (September 1960):162-67, 80-82, 87-89, 92. For a contemporary account of early professionalization activity in information science see Robert S. Taylor, "Professional Aspects of Information Science and Technology", in Annual Review of Information Science and Technology: Volume 1, ed. Carlos A. Cuadra (New York: John Wiley & Sons, 1966). Attention within the information science community has recently turned toward its own history -- see Trudi Bellardo Hahn, Robert V. Williams, and Mary Ellen Bowden, eds., Proceedings of the Conference on the History and Heritage of Science Information Systems (Medford, NJ: American Society of Information Science, 1999).

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In 1959, the corporate librarian of Eli Lilly published an article in Harvard Business Review, in which he tried to convince his executive audience that any effective "intracompany information program" must have "the library as its hub" and that, "the librarian knows where facts are located; knowledge of sources of information and ability to tap new pipelines of data are his stock in trade.... He is a member of a profession which cuts across all subject fields, thus providing him with sources regardless of geographical boundaries and sometimes with facts which have not even appeared in print." He proposed the establishment of a new "centralized company-wide information service," and argued that librarians should also be given central control over all records and files.[465]

William Aspray has documented the links between the Information Science school of the University of Pittsburgh – the first of its kind to be created in the United States, and the cold war systems elite. One of its most important early leaders, Anthony Debbons came from the Air Force and had become interested in the information systems concept when he worked on military command and control systems with the Mitre Corporation. Debbons eventually created a degree program to train "information counselors" to act as staff assistants to senior managers – through as it turned out, few corporations were willing to create such posts. Another militarily inspired concept current in the 1950s and 1960s was that of "business intelligence," intended to provide corporate decision makers with information in much the same way that the CIA and military intelligence worked in their own fields. The term generally implied a team of experts gathering and analyzing information on competitors, sometimes with an emphasis on covert action. [466]

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[465] Irene M. Striby, "Looking Around", Harvard Business Review 37, no. 3 (May-June 1959):33-34, 36, 144, 46, 48, 50.

[466] William Aspray, "Command and Control, Documentation, and Library Science: The Origins of Information Science at the University of Pittsburgh", IEEE Annals of the History of Computing 21, no. 4 (October-December 1999):4-20. The Business Intelligence concept is mentioned in Bello, "How to Cope with Information", page 192 where it is attributed to H. Peter Luhn, a long-time CIA expert on information systems. Its inspiration is clearly visible in William R. Fair, "The Corporate CIA – A Prediction of Things to Come", Management Science 12, no. 10 (June 1966):B489-B503.

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But despite the best efforts of the "information scientists" to colonize business culture, information's closest and most enduring corporate association was with computer technology. Shannon's ideas found their most direct applications in the construction of digital computers. Digital information is transferred constantly within a computer, as signals move backward and forward (for example, between arithmetic units and memory registers inside the central processor, or between a tape drive and the main memory). The creation of efficient and reliable schemes to encode letters and numbers was central to the feasibility of these machines. As the concepts of information theory were taken up and applied, with varying degrees of success, in different technical fields the distinction between storage and communication was eroded, as the ideas of information theory were applied to symbol sequences stored (for example in genes, or on computer tape) as well as those transmitted. By the late 1950s, "information processing" was being promoted as a possible name for the nascent academic discipline that became computer science. While this did not truly catch on in the United States, most European countries settled on a variation of "informatics" to describe the field.[467]

This relationship between computer and information was the organizing theme of Edward Berkeley's seminal 1949 book Giant Brains, or Machines That Think – which, as we have seen, was the first to introduce electronic computers and their potential use in business to a general audience. Berkeley gave early expression to the idea of information as a ubiquitous commodity in the natural and social worlds. He presented the computer as the latest and most powerful in a series of pieces of "physical equipment for handling information" that included everything from nerve cells to writing to human gestures. Information became a quantity in its own right,

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[467] Isaac L. Auerbach, "The Start of IFIP-Personal Recollections", Annals of the History of Computing 8, no. 2 (April 1986). Eric Weiss, "Obituary: AFIPS", Annals of the History of Computing 13, no. 1 (January-March 1991):100-01. Information processing is mentioned as "the phrase coming into acceptance" in Anonymous, "Is It Overhaul or Trade-In Time (Part II)", Datamation 5, no. 5 (September-October 1959):17, 19, 21, 23, 25, 26, 44-35.

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regardless of whether it actually informed anyone of anything. It could sit undisturbed inside a computer and still be information.[468]

Information and the computer were also intimately associated with "Cybernetics," a fashionable theory of feedback and automatic control developed by Norbert Wiener. Cybernetics brought an intellectual veneer to American business's fascination with automation, which in the 1950s was generally presented to management as an end in itself. The latter term, a contraction of "automatization" popularized by consultant John Diebold in his 1952 book of the same name, was essentially a high-technology version of mechanization. Diebold, and the many popular and business press reports he inspired, promoted the idea that fully automated factories were giving rise to a new social order, exaggerating both the prevalence and complexity of automated production lines. In this context, the inherent efficiency of automation was a given. The computer was the most complex, most modern, most automated machine of all. It promised to automate information and control, just as earlier machinery had automated physical production.[469]

Contemporary observers were well aware of information's unfamiliarity. As Dun's Review pointed out to the world of industrial management in 1958, "only in the past dozen years has the concept of information—as distinct from the papers, forms, and reports that convey it—

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[468] Berkeley, Giant Brains or Machines That Think, 10-17. The Oxford English Dictionary (second edition) supports my claim of a distinct new postwar usage of information to denote a quantity capable of storage and retrieval. The use of ahistorical claims to universalize information is discussed in Geoffrey Bowker, "Information Mythology: The World Of/As Information", in Information Acumen: The Understanding and Use of Knowledge in Modern Business, ed. Lisa Bud-Frierman (New York: Routledge, 1994).

[469] Industrial automation receives its classic historical treatment in Noble, Forces of Production: A Social History of Industrial Automation. For Diebold's original usage of Automation, see John Diebold, Automation, the advent of the automatic factory (New York,: Van Nostrand, 1952). Automation enjoyed very wide coverage in the elite business press of the 1950s and 60s - see Diebold, "Automation - The New Technology", James R. Bright, "How to Evaluate Automation", Harvard Business Review 33, no. 4 (July-August 1955):101-11, George J. Kelley, "We're Easing into Automation", The Controller 25, no. 2 (February 1957):66-69, Malcom H. Gibson, "Automation Should Be Your Whole Philosophy", The Office 51, no. 1 (1960):134, 36. Only during the mid-1960s did a more nuanced conception gain ground even in elite business discourse - see Charles E. Silberman, The Myths of Automation (New York: Time Inc., 1966) and Wickham Skinner, "The Anachronistic Factory", Harvard Business Review 49, no. 1 (January-February 1971):61-70

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really penetrated management's consciousness. That it has done so is largely due to recent breakthroughs in cybernetics, information theory, operations research, and the electronic computer...." Others were in accord as to the novelty of "information" and its intimate association with the computer. Alex W. Rathe, a professor of office management at Columbia who was among the first to develop an interest in the new topic, claimed that, "as late as 1946 there were in the combined professional, technical and scientific press of the United States only seven articles on the subject of information."[470]

Systems man and consultant Howard S. Levin was among the first to turn information into a claim to organizational power. His 1956 Office Work and Automation argued that, "to view office work as equivalent to business information handling requires we consider... the executive who analyzes budget requests," as well as clerks themselves. Levin made many claims for information: it was the basis of all decision making; investment in information was vital to future prosperity; information handling was synonymous with office work; information costs would be sharply reduced by the computer. He argued for business to support a new breed of "information specialists" or "information engineers" and a "Vice President—Information" to improve its effectiveness. Information was a single word that could mean many things. It encompassed clerical work and strategic decision, when both were abstracted as different kinds of information processing. Levin achieved this by eliding differences between the new, technical sense of information as a quality processed by a clerk or a computer and the older sense of information as the thing that allows management to make informed decisions on key matters.[471]

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[470] The first quote is from Anonymous, "Today's Office--Room For Improvement", Dun's Review and Modern Industry 72, no. 3 (September 1958):50-51, 79-86. Similar figures on the sudden emergence of information are presented in Carlos A. Cuadra, ed., Annual Review of Information Science and Technology: Volume 1 (New York: John Wiley & Sons, 1966) The management professor is Alex W. Rathe, "Management's Need for Information", in Control Through Information: A Report on Management Information Systems (AMA Management Bulletin 24), ed. Alex W. Rathe (New York: 1963).

[471] Levin, Office Work and Automation.

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Levin was also among the first, at least in a business context, to attempt an explicit definition of the difference between information and data. During the 1950s the two were often used interchangeably in discussion of administrative computing, except for the general sense that information implied a specific act of communication. Levin followed this usage most of his book. At one point, however, he suggested that data be viewed as the raw factual material stored in computers or copied by clerks. Information, in contrast, was useful knowledge – data that had been processed so as to have direct relevance to the business. From this point on, information was increasingly the aspirational term of choice for groups, such as the systems men, who wished to be seen as managerial and higher level. It worked in opposition to the humdrum data processed by computer and punched card technicians.[472] This separation of information, knowledge and data took place only slowly, and indeed, many of the bold claims associated with information had previously been made using different terminology.

In 1958 two University of Chicago business school professors, Harold J. Leavitt and Thomas L. Whisler, put together computers, information, automation, and management and rebadged the computer as "Information Technology." Their Harvard Business Review article "Management in the 1980s" depicted a future in which this combination of computer hardware, operations research methods, and simulation programs, had transformed the corporation. The computer remained a tool of automation, but it had spread its reach beyond clerks and manual labor to the work of management itself. Middle managers had largely disappeared from the corporations of the 1980s, after computers automated their decision-making duties and removed their autonomy. Executive ranks had been swelled by "researchers, or people like researchers," with stronger technical skills and a "rational concern with solving difficult problems." (A cynic

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[472] Ibid., 8. Levin's distinction is taken up to criticize data processing technicians in Milton D. Stone, "Data Processing and the Management Information System: A Realistic Evaluation of Data Processing's Role," in American Management Association, ed., The Modern Business Enterprise in Data Processing Today: A Progress Report -- New Concepts, Techniques and Applications (New York, 1960).

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might conclude that they had in mind business school professors and their students). In "staff roles, close to the top" were to be found the programmers, free to perform their own research and decide what and how to program. Management would spend most of its time tweaking decision making systems, rather than making individual decisions. Decentralization and delegation, two crucial developments of the 1950s, had merely been unfortunate necessities that were fortunately no longer necessary.[473]

The ideas of Leavitt & Whisler were to stimulate a great deal of activity within management research, and many of their specific predictions were challenged by other researchers. But their vision of huge computerized information, control and decision-making systems as the backbone of future management was widely and profoundly influential. Herbert Simon, already a major figure in administrative theory, provided an intellectual framework for this vision through his various attempts to show that both the computer and the organization itself were decision-making and information processing machines possessed of potentially superhuman rationality. Simon suggested that computers would be capable in principle of automating any managerial decision by 1970.[474]

The appeal of this science fiction future to operations research and "management science" researchers is quite obvious. But it was also to stir up a flurry of interest among systems men and computer specialists for whom the association of the computer with "information" and

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[473] Leavitt and Whisler, "Management in the 1980s". They use the term programmer to mean one who programs decision making rules, rather than the more specialized idea of a computer programmer that was soon to be established. Later articles assert that Leavitt and Whisler coined the term "information technology", although Bello, "How to Cope with Information" 1960 mentions that the term was used in 1957 to derive the name of a maker of scientific information retrieval equipment called "Infotek". Some of their ideas were anticipated by Bradshaw, ed., Automatic Data Processing Methods The author, a partner of the consulting firm Cresap, McCormick and Paget, suggested that effective use of EDP would "force" a shift to a new kind of management based on more deliberate design of control systems and organizational structure.

[474] Simon addressed this specific question in Herbert A. Simon, "The Corporation: Will It Be Managed By Machines?" in Management and Corporations 1985, ed. Melvin Anshen and George Leland Bach (New York: The McGraw-Hill Book Company, 1960).

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executive management provided a welcome alternative to the identification of computers as data processors. What had previously been quite different things such as accounts, market forecasts and inventory records were now grouped together under a single heading, that of information, and were demarcated as a single area of professional responsibility, that of the information technologist. Leavitt and Whisler had concluded their article with an appeal for executives to search for "lost information technologists" languishing unappreciated within the staff ranks. The systems men wasted little time in volunteering themselves.

By 1963, discussion of information and its relationship to systems and to computers was ubiquitous in systems circles, and the systems movement had largely restructured its sense of its own mission around the concept of information and the construction of massive, computerized information systems. The systems men tied themselves more and more closely to the computer, until "systems analyst" became a job title implying a kind of higher level computer worker, and systems and procedures departments were increasingly merged together with the firm's computer operations. While Leavitt and Whisler's 1958 conception of the computer as information technology clearly played a part in this, the direct source of the injection of information into the heart of the systems movement appears to have come the next year. Instead of borrowing Leavitt and Whisler's term the systems men created another phrase that fused information more directly to their existing claims to expertise in system and management: the Totally Integrated (often just Total) Management Information System.

## The Totally Integrated Management Information System

MIS made its initial impact in 1959 at a small conference on "Changing Dimensions in Office Management" sponsored by the American Management Association. This was the first unveiling of the results of a working group called the Continuing Seminar on Management

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Information Systems.[475] Perhaps the most influential statement of the AMA conference belonged to Charles Stein, a consultant and member of the continuing seminar, who formulated the "integrated management information system" as a computerized tool that would meet the needs of all levels of management in a "timely, accurate and useful manner." Variations on this phrase were to appear hundreds of times over the next decade. The management information system was singular for any given firm - one system that tied together all others. More than this, it would include mathematical models to provide instant feedback on the impact of any decision upon corporate-level goals. Every departmental decision could be evaluated instantly and empirically for its impact on corporate profits, thus banishing forever the problems of organizational politics. Facts would speak for themselves.[476]

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[475] The group was convened by Gabriel N. Stillian, a fellow of the IBM Systems Research Institute and head of the AMA's Administrative Services Division and included senior representatives of McKinsey and industrial giants such as Lockheed and DuPont. The genesis of the Continuing Seminar on Management Information Systems is discussed in the introduction and foreword of James D. Gallagher, Management Information Systems and the Computer (New York: American Management Association, 1961). The AMA had a long history of promoting the modernization of administrative techniques, first through the pre-war work of its Office Executives group and later through a series of seminars on the use of electronic equipment. As the use of this equipment became commonplace, it re-oriented its efforts towards a broader consideration of the use of computers for management. The conference proceedings themselves are contained in American Management Association: Office Management Division, ed., The Changing Dimensions of Office Management (New York: American Management Association, 1960). The Society for Management Information Systems, Research Report One: What Is A Management Information System (Chicago: The Society for Management Information Systems, 1972) discusses the seminal role of this conference.

[476] Charles Stein, Jr., "Some Organizational Effects of Integrated Management Information Systems", in The Changing Dimensions of Office Management, ed. American Management Association. Office Management Division. (New York: American Management Association, 1960).

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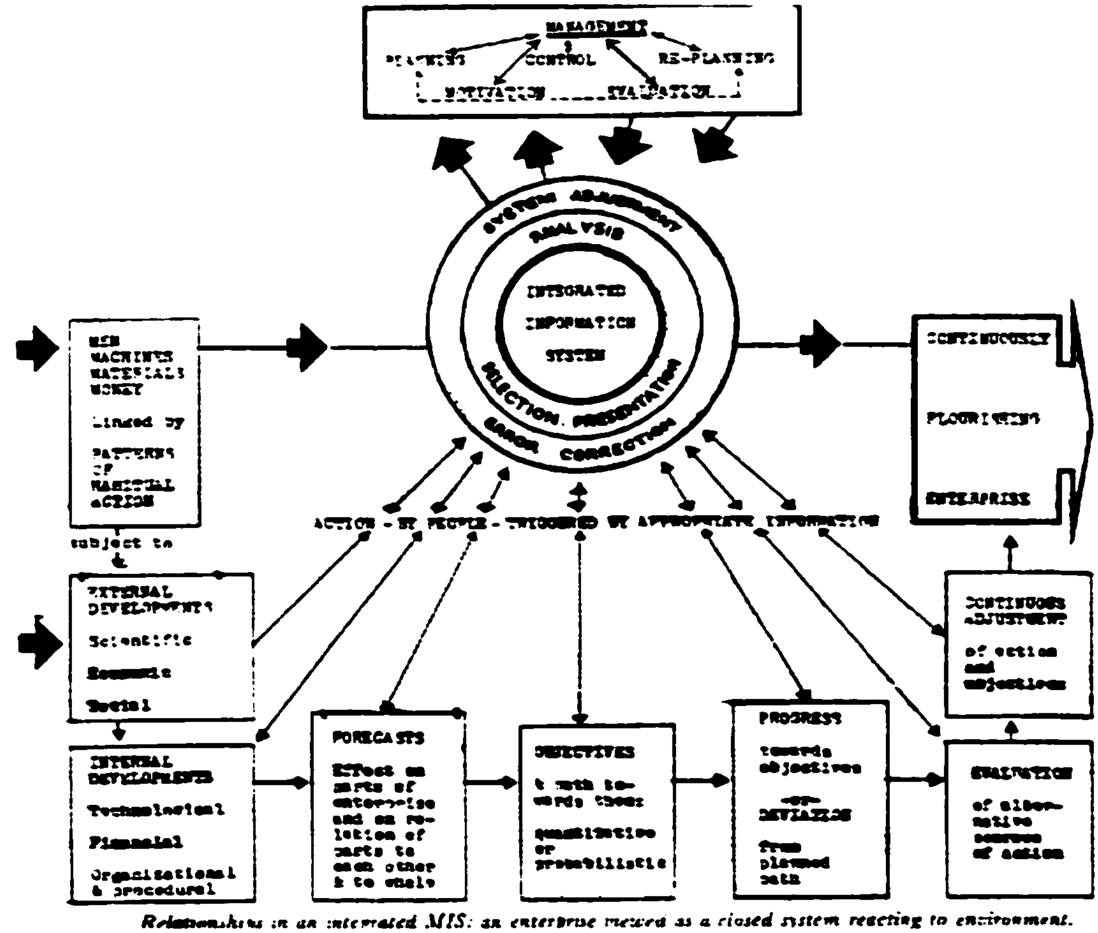

**Figure 23: This 1963 diagram of an "Integrated MIS" captures the enormous expectations raised for the scope of such systems. Note the use made of cybernetic feedback concepts to yield a "continuously flourishing enterprise."** [477]

Speakers at the conference included representatives of computer manufacturers, academics, consultants, the heads of professional associations and prominent industrial systems men. The industrial participants (from DuPont, Lockheed and the Minneapolis-Honeywell Regulator Company) emphasized the need for such a project to be headed by a strong manager able to cut across departmental boundaries and taking a systems-oriented rather than a machine-oriented viewpoint. The speakers from Univac and RCA were keen to promote the potential of

[477] John Hockman, "Specification for an Integrated Management Information System", Systems & Procedures Journal 14, no. 1 (Janurary-February 1963):40-41, page 40. Its author, manager of office systems and procedures for Canadian National Railways, claimed that this diagram represented a new consensus on "total systems."

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their machines as management tools, predicting the imminent emergence of a top-level staff manager to organize "every level and every kind" of information in the company via control of electronic and manual data processing, corporate planning and operations research activities.

MIS was in many ways an extension of "Integrated Data Processing" (IDP), one of the largest-scale and most technologically advanced systems activities of the mid-1950s. Integration here suggested that data be transferred directly from one office machine to another, using punched cards or paper tape, rather than retyped many times. New kinds of teletype machines and automatic typewriters even allowed transmission of orders directly from head office to remote warehouses. This promised accuracy, speed and efficiency. Although this concept predated widespread use of the computer, its appeal was only strengthened as computerization proceeded. MIS was IDP writ large, emphasizing better decision making rather than operational efficiency and additionally applying techniques from operations research to transform mere data into managerially relevant information.[478]

MIS appeared roughly simultaneously in military usage, with the 1959 publication of a US Navy report called "Data Processing in Navy Management Information Systems," credited to one John H. Dillion. Its usage here was strictly to refer to administrative systems, not to the real-time command and control systems that were to inspire some civilian concepts of MIS. Like the civilian variant, the military strain of MIS involved "more scientific management," the integration of operations research with data processing, a patina of feedback loops and cybernetic jargon, and a shift of emphasis from simple automation to overall managerial effectiveness. The end result

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[478] The idea of "integrated data processing" was originated at U.S. Steel and popularized through an AMA conference held in February of 1954. American Management Association (ed.), A New Approach to Office Mechanization: Integrated Data Processing through Common Language Machines (New York, 1954). J. M. Otterbein, "An Integrated Data Processing Application", Systems & Procedures 12, no. 4 (June-July 1961):19-30 deals with Integrated Data Processing using a variety of automated office machines but no electronic computers. While discussion on IDP was largely replaced by discussion of MIS and total systems after the early 1960s, it did not vanish entirely. See William F Blose and William P Carter, "Integrated Data Processing", Data Management 9, no. 3 (March 1971):14-18.

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was to be, "the ultimate management exploitation of 'Automatic Data Processing Systems' in AN INTEGRATED NAVY MANAGEMENT INFORMATION SYSTEM." This system would hold all administrative information for the entire service, to produce, "one whole 'Navy Memory'." It would be "a communication system" as well as a file – in the somewhat strained parlance of the military it was required to "communicate the directives which will cause the actions that fulfill the need."[479]

The report suggested that this would result in higher quality management, and a reduced need for assistants and advisers because their information-seeking role would be subsumed within the system itself. The Navy MIS would demand the crossing of organizational lines, the study of external as well as internal information requirements, and a director with direct access to top management. Managers would be able to interrogate the system interactively, and it would automatically link planning information with operations and check current achievements against objectives. In a strikingly futuristic prediction, the report suggested that long term developments would see, "a management information system primarily not of words and numbers, but in 'animated' shapes, symbols, patterns, colors, and other displays of analogies and simulations of organized resources."[480] But the report's impact was clearly intended to come in the very near future – it included detailed guidelines for computer procurement and the establishment of data processing groups that were intended to allow rapid integration of this unified MIS. Despite this very early endorsement of the concept, this work by the Navy received little attention in civilian circles and does not seem to have exerted much influence. (Both its relationship to the AMA group and any follow-up that may have taken place within the Navy remain intriguing topics for future research.)

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[479] For the Navy's embrace of the concept, see Dillon, Data Processing in Navy Management Information Systems, SecNavInst. P 10462.7.

[480] Ibid, II-4.

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In the civilian administrative systems community, however, the MIS concept spread rapidly, encouraged by a spate of subsequent reports and conferences sponsored by the American Management Association. In 1961 the association published the first book-length treatment of MIS, authored by James A. Gallagher, another McKinsey man. The same year, the conference program of the SPA was suddenly awash with papers on the "total systems concept." Throughout the early 1960s, terms such as "management information system", "totally integrated management information system," "total systems concept," "totally integrated data processing system," "totally integrated system," and "total system" were used interchangeably and ubiquitously by the systems men. The latter was the vaguest and initially the most popular.

## The Origins of Totality

What did this strangely ubiquitous "total" mean in the context of corporate administration, and why did the idea win such ready acceptance? Both are best explained as a combination of opportunism and misunderstanding resulting from the mangling of new "systems engineering" ideas as they entered the community of corporate systems men. Although the idea of "system" was widespread in Victorian business, by the 1950s its renaissance was strongly associated with the new world of high technology military contractors.

The United State's military build up of the early cold war placed an unprecedented emphasis on technological complexity. Two projects in particular - the SAGE air-defense network and the Atlas intercontinental missile - served to showcase a new "systems engineering" approach to the development of technology. In both cases, the need to develop and integrate a host of unproven technologies spurred the creation of new administrative structures themselves engineered to support the project. Aerospace projects like Atlas demanded that different characteristics like range, weaponry, acceleration, accuracy, and so on be traded-off against each

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other so that the overall weapon system functioned optimally. The systems engineer, unlike the lesser engineers working on subsystems, was concerned with the total system. [481]

The post-war language of systems has attracted considerable historical attention in recent years. It represented the construction of a new kind of expertise, founded not on detailed factual knowledge of any single domain but on a more general understanding of the allegedly universal principles of cybernetics and simulation. According to its adherents, concepts such as feedback and categorizations such as open system or closed system transcended their origins in engineering and underpinned biology, society, economics, business, and even psychology. Yet viewed in sociological terms, the actual realm of this systems expertise was far more specific. It surrounded the well-fed military contractors, the more forward looking of their compatriots in the armed forces and, above all, the water coolers and bulging foreheads of the air force non-profits of southern California. At the end of the 1950s, business was booming for the systems experts of the MITRE Corporation and the RAND Corporation. Their staff conducted research on machine translation, air-battle simulation, economics, psychology and a host of other areas. As the unfamiliar technologies of nuclear bombers and missiles invalidated traditional military strategies, the RAND staff were able to claim their experience in systems analysis and simulation as the basis of new approaches. Nobody, after all, had ever fought such a war. The people with

[481] For a recent collection of papers on the use of systems approaches in a variety of social arenas see Hughes and Hughes, Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After. SAGE, Atlas and the development of "systems engineering" techniques are discussed at length in Hughes, Rescuing Prometheus. For a treatment of SAGE's role in Cold War political culture, see Edwards, The Closed World: Computers and the Politics of Discourse in Cold War America. SAGE was frequently mentioned as an inspiration and proof of concept for elaborate planned commercial systems, for example in D.G. Malcolm and A. J. Rowe, "An Approach to Computer-Based Management Control Systems", in Management Systems, ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1967).

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mathematics, science, advanced degrees, and computer power on their side were better placed than anyone else to address these intricate hypotheticals.[482]

These technocratic impulses were part of a broader faith among the educated elite of America, a faith that rational analysis and a practical yet intellectual approach to problem solving would soon render obsolete the differences in politics and ideology that had marked earlier eras. Republicans and Democrats, business leaders and union leaders, rich and poor all appeared to be moving closer together. The systems approach promised apolitical means of government, in which petty parochial interests were subordinated to the optimization of the common good. Robert McNamara brought the systems approach with him to leadership of the Defense Department and the Vietnam War, while RAND and others were keen to apply their insights to the social problems and urban unrest targeted by Johnson's Great Society programs. In the end, of course, it all fell apart – along with faith in political consensus and the long economic boom on which it had been built. But at the end of the 1950s the military-industrial-academic complex was young and full of hope for the glorious future that lay ahead. With the power of total systems seemingly proven in the area of high technology aerospace projects, the cold war systems elite set about exporting it to the rest of American industry.[483]

In 1959, the Systems Development Corporation held a conference at its Santa Monica headquarters on the topic of "Management Control Systems." SDC, a 1957 RAND Corporation spin-off and key SAGE contractor, identified itself as "The Total Systems Company" on its

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[482] Despite moves by RAND to open its archives to historians, no full length scholarly history has yet been written. The role of systems analysis in RAND's defense work is treated in David A Hounshell, "The Medium is the Message, or How Context Matters: The RAND Corporation Builds an Economics of Innovation", in Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, ed. Agatha C Hughes and Thomas P Hughes (Cambridge, MA: MIT Press, 2000).

[483] McNamara's role in bringing systems thinking into the Department of Defense, and its subsequent spread through the federal bureaucracy, are the subject of David R Jardini, "Out of the Blue Yonder: The Transfer of Systems Thinking from the Pentagon to the Great Society, 1961-1965", in Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, ed. Agatha C Hughes and Thomas P Hughes (Cambridge, MA: MIT Press, 2000).

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brochures. Although SDC was, like its parent, a not for profit corporation, it was created explicitly to develop and build large-scale systems; whereas RAND itself was often said to stand for Research And No Development due to its theoretical bias. Done properly this development work was a lucrative business. As the first waves of what would eventually be a $150 million tide of cash flowed in from the SAGE programming contract, SDC began to look for additional projects and alternative sources of funds. In the decade to come, this would lead it toward the active solicitation of civilian projects, and an eventual conversion to for-profit status. In 1959, however, its growing interest in the application of its techniques to management seemed to coincide happily with an abundance of surplus cash and a public-service mission to spread the findings of the new "systems sciences" to new areas. These projects consumed its excess income while shining its public image and laying the groundwork for future contracts.[484]

While the systems men of corporate administration certainly looked up to the systems engineers and operations researchers of RAND, their community was largely separate from this cold-war elite (and even from industrial engineers and operations research specialists working in their own companies). The conference was therefore something akin to a summit meeting between the military-industrial systems elite and the corporate systems men and consultants pursuing administrative systems work. Its organizers were among the most industrially-oriented members of the SDC community. The main conference coordinator, Donald G. Malcolm, was past-president of the American Institute of Industrial Engineers, a veteran of General Motors, and

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[484] Other research projects included the "Leviathan" project to model the behavior of large social groups and another project to explore learning through programmed instruction. For use of the "Total Systems Company" tag on promotional materials see System Development Corporation, SDC: The Total Systems Company, n.d., contained in Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis (internal evidence suggests that this dates from the late 1960s). As late as 1981, an executive vice president of SDC was still sticking to this language, when he claimed that, ""Throughout its history, SDC's dominant strength has remained the same: the design of the total information system." Baum, The System Builders: The Story of SDC, 7. For the reference to "Research And No Development" see Hounshell, "The Medium is the Message, or How Context Matters: The RAND Corporation Builds an Economics of Innovation".

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former head of Operations Research for consulting firm Booz, Allen and Hamilton – in which capacity he designed the hugely influential PERT project control system for the Navy's Polaris program. In the context of this conference, Malcolm must have appeared a bridge between the mathematically oriented, scientific world of SDC and the grubbier realities of practicing corporate systems men.

The conference marked the start of a planned research program to which SDC publicly promised to devote half a million dollars per year for the indefinite future. Its goals were not modest. SDC felt that its previous experience in military systems offered "a distinct opportunity for innovation in management controls -- an opportunity to make a quantum jump in the field to a total integrated system… a task heretofore untackled and one of tremendous scope."[485] This was expected to solve the many problems posed by the increasing size and complexity of business, problems for which existing measures such as additional layers of management and new staff functions could, according to SDC, only be temporary solutions.

SDC was inclined to overestimate the applicability of its existing work to the construction of general purpose, civilian management systems. While most of the conference speakers threw around the language of automated control and pondered the merits of closed and open loop systems, they were hard pressed to map these lofty ideas directly onto the actual activities of top management. M.O. Kappler, president of SDC, suggested that because on-line, real time control systems such as SAGE, "connected to… automatic data inputs" and presented information on the "operation while it is in progress" they had an important role to play in business. The needs of top management, he suggested, were similar to those of military command and control. Kappler assumed that more than just the general concept of an on-line, real-time system could be transferred to industry. "In developing military systems," he said, "we have

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[485] Malcolm and Rowe, eds., Management Control Systems, viii.

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learned to provide aids for decision making. The problems in business should be amenable to a similar approach."[486]

According to Kappler, the firm planned, "to learn how to establish a management control system that would be as integrated and as automated as we can make it." This effort would start with rapid simulation on computer – only later would data from real firms be gathered to validate and enrich the model. At this suggestion, even James Gallagher, then a systems man at Lockheed and already an ardent proponent of total systems thinking, cautioned that, "[r]ather than attempting to apply the military systems experience, maybe research on business systems should start at a much lower level." Yet SDC's operations research staff appeared deeply wedded to the idea that fundamental breakthroughs in any field could come only from scientific work under laboratory conditions. Alan J. Rowe, a former academic and head of the SDC Management Controls Research group, conceded that, "interaction with the real world" might "possibly" produce useful thinking. He insisted, however, that this could never produce the "fundamental laws" required. "What is needed," he said, "is fundamental research where one can test hypotheses through experimentation. Further, I can't see how this experimentation can be done in the real world."[487]

Though these men do not seem to have had a particularly clear idea of what a "fundamental law" of management might look like, they were quite clear that it would be scientific. Thus Sisson could state, with little more than metaphor to guide him, that, "it keeps occurring to me that most of the advances in other sciences are made by people who are quite far

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[486] M. O. Kappler, "The Opportunity for Innovation in Management Controls", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).

[487] The discussion between Kappler and Gallagher is from Ibid. Rowe's comments are from John F. Lubin, "Some Basic Questions", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960). John F. Lubin of the Wharton School and Roger L. Sisson (Canning's longtime collaborator, at this point a systems manager for Ford's "Aeroneutronic" division) both endorsed the idea that, "basic system research" must take place outside actual businesses.

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removed from the physical experiments." The truth of this assertion was dubious at best, but it gives a powerful insight into the thinking of the group. If managers did not as yet think of themselves as scientists, or act like scientists, then the answer was not to stop thinking of management as science but to wait for managers to change their natures. Rathe, the office management professor turned information systems pioneer, asked, "How can management ever achieve the obligations of a profession if it isn't backed up by one or several disciplines?" Malcolm went further, suggesting that, "over the long run, if the individual manager doesn't measure up to some sine qua non, he isn't a manager very long after that. These standards may not be easily or generally defined but they must exist... I am certain that in ten or fifteen years time we can expect to have a management profession." It does not seem likely that Rathe expected most of those currently employed as managers to make the grade.[488]

Practicing systems men, with experience in the realities of life in an administratively-oriented corporate staff group, immediately spoke up against these hothouse dreams. H. Ford Dickie, a senior systems figure at General Electric, argued that to wait a decade in hope for fundamental breakthroughs and optimal solutions would be foolish when there were practical solutions available today. He called for "smaller, cleaner projects" because "the motivation is greater, the results more quickly useful, and the ideas more easily conveyed to operating management."[489]

Dickie was no skeptic when it came to systems thinking. In fact, he gave an early and enormously enthusiastic statement of the civilian version of total systems thinking. This makes his refusal to endorse SDC's hopes for a dramatic conceptual breakthrough even more striking. Dickie agreed that application of "the kind of technique RAND and other organizations have

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[488] Sisson's remark is in Lubin, "Some Basic Questions". The others are found in Harold O. Davidson, "Research and Development in Management Controls", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).
[489] Lubin, "Some Basic Questions".

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devoted to military systems problems" was vital for GE. He claimed the firm was already applying it to link the office and the factory, "break historically accepted business systems patterns" and fundamentally redesign its operations without regard to "conventional organizational or functional divisions." He also saw the computer as a fundamental part of this transformation: "true integration should follow lines of information flow; it should cut vertically through all functions in a product line... by having all the information processes linked together inside the computer, it is unnecessary for each function to duplicate the others' files."[490]

The most impassioned rebuttal of the dream of management as a cybernetic science came from H. O. Davidson, himself a senior operations research consultant. In likening this endeavor to the excesses of scientific management he made a comparison that its adherents would have found most objectionable.

> There have been earlier explorers and quite a few have left their bones on the field. In fact, there have been organized parties in or near this field continuously for the past eighty years, and most of them have perished. There are only a few survivors left of the "Scientific Management" party, which came upon hard times because it understood too little of science. If misfortune comes upon the presently active "Management Science" group it will be, I predict, because it understood too little of management. Among some members of this group, the "executive" has already slipped away into a dim abstraction—a little black box concept called "decision maker."[491]

This meant that the usefulness of abstract models was likely to be negligible. Davidson's suggestion that, "one really has to go out and study management, not sit back and say 'Let's write some equations about management'," was seconded by Andrew Schultz of Cornell's Industrial

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[490] H. Ford Dickie, "Integrated Systems Planning at G.E." in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).

[491] Harold O. Davidson, "Management, Engineering and Scientific Functions", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960). Davidson's critique also showed a surprising discomfort with the concept of science itself that was implicit in SDC's agenda. He suggested that science itself was a creative and subjective enterprise, in which objectivity was not an absolute but "is defined by rules agreed upon by scientists in the field as being appropriate." These rules did not appear to apply very well to management. Science, he pointed out, was concerned with the publication of results, not the implementation of systems. The appropriate model, he felt, lay elsewhere: "the scientist who wants to be directly helpful to executives had better learn to 'act like' an engineer."

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and Engineering Administration department. Schultz suggested that, "I cannot conceive of a management control systems model any more than I can conceive of an electronics control systems model which has anything more than the grossest conceptual value." While such models might, he conceded, have been useful in the context of SAGE, where the parameters were well defined and highly demarcated, he thought the approach quite absurd in an attempt to solve the problems of management for the general case.[492]

Warren E. Alberts, VP of Industrial Engineering for United Airlines, was uncomfortable with a too literal translation of military control concepts. Picking up on the cybernetic underpinnings of the comparison, he suggested that:

> we might compare business to a missile. We can think of the thrust section as the operating organization, the programmed section as the plan to hit the target or goals, and the nose section as the control system. But now we run into some real differences. First, management is not sitting in any bombproof control section, but is riding with the missile; second, the thrust section, a man-machine organization, is extremely variable and dynamic. In addition, the real target is never seen, only sensed, and its position is only guessed at.[493]

Such reservations explain the failure of SDC's concept of "management control systems" to thrive in the corporate sector (despite, it must be pointed out, both the ubiquity of systems talk and the continuing use of "control" to describe the work of the controller and the internal accounting systems he supervised). "Management control," it soon became clear, was a phrase which appealed primarily to the militarily and academically inclined participants. Corporate systems men felt more comfortable advocating management <u>information</u> systems than management <u>control</u> systems. It was one thing to inform managers, and quite another to control them. Alberts tackled this head on with his opening suggestion that, the "term 'control' in management control systems is easy to use but hard to define. It has unfortunate reactions when

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[492] Ibid.

[493] Warren E. Alberts, "Proper Perspectives in Developing Management Controls", in <u>Management Control Systems</u>, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960).

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transferred too literally from physical to human systems. A better term to use would be 'information' in place of 'control' so that we can concern ourselves in a positive fashion with the total communication interchange within a business organization."[494]

To adapt a famous quip, one might speak of the cold-war military-academic systems elite and the industrial systems men as two communities divided by a common language. The language in this case was the putatively universal language of systems – feedback, control, totality, hierarchy, modeling, and automation. One can, of course, draw some direct connections between the two groups. In addition to the corporate interests of firms like SDC and individuals like Jay Forrester, it is easy to point to other connections: the ostentatious and often facile use of systems theory in many MIS and industrial systems textbooks, the continuing importance of systems concepts and operations research in many business schools, and periodic attempts by consultants to persuade firms to build elaborate electronic control centers modeled on SAGE and its descendents.

It would, however, be a mistake to view the two groups as merely opposing sides of the same coin. The administrative systems men were not merely acting out their own part of some larger discourse, as the passive recipients of techniques and attitudes shaped elsewhere. While they were happy to draw upon the mystique of this new and powerful version of the systems concept, it does not appear to have exerted a fundamental influence on their thinking, their techniques or their motivations. These evolved gradually over the course of the twentieth century, and as we have already seen can be traced back to Taylor and to Leffingwell far more convincingly that to RAND or the military.

Even when corporate systems men borrowed phrases, such as "systems analyst" or "total system" the meanings of these terms were altered in translation. Some definitions of "total"

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[494] Ibid.

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corporate systems preserved the original systems engineering sense: totality meant that processes were coordinated and decisions evaluated according the interests of the firm as a whole rather than the parochial concerns of different departments. This was apparent at the SDC conference, when Rowe argued that this was particularly important because lower levels of management, "are not in a position to see how their actions affect the performance of the system as a whole." Kappler boasted of SDC's success in achieving this with its System Training Program for SAGE, saying that, "the way to fight it is to be sure that the team result is visible to the one who is suboptimizing. He must see how his actions affect the total system." Of course, how to build such a model of the company was quite a challenge. [495]

A similar sense of total is given in one of the first reports on MIS issued by the AMA, written by Robert M. Gordon, then the Associate Director of the Stanford University computer center but soon to employ his mastery of systems jargon as an Arthur D. Little consultant. "The choice of the adjective "total" to describe an information system is not an accident. It is meant to signify that the information system is intended, primarily and specifically, to satisfy the needs of the whole enterprise." Gordon was also clear that this represented a decisive break with the lower status activity of data processing. "A total information system is concerned with generating information, not merely processing data--an important distinction. The former activity includes the latter, which is but a small part of it. Unfortunately, data processing has developed a certain connotation of passivity, in that it seems to be concerned largely with record-keeping to provide evidence required by law, custom, or prudence."[496]

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[495] Gallagher, "Organization of the Data-Processing Function".

[496] Robert M. Gordon, "The Total Information System and the Levels of Data Processing: An Exploratory Analysis of the Uses of Business Data Processors", in Data Processing Today: A Progress Report -- New Concepts, Techniques and Applications -- AMA Management Report Number 46, ed. American Management Association (New York: American Management Association, Finance Division, 1960).

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"Totality" was an essential goal in a systems engineering project, such as the Atlas missile, where functional specifications could unambiguously describe the performance of the system as a whole and the results of trade-offs at the component level could be scientifically evaluated. This kind of systems engineering was well suited to high budget, urgent military research and development projects. But discussions of the kind conducted at the SDC conference show that the application of these engineering project management techniques to the general setting of corporate strategy was not so much unsuccessful as impossible – nobody could figure out what the system was, or how to represent its goals.

As the phrase "total systems" percolated though the broader systems and data processing communities, subtler definitions were soon crowded out by the idea that a "total" or "totally integrated" system was simply a system that had everything in it. Exactly what made a system "total" was never quite agreed upon. For the systems men, the power of this phrase rested primarily in its opposition to the unsatisfactory and limited nature of existing arrangements. It enshrined their long sought right to cross organizational boundaries at will. An early book devoted to the subject introduced the total system as a "totally automated, fully responsive, truly all-encompassing information system embodying the collection, storage and processing of data and the reporting of significant information on an as-needed basis." Despite the obvious problems inherent in building such a system, similar definitions were widely propagated throughout the 1960s. [497]

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[497] The quote is from Alan D. Meacham and Van B. Thompson, eds., Total Systems (Detroit, MI: American Data Processing, Inc., 1962) J.W. Haslett, "Functions of the Systems Department", in Ideas for Management: 14th International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1961). For the SPA conference, see Roger W. Christian, "The Total Systems Concept", in Ideas for Management: 14th International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1961) and other articles in same volume.

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ORGANIZATION STRUCTURE BASED ON INFORMATION FLOW

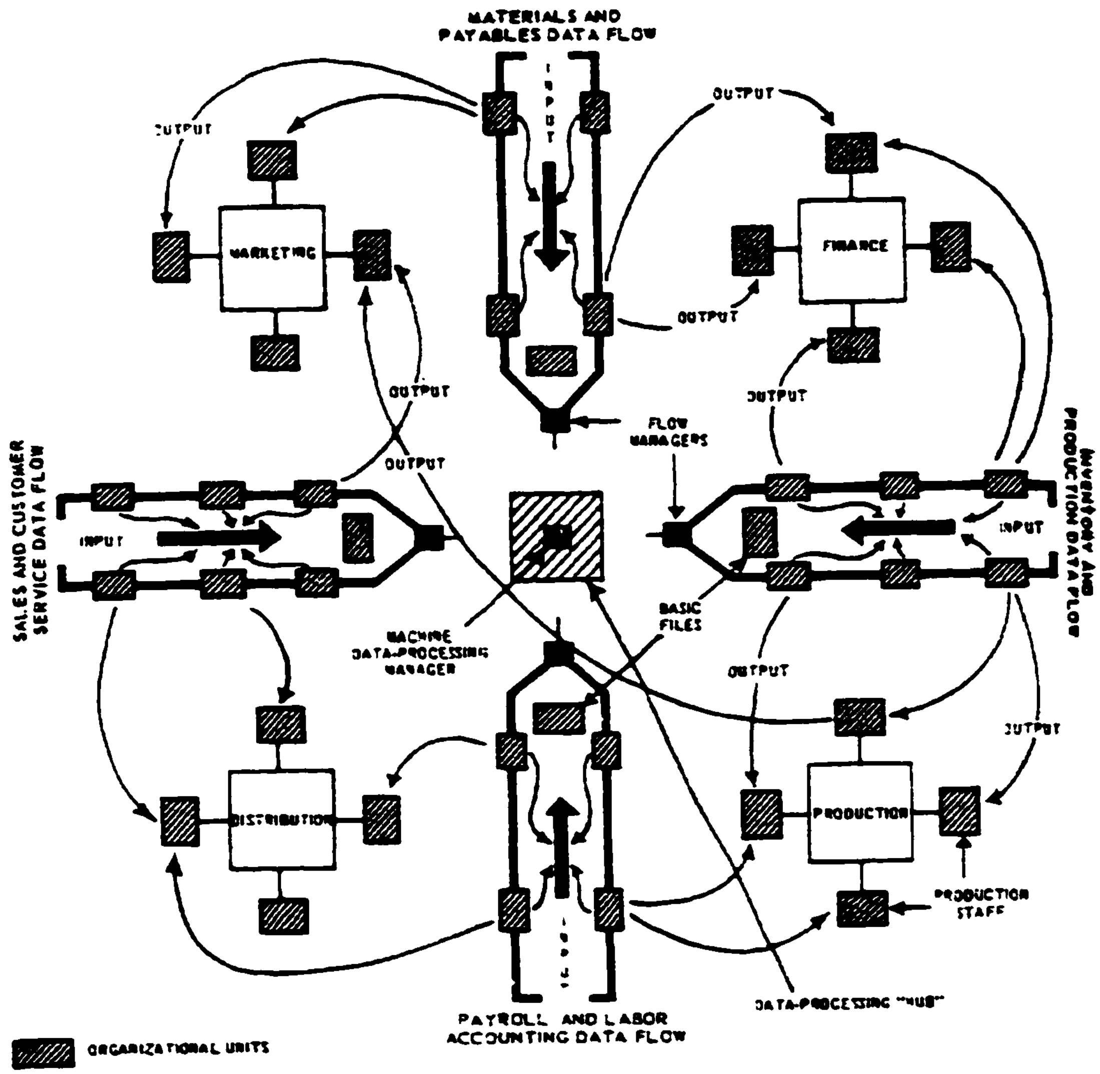


**Figure 24: A chart of "Organization Structure Based on Information Flow" presented by the International Latex Corporation to illustrate its planned integration of operations around the "total systems approach."[498]**

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[498] Lionel E. Griffith, "An Outline of Organization for the Vice President/Director of Administration: His Responsibilities, Objectives and Contributions as a Top Management Official", in Shaping a New Concept of Administrative Management: Administrative Services as a Top-Level Corporate Function -- AMA Management Report Number 55, ed. American Management Association (New York: American Management Association, 1961), 38. Note the influence of cybernetic feedback concepts, and the central position of the 'Machine Data-Processing Manager" and the "Data Processing 'Hub'."

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As the total systems concept spread, the exact meaning and degree of its totality were earnestly discussed. Most definitions insisted that this meant the whole of the firm's operations, although opinions differed as to whether this implied that everything had to be computerized. Even the limits of the corporation itself were insufficiently total for some, who suggested ("our earlier 'total systems' thinking may have fallen short conceptually of the real meaning of 'total'....") that the system should tie together companies with their customers and suppliers. To be truly total, a system would have to include everything from the smallest inventory item to an overall model of the economic sector in which the company worked.[499]

The Hughes Aircraft company provides an example of what a full scale attempt to organize around "total systems" was liable to mean in practice. Aerospace contractors were the first firms to adopt the systems engineering approach to high technology project management, so it is not surprising that they were also among the most enthusiastic in the attempt to apply these methods to the more general problems of administration. Borrowing a phrase from military computing pioneer Jay Forrester, the firm set up an "Industrial Dynamics" department early in 1959. According to a case study presented to the AMA, the "basic philosophy behind the entire operation was the total-systems approach, and the mechanism for implementing this approach was the organizational integration of computers, systems design, and operations research activities." To this end, the entire data processing staff, its computers and its "acres" of punched card machinery were merged into the new department and responsibility for systems work was centralized.[500]

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[499] Felix Kaufman, "Data Systems That Cross Company Boundaries", Harvard Business Review 44, no. 1 (January-February 1966):141-55. For systems in organization theory, see Fremont E. Kast and James E. Rosenzweig, "General Systems Theory: Applications for Organization and Management", Academy of Management Journal (1972) and W. Richard Scott, Organizations : rational, natural, and open systems (Englewood Cliffs, N.J.: Prentice-Hall, 1982).

[500] John T. Pettit, "Industrial Dynamics in Action", in Advances in Management Information Systems. AMA Management Bulletin No. 16., ed. American Management Association (New York: American Management Association, 1962).

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Hughes was thus attempting to do what so many before and after had urged: to harness the computer as part of an independent, integrated department devoted to the most important challenges faced by management. The results, however, were disappointing. This was blamed, in large part on the background of the programmers involved, whose experience had been in programming simple financial applications and, "whose background as tabulating-machine operators limited the use of the computers to that of a high-speed tabulating machine." As we saw earlier, continuity of data processing staff from the tabulating era to the computer era exerted a powerful force on the shape of corporate computer operations, and one which a mere name change and corporate reorganization was unlikely to shift. In this case, decentralization and severe cutbacks followed a dip in defense spending in 1960. The group claimed some successes in an early application of the PERT project control system, and in using what it claimed to be America's largest RAMAC installation to issue real-time reports to foremen on jobs in progress. Before long, however, responsibility for computer operations and programming was removed from the industrial dynamics organization and returned to the controller. By 1963, a much smaller internal dynamics group was "primarily devoted to the development of systems packages" with internal departments as its customers. The author speculated that the original mission might have been premature, because there were, "still far too few people coming out of the business schools who have had sufficient training in the use of advanced management techniques and tools to understand what the potential really is."[501]

## "Two Paths Diverge": The Systems Men and the Computer

Why did MIS concepts spread so fast through the rank and file of the systems movement during the early 1960s? A close examination of the systems and procedures literature of the late-

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[501] Ibid.

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1950s and early-1960s suggests that this was because the idea of a totally integrated management information system allowed the systems men to solve an increasingly pressing dilemma: how to reconcile the technical nature of computer work with their managerial aspirations.

MIS, and the concept of the computer as an information machine, proved far more attractive to the systems men that the earlier concept of the computer as a data processing machine. The computer had loomed above the systems men of the late 1950s, offering what seemed an insurmountable opportunity to overcome their managerial marginality. In a 1958 speech, F. Walton Wanner, president of the Systems and Procedures Association (SPA), had argued that the computer "opens doors heretofore not open to systems activities." Acknowledging that top management had previously been at best "half-hearted" in its attention to paper-handling techniques, he optimistically suggested that the appeal of the computer had changed this apathetic attitude. The new electronic tools allowed the systems man to cross departmental lines at will, "merging and consolidating work on a truly functional basis," eliminating unnecessary departments, and "re-engineering and replanning the entire system."[502]

A similar idea was presented by Whisler himself, who suggested in a 1960 article that the computer was in effect a Trojan horse for the forces of management modernization: "the installation of computers and other information processing techniques very often permits other procedural and organizational changes because these are believed to be part of the computer 'package'. The computer, in effect, becomes the vehicle for other desired changes."[503]

By the end of the 1950s, the domain of the systems men was under threat from the highbrow modelers and analysts of operations research, as well as the newly ascendant forces of

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[502] Wanner, "Design for Controlled Professional Development," 1958.

[503] Thomas L. Whisler and George P. Schultz, "Information Technology and Management Organization", in Management Organization and the Computer, ed. George P. Schultz and Thomas L. Whisler (Glencoe, Illinois: Free Press, 1960).

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data processing. The number of potential rivals seemed to be multiplying. As a senior consultant for Arthur Andersen reported in 1961, "[i]n many companies today we find that in addition to a so-called systems department there may be an operations research group, an electronic data processing group, a cost accounting group, a clerical cost control and work simplification group."[504]

The consultant's suggestion was that industrial firms follow the example of Andersen itself and reorganize all these functions into a powerful "Administrative Services" group, headed by a forward thinking systems man. He felt that the vague and misleading phrase of "systems and procedures" was actually holding back more general acceptance. "When I speak of upgrading the systems function, perhaps one of the first things we should do is to try to eliminate this somewhat confusing name for our work."[505] The administrative services tag also won support from the American Management Association, which used the name for one of its own divisions. The term enjoyed a minor vogue in the early 1960s, during which it was often associated with the total systems concept. Together with "management services," it found its way onto some business cards and organizational charts.

It was, however, ultimately to MIS that the systems movement turned in search of a redefinition and an upgrade. The rapid and widespread proliferation of MIS was a result of its ability to unite these many separate groups more effectively than the relatively weak concepts of systems generalism or administrative services. The systems men felt themselves to be the best placed to oversee the integration of this unified system of systems. As one wrote in 1962, "The successful enterprises in the future will be those that learn to master the problems of creating,

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[504] Joseph E. Carrico, "Research in the Field of Business Systems", in Ideas for Management: 14th International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1961).

[505] Ibid. Criticism of the term "systems" on the ground that it "fails to convey the real significance of the activity, and has in fact been preempted by the industrial engineering profession" had been made as early as 1957, but does not appear to have spread widely. Anonymous, "Editorial: The Genie Out of the Electronic Computer", Systems and Procedures 8, no. 4 (May 1957):38-39.

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processing, and disseminating information.... The present outlook of industrial engineers is too narrow; the operations researchers are too far up in the blue; and the accountants are too restricted in viewpoint to do the job."[506]

For many systems men, the combination of the computer and the total systems concept appeared as a means of demonstrating to the rest of the company, and in particular to the controller, the long-familiar virtues of clerical centralization. In 1963, Robert H. Long, one of the pioneer members of the SPA and a member of the office management group NOMA, suggested that administrative services had been "tendered a secondary place" and so "costly results" from the preoccupations of controllers on other matters had "gone unidentified." Controllers had "been able to hang onto their own stenographic typing, copying and clerical services partially because of a general misconception that they can be handled with one hand tied behind one's back." The result was a lack of respect for the systems man. "What monopoly on expertness to these new upstarts maintain? Anyone can design a form, pick out a copying device, write a procedure."[507]

"Of course," Long continued, "developing a data collection and transmission application and a computer program is different." He challenged his fellows to embrace information and the computer as the key to a new kind of systems work. "Now the systems man, as he should have at the advent of EDP, must appear to cross departmental fields, operating as a professional with a basic philosophy and a concept of the total field of business information processing." Controllers soon "must recognize the handwriting on the wall and quit resisting the inevitable." A focus on information also put the existing computer staff in their place. A programmer, he suggested, "doesn't approach professionalism as a specialist in his particular line unless he's doing his

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[506] John W. Field, "Management Information Systems: A Report on Techniques", in Advances in Management Information Systems. AMA Management Bulletin No. 16., ed. American Management Association (New York: American Management Association, 1962).

[507] Robert H. Long, "You Can't Have Your Cake and Eat It!" Systems & Procedures Journal 14, no. 4 (September-October 1963):20-24.

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programming job supported by a strong systems philosophy and concept of the total field of business information processing."[508]

Unfortunately for Wanner, Long, and their colleagues, the jurisdiction of corporate systems men over the computer was unclear during the 1950s. As we have seen, administrative computing rapidly became associated with data processing, an identity which stressed the continuity between computers and punched card machines. The NMAA was keen to position its own members as the leading force in administrative computing. Following its 1962 conversion to become the Data Processing Management Association (DPMA), its executive director, Calvin Elliot, insisted that the new profession demanded a "combination of line and staff responsibilities." This threatened to usurp the territory of the systems men themselves.[509]

Systems men were already acutely aware of this prospect. In 1957 a Systems and Procedures editorial called, "The Genie Out of the Electronic Computer," asked, "Why have the top executives of American business, who have so long been indifferent to the systems man's struggle to integrate their companies' clerical effort, suddenly had their imagination captured by the EDP complex?" It answered its own question with reference to the "mystery and glamour" of data processing hardware, the high cost of such systems and the "startling claims of savings cost and output." Its author suggested that such savings must, in reality, "bear witness to the antediluvian state of their paper work operations before EDP," but cautioned that top management might not see it this way. Thus, while the new technology would make executives realize that, "all paperwork is independent" and must be controlled by a single top-level executive, it was by no means clear that the systems man would be able to claim this spot for himself. "Herein," he continued, "also lies a grave implication affecting the system man's future.

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[508] Ibid.

[509] R. Calvin Elliott, "DPMA: Its Function & Future", Datamation 9, no. 6 (June 1963):35-36.

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Can he convince management to keep the electronic computer in its proper place as another tool to be used in data processing? Or will the glamour of EDP result in the tool being wrested from his grasp and cause him to evolve into a mere adjunct to the machine?"[510]

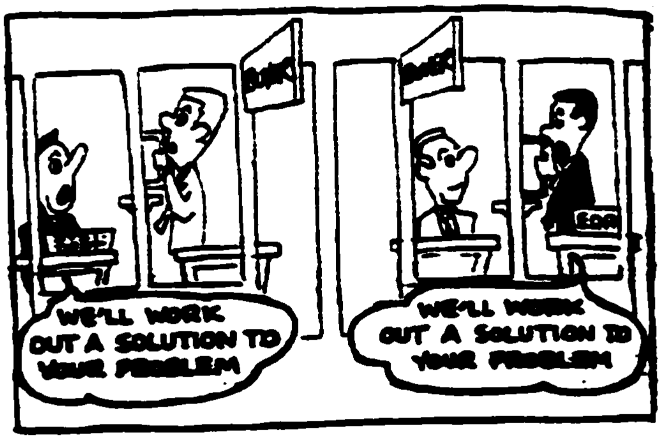


**Figure 25: Systems men worried that EDP (Electronic Data Processing) departments were taking over their responsibilities.[511]**

Despite its undeniable attractions, involvement in data processing threatened two key goals of the systems men. The first, shaped by the earlier failure of the office managers to overcome their role as head clerks, was to avoid at all costs becoming direct supervisors of clerical production. They wanted to define new administrative systems as consulting staff experts, not oversee their daily operation as plodding office supervisors. Thus William C. Gill, systems man with Douglas Aircraft, warned that if machine accountants aspired to the status of systems men, they must, "leave their line responsibility of machine or electronic computer operations behind them and render more pure their systems approach. Systems should not, then, carry a line responsibility for machine operations along with its basic staff function." This opinion was endorsed by a panel, chaired by Gill, at the 1958 SPA meeting, where all involved agreed that the "operation of electronic data processing is a line or operating function and therefore should be

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[510] Anonymous, "Editorial: The Genie Out of the Electronic Computer".
[511] Long, "You Can't Have Your Cake and Eat It!" page 22.

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outside the scope of this discussion, and let me add out of the systems management field generally."[512]

Their second overriding goal was to remain management experts rather than technicians specialized in one or two tools. Those working intimately with computers found themselves immersed in a new world, which demanded the acquisition of specialized, craft-based technical skills. During the late 1950s, an increasingly wide cultural gulf separated computer programmers and analysts from their former comrades in accounting, office management, and systems and procedures. Neuschel himself, author of the systems and procedures bible Streamlining Business Procedures, was quoted by Fortune in 1957 as saying that electronic equipment was rarely needed and that he had "not yet recommended EDP to a single client."[513] Scarcity of experienced computer staff raised their pay and made it easier for them to move between than within companies, ensuring that data processing staff bonded more closely with each other than with their non-technical colleagues. Many systems men had a particularly low opinion of the new breed of so-called systems analysts without experience in broader administrative work. One, the systems manager for an Okalahoma oil firm, slammed the EDP specialists who had "buffaloed management [but whose] bubble was now bursting." While such technicians had "perhaps, a real talent for working with numbers," they could not compare to the true systems man who remained, "a professional advocate of the management techniques." Of course, the same author also had little time for "former systems men [who] have joined the ranks of EDP or computer technicians and abandoned the systems profession."[514]

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[512] The first quotation is from William C. Gill, "Systems and the Systems Function", in Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, ed. Gibbs Myers (Detroit: The Systems and Procedures Association of America, 1958), 353, the second from Gill, "Systems and the Systems Function", 259-60.

[513] Neuschel was quoted in Perrin Stryker, "What Management Doesn't Know Can Hurt," *Fortune* 56 (Nov. 1957).

[514] The quotes are from John T. Leslie, "Are Systems Men Industry's Displaced Persons?" *Systems and Procedures Journal* 14 (Nov.-Dec. 1963): 30–3.

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As early as 1958, one management consultant issued a call for a return to systems fundamentals:

> The feeling is slowly gaining among systems personnel that we have perhaps permitted ourselves a bit too much concern with the theory, application, and mechanics of electronic computers at the expense of the basic techniques of our profession. Most of us would be hard pressed to remember the last time that the pre-dinner discussions at a chapter centered around how to write and present a good report or what constitutes good interview procedure; it has become much more fun to speculate on the potential uses of a machine which will do, not thousands, but millions of additions a second.[515]

Yet Wanner's point remained valid. The computer was an opportunity as well as a challenge. In an address to the 1961 SPA conference, a senior Arthur Andersen consultant who specialized in EDP summed up the situation. On the one hand, if systems men ignored progress being made in data processing, "you may wake up one day and find that the top executives of your company have created another department to study the potential of this new development and that you, as a systems man, will have been left behind." But, on the other hand, systems departments were already paying too much attention to technicalities and ignoring important subjects such as inventory control, cost accounting and operations research. The future, he believed, was bleak for systems departments unable to take control of the computer and apply it to better ends. In most companies, "the emphasis seems to be on forms design, punch card mechanization, computer mechanization, and other similar technical areas.... if you are strictly a systems technician you are using the brains of other people and helping to implement the original thoughts created by others. It is seldom that a mechanic achieves stature in an organization."[516]

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[515] Pomeroy, "Basic Flow Charting Techniques", page 2. The "back to basics" plea can be found in A. J. Leighton, "The Real Job of Systems and Procedures", Systems & Procedures Journal 13, no. 1 (January-February 1962):15-17; Ray Marien, "Forms Control: A Reappraisal", Systems & Procedures Journal 14, no. 3 (May-June 1963):44-45 and Edward M. Grapp, "Adder or Space Machine But Nothing In-Between", The Office 51, no. 1 (1960):166, 263-64.

[516] Carrico, "Research in the Field of Business Systems".

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The computer had the attention of top management, a distinct glamour, and a degree of tangibility and security that more traditional systems could never match. The challenge to the leaders of the SPA was to assert control over the computer without seeing its membership trade their managerial dreams for careers as either programmers or high technology foremen. To cast one's lot with the data processors was to give up the dream of becoming a true management specialist. "[Is] this tool becoming the master instead of the servant? Is the analyst turning into an artisan making application of punched card and magnetic tape equipment?" asked one of their ilk in 1960. An analyst for Air Canada lamented that, "a misled faith in the computer 'cure all' was sometimes abetted by mesmerized systems and procedures personnel who were so engrossed in working out the complexities of machine procedures that they unconsciously became completely computer-oriented and convinced that machine handling [was] the 'only way'."[517]

A third, and related challenge, was the perpetual headache of trying to reorganize the departments and procedures of entrenched line managers while armed with only staff authority. While Gill was staunch in his insistence that systems men should never be part of a department that was responsible for operating computers, others favored a push into new areas. As we have seen, the concept of "staff" authority was a mutable one – an amalgam of Urwick's military vision of executive assistants and advisors and a more functionally oriented conception of staff specialists as experts with direct authority over things like accounting, personnel or legal contracts. While Neuschel had condemned as incompetent any systems man who blamed his lack of success on the failure of top management to compel divisional managers to implement his recommendations, systems men continued to chafe against the limits of advisory roles.

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[517] The first of these is George W. Brook, Jr., "A New Look", Systems & Procedures 11, no. 1 (February 1960):7-15; the second, William Heshka, "This Point Cannot Be Overemphasized", Systems & Procedures Journal 17, no. 4 (July-August 1966):48-49.

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With the emergence of new technologies, some were quick to declare the line/staff division obsolete. While a simple staff position might make perfect sense for an "analyst," systems men were becoming increasingly vocal in their demands for more. In 1960, John W. Haslett, systems head for Shell Oil and one of the founders of the SPA, suggested that the character of the job had changed. While analysis of existing systems had once been a crucial part of the job, the focus had now shifted toward the design of new ones ."Putting ideas and operations together in systems and procedures work," had, according to Haslett, "become a much greater consequence than the simple analysis of the ingredients." The systems man must become a unifier of other specialties, able to communicate their results to top management and take on a "new role as leader of the systems 'integration' movement."[518]

Haslett saw the computer and operations research as an opportunity to tackle the problems of the company as a single, integrated system "without regard to departmental lines." As he put it:

> the present emphasis on electronic computers has projected the former analyst into today's new role - that of the synthesist. One technology he has freely borrowed is operations research..... The systems man, using the team approach, as in operations research, has sought knowledgeable help in his problem from other types of company specialist; the communications engineer, the data processing programmer and the manufacturing or production specialist, for example. Together they have evolved the concept of integration among administrative processes, procedures, and systems on a company-wide basis.[519]

In 1960, no less an authority than Douglas McGregor, whose Theory X and Theory Y on human motivation remain to this day a fixture in every introductory management course, warned that the problems in the line-staff relationship threatened to hamper the application of information technology. According to McGregor, staff experts were underpaid and their help was seen as interference by others, and often sabotaged. Middle managers regarded any staff group with

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[518] Haslett, "A New Role for the Systems Man".
[519] Ibid, 39-40.

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independent authority as "narrowly concerned with their own specialty, long-haired, impractical, indifferent to line concerns."[520] These problems were well known inside the systems field. In 1962, Matthies admitted himself frustrated by managers' continuing indifference to the potential of staff work. "Far from making good use of staff workers," he wrote, "most managers seem to suspect them or even to fear them." They continued to "give lip service to systems" while restricting its role to forms control, feasibility studies and the occasional manual. Not even an influx of MBAs seemed to do the trick. "You'd think that particularly some of the younger managers coming out of school now.... and just beginning to get into the middle and top management ranks... would pick up systems and really run with it. But they don't."[521]

Faced with this situation, some systems men were less willing than Matthies to maintain their faith in the staff concept. One 1965 article suggested that the line-staff divide was entirely obsolete and called for a more functional approach, one which recognized "the fact of multiple supervision." It warned that, "we are the captives of a philosophy which declares that certain individuals who are called line shall be charged with the responsibility of running the business while certain other individuals who are called staff shall be charged with the responsibility of proving that they are running it wrong," something the author viewed as an unnecessary and "mutually destructive" struggle.[522]

According to another systems man, he and his colleagues were working on behalf of top management, and therefore had not just a right but a duty to impose fundamental change. "During the course of the systems study," he wrote, "the analyst must not seek approval from operating department managers.... In fact, the purpose of system is to convince management that new

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[520] Douglas McGregor, "What Have Computers To Do With Management?" in Management Organization and the Computer, ed. George P. Schultz and Thomas L. Whisler (Glencoe, Illinois: Free Press, 1960), 105. Discussion of information technology is on pages 115 to 117.
[521] Matthies, "The Systems Function in Management".
[522] Boyle, "How to Integrate Line and Staff".

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approaches are feasible and necessary, and to make acceptable that which was once unthinkable...." Rather than meekly serving managers, the systems group should be, "assigned the task of instituting order, efficiency and service and must attack the status quo with vigor and an occasional punch below the belt." Existing management was part of the disease, not part of the cure. "The basic problem is that the management that allowed the old, cumbersome, inefficient system to develop is usually still present and perpetuating itself and its methods." Eschewing the idea of a customer service approach, he insisted that the "new race" of ambitious systems men (headed, presumably, by Wharton graduates such as himself) should take charge. These young men, he boasted, would seek responsibility and personal credit for their ideas above all else (particularly popularity). Should it be necessary, the systems man must be willing to appeal for top management's support against any resistance he might meet - and while this would spend his political power by alienating the reorganized department, a major success would reap "dividends of power" and prestige.[523]

The leaders of the systems movement thus faced three challenges: to stave off the challenge of data processing and reassert the value of managerially-oriented generalism in the face of a glamorous and tangible new technology; to take control of the computer without becoming mere narrow technical specialists themselves; and to gain power to reorganize managerial structures and force new systems on unwilling line managers while operating from an advisory staff position.

These issues threatened to split the systems movement. Only the new ideas of total systems and management information held the promise of reconciliation. In 1963, R. Lee

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[523] Milton C. Spett, "Modern Systems Management and the Systems Game", Systems & Procedures Journal 17, no. 6 (November-December 1966):22-28, 26. The systems game of the title is the cowardly tendency to play politics and to seek personal advancement through acquiescence to operating management. A similar, and earlier, call to power is found in M. J. Lonergan, "A Look at the Systems Profession", Systems & Procedures 12, no. 2 (March-April 1961).

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Paulson, a systems man working as manager of data processing for the Kroger Corporation, gave clear definition to both problem and solution in an article entitled, "Two Paths Diverge." Paulson challenged his fellows to make a choice. "Today," he wrote, "the systems man schooled in non-computer oriented phases of his field stands at a crossroad.... The individual systems man must take a position – he is betting his future on it. The time for decision is here." According to Paulson, one of these paths led toward the computer and operations research, while the other returned to the traditional areas of time and motion study, form control and procedure writing. He himself had no doubt as to the correct direction. The new techniques, Paulson argued, were "scientific," and allowed the systems analyst in computer work to serve as "the big picture man" who devised new approaches. Thanks to his alliance with the computer, the systems man would gain the "authority and responsibility" to do something about the lack of unified, corporation-wide systems – a task that had been "organizationally beyond" his previous scope of authority.[524]

How could Paulson promise all this – a systems man who was at once empowered to enforce real organizational change, able to deal with the big picture, and the master of the firm's administrative computing operations? The answer lay in his recognition of the power of information. As he put it, "'Systems,' as a concept of information gathering and dissemination for management, is replacing the old concept of systems." The computer was no longer a tool for the routine processing of data, but a channel through which information would flow throughout the company. [525]

> The EDP systems man views the river of information as an engineer world: he wants to harness it for the maximum benefit of his company, change its course, dig new channels, and widen it. Every company, large or small, has always had an information system of one kind or another. Before computers the

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[524] R. Lee Paulson, "Two Paths Diverge..." Systems & Procedures Journal 14, no. 3 (May-June 1963):32-35.
[525] Ibid.

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> systems and procedures man was charged with the responsibility of insuring that reports, records and data were collected systematically and on time to be presented to the proper authorities for analysis and action. In short, he kept the river free from log jams, snags and debris, but had little to do with the course of the river or what was in it. Today, an information system is defined as being concerned with the total course of the business...[526]

## Uniting Systems, Operations Research and Data Processing

MIS was the lynchpin of an alliance around which ambitious systems men, data processing staff, and operations research experts could unite. It offered something for everyone. Systems men saw a way of claiming control over the burgeoning field of corporate computing while strengthening their claims to general managerial authority. Computer specialists hoped to shed their reputation as introverted technicians and obtain a more prominent and respected organizational role. Operations research practitioners were keen to move beyond specialist service groups to build their models directly into the management systems of the company itself. In addition, MIS promised a bonanza to manufacturers of computer equipment. MIS and the new machines promised to all concerned a kind of class mobility within corporate society, and they seized it enthusiastically.

In a 1963 interview, the president of ORSA (the Operations Research Society of America) supported the construction of corporate, "total systems with a mathematical model of the whole company operation, and a model of the industry in which that company operates, and perhaps also a model of the segment of the economy in which the industry participates." When prices rose or productivity fell, the computer would instantly factor this information into the models by which executives made all strategic decisions.[527] Some of the more practically oriented members of the OR community were beginning to worry that their field was failing to achieve practical results and was in dander of becoming marginalized. An article published in the Harvard

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[526] Ibid.
[527] Forest, "The Operations Research Society of America: Interview with ORSA's President".

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Business Review the same year suggested that, contrary to widely held "myths," OR had not been applied widely in any industry, would not offer complete or optimal solutions to real-world problems, and had few well documented successful applications. It suggested that OR efforts could not be successfully undertaken by detached "researchers" because a successful project would demand the full support of top management, the incorporation of huge amounts of data, the crossing of organizational boundaries, and close collaboration with operating management. This made the OR practitioner sound more like a systems man who used computers, and less like a mathematical researcher.[528]

The idea of MIS as the intersection point of several distinct fields is not merely a convenient narrative device. It received early, unequivocal and literally graphic demonstration in an address by Norman Ream, Director of Systems Planning for Lockheed, at the 1959 SDC conference on management control systems. Ream was also the 1960/61 chairman of the Executive Committee of the AMA Continuing Seminar on MIS, replacing Gallagher in this position. As the chart shows, MIS was explicitly conceived as the union of systems work, operations research and data processing. [529]

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[528] Harvey M. Wagner, "Practical Slants on Operations Research", Harvard Business Review 41, no. 3 (May-June 1963):61-71.

[529] Norman J. Ream, "The Need for Compact Management Intelligence", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960). On Ream's role in the continuing seminar, see the summary of its composition in Gallagher, Management Information Systems and the Computer, 8-11.

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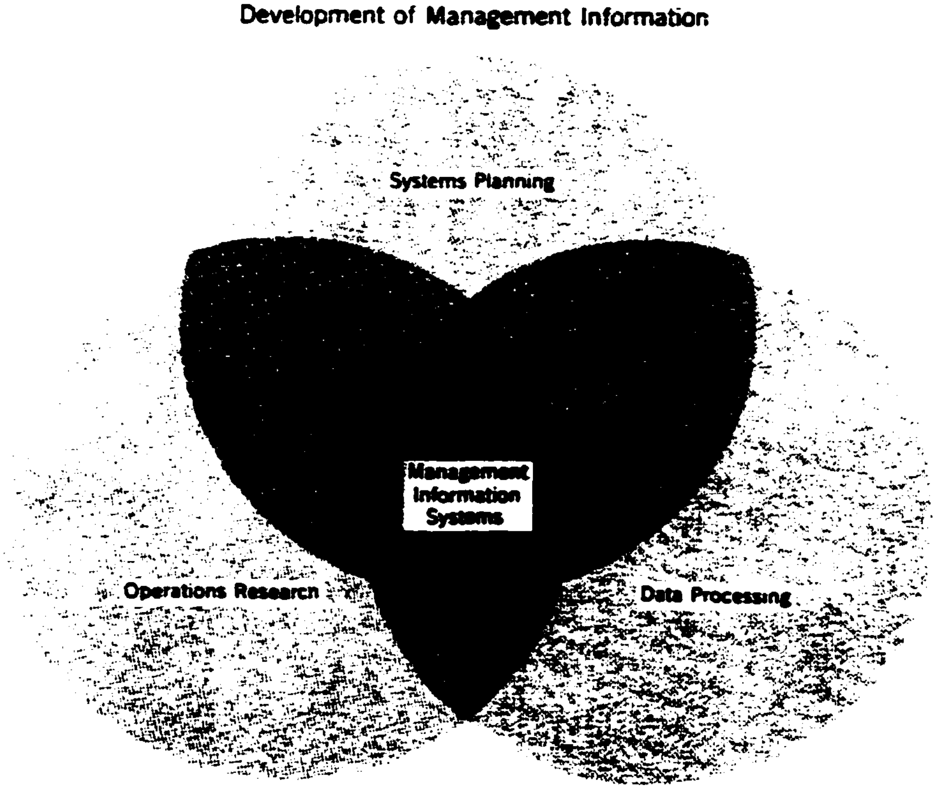


**Figure 26: "Development of Management Information", as presented by Ream at the 1959 SDC conference on Management Control Systems.**

According to Ream, a true MIS would be an "optimal system" and embed "advanced scientific management techniques," which was the hallmark of OR, yet cover the entire company, which was the long-sought goal of the systems men. It would provide all performance measures and all information needed for operational control throughout the entire management structure of the corporation. It would unite the electronic technologies of data processing with the existing clerical techniques of procedures work and office management, reshaping both toward higher ends. As he put it "such an optimal system requires the maximum utilization of all known data-processing techniques, including clerical and machine systems, electronic data-processing

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equipment, electronic source data automation and communication equipments. Information processing is not confined to the use of electronic data processing equipment alone."[530]

This approach represented a reorientation of computer technology, but one that might be expected to appeal to systems men and to ambitious, managerially-oriented data processing supervisors alike. According to Ream,

> Merely applying data-processing equipments to the refinement of existing information systems may speed up the production of existing reports, but it does little to further progress in the development of an integrated information system.... many managements feel that that the basic information problem they have faced is concerned with the organization of existing data on a faster, more timely basis. The management information systems concept, however, is more basic and profound in that it requires dynamic analysis of the entire management problem, with emphasis on the development of an integrated management intelligence system, not merely the refinement of single existing functional reports.[531]

Despite the ultimately quixotic nature of the undertaking, widespread acceptance of MIS as the goal of both corporate computing and of operations research departments led during the 1960s to a general assimilation of OR teams into systems or data processing groups. As a 1963 article in the Harvard Business Review noted, "virtually every company that has a science-oriented computer staff claims to be involved in OR."[532] By 1967, the famous management science academic Russell L. Ackoff could suggest that, "for some the design of [MIS] has almost become synonymous with operations research or management science." For Ackoff, this was regrettable, but he conceded that, "enthusiasm for such systems is understandable: it involves the

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[530] Ream, "The Need for Compact Management Intelligence".
[531] Ibid, 91.
[532] Wagner, "Practical Slants on Operations Research".

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researcher in a romantic relationship with the most glamorous instrument of out time, the computer."[533]

Looking back on these developments, in 1972 a panel of prominent operations research experts lamented the inward and technical direction that academic research and training in the field had taken. Corporate work in the area, by contrast, had largely merged with MIS efforts – leaving little common ground between academic and practical work. One participant, from RCA, said that he was, "absolutely convinced that good practical, responsible Operations Research is indistinguishable from practical, responsive, relevant MIS." Another, less happily, reported that during the 1960s most corporate OR groups had become "narrowly technique oriented," in their use of the techniques of the systems men, and that, "computer and computer oriented activities frequently made OR/MS into an appendage of the MIS activities."

There was no clear or unchanging conceptual core beneath all these different invocations of military and cybernetic concepts as the wave of enthusiasm for total management information systems swept corporate America. One is left instead with a soup of half-understood and loosely related ideas: the demonstrated feasibility of systems such as SAGE (and later SABRE); the idea that the computer heralded a managerial revolution; the new language of total systems; and a deeply held conviction that the systems department ought to be a managerial force in its own right. During the early 1960s these ideas blurred together as they spread through the rank and file of the systems and data processing communities. One proposition was particularly ubiquitous: that management was starved of adequate information, which only the computer – the information machine – could supply them with. The manifest destiny of corporate computing became a real-time, on-line total management information system that delivered all relevant

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[533] Russell L. Ackoff, "Management Misinformation Systems", Management Science 14, no. 4 (1967):B147-56. This was not a new topic for Ackoff – see Ackoff, "Operations Research - Its Relationship to Data Processing".

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information to all managers in a timely, complete and accurate manner. Managers would make decisions faster and more rapidly, assisted by complex models and simulations built into the system.

In conjunction, these propositions formed the manifesto for what Dun's Review and Modern Industry called a looming "Managerial Revolution." The system men were part of a very broad array of fellow travelers working toward the overthrow of the traditional manager. The same period saw a new interest in management theory and self-conscious experimentation with organizational forms. Fashionable techniques included business games, budgeting systems, operations research, and formalized approaches to the strategic planning process. All these approaches involved reliance on the computer and a caste of managerial technicians surrounding it. They were also largely interdependent: for example, having a computer sound the alarm when a performance target is missed or a budget exceeded depended on having a managerial mechanism to set such targets. Like most utopian visions, this one offered its true believers a vision of a better, cleaner world that made perfect internal sense – what James C. Scott has called a "high modernist ideology" of technocratic control.[534]

## Selling MIS and the Third Generation

One class of companies stood to benefit most dramatically from the revolution. Computer vendors loved the idea of turning their machines from labor saving office equipment into the

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[534] Revolution through total systems, operations research and computers was expounded in Herbert E. Klein, "Computer in the Board Room," Dun's Review and Modern Industry 64 (September 1954). For a more critical take on the claims of revolution see Melvin Anshen, "The Manager and the Black Box," Harvard Business Review 36 (November-December 1960). On the failure of grand attempts to formalize strategic planning, a story with many parallels to that of MIS, see Henry Mintzberg, The Rise and Fall of Strategic Planning : Reconceiving Roles for Planning, Plans, Planners (New York: Free Press, 1994). On systems thinking and formal methodologies in public administration see Ida R. Hoos, Systems analysis in public policy; a critique (Berkeley,: University of California Press, 1972). On high modernist ideology see James C. Scott, Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed (New Haven, 1998).

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indispensable core of modern management itself. Not only would this give computing a direct and respected job serving the firm's senior decision makers, but it would involve the purchasing of vast amounts of the newest and most expensive computers, terminals, communication equipment, and disk storage units. Because of IBM's stranglehold on traditional data processing, smaller players such as RCA, GE and Univac devoted particular effort towards designing and promoting equipment suitable for managerial applications. These firms advertised their computers at essential technology for the creation of MIS. RCA offered for emulation a plan for total MIS based on rigorous analysis of its entire business that would take ten years to go from initiation to completion.[535]

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[535] RCA's ten year plan is offered for emulation by its customers in James L. Becker, "Planning the Total Information System", in Total Systems, ed. Alan D. Meacham and Van B. Thompson (Detroit, MI: American Data Processing, Inc., 1962).

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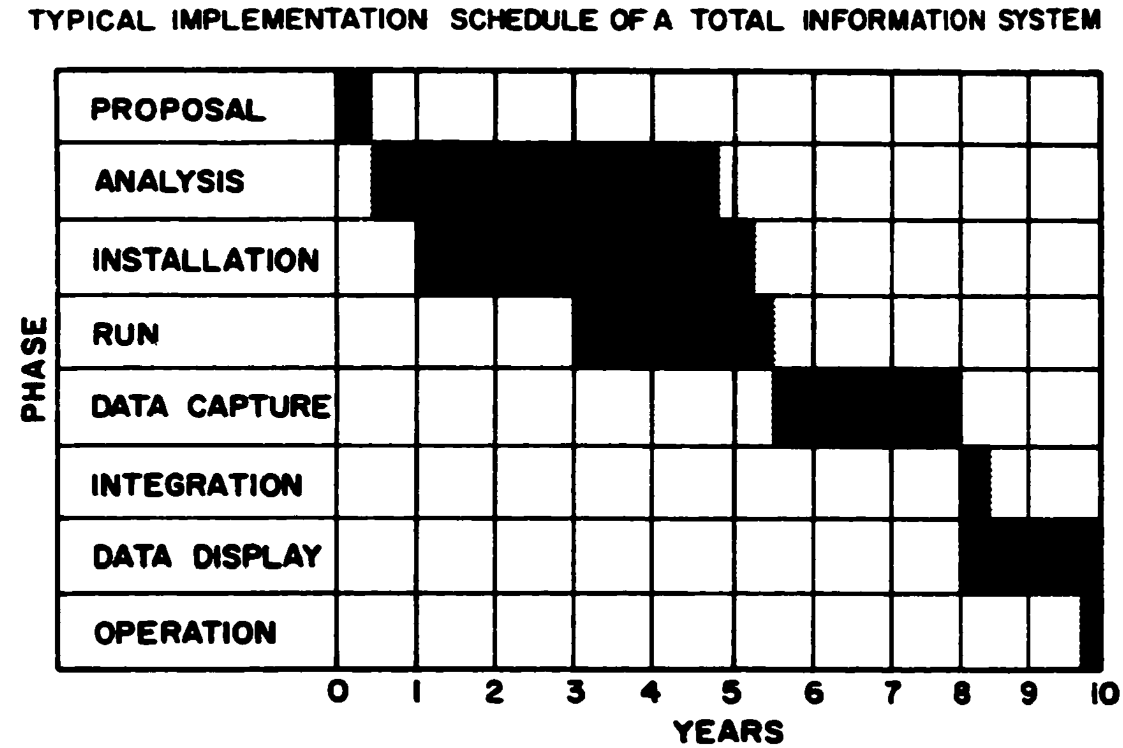


**Figure 27: "Typical Implementation Schedule of a Total Information System" as promoted by RCA.[536]**

During the mid 1960s, vendors cemented their commitment to the new vision of real-time, on-line, managerially-oriented systems by promoting their latest computers as part of the new, "third generation" of computer technology. As discussed previously, these machines were intended to take technologies for communications and interactive use pioneered in systems like SAGE and SABRE and make them an integral part of every data processing center. Much larger internal memories, coupled with high-speed disk storage, made it possible to keep relatively large volumes of data available on-line for immediate retrieval.

[536] Ibid, 69.

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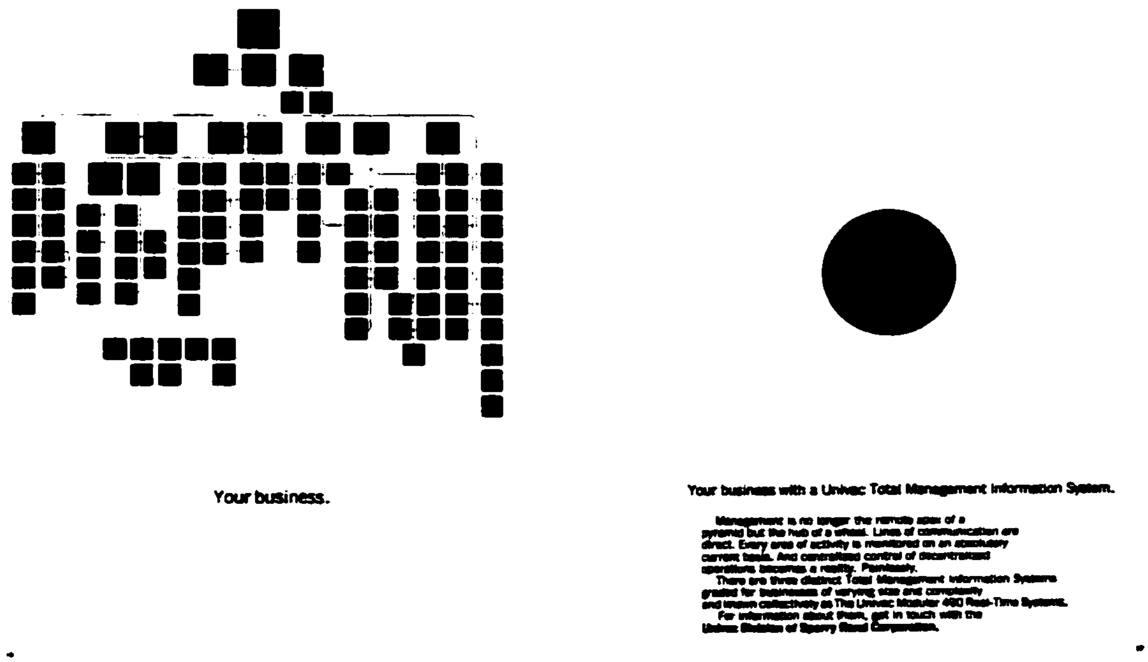


**Figure 28: "Your Business With a Univac Total Management Information System" (advertisement used in Fortune, Datamation, and Business Week, 1965).** [537]

In the advertisement series illustrated above, Univac suggested that its newest computers were, in themselves, management information systems, and would bring "painless" central control of all corporate activities. The symbol on the right represents a reel of magnetic tape, into which the entire organization has been somehow subsumed. While the illustration shown above illustrates the elimination of organizational boundaries, others in the series showed dots and connections on a map representing a geographically diversified firm – which with the aid of a

[537] Fortune, October 1965, pages 32-33. Text on left reads "your business". Text on right readings "Your business with a Univac Total Management Information System. Management is no longer the remote apex of a pyramid but the hub of a wheel. Lines of communication are direct. Every area of activity is monitored on an absolutely current basis. And centralized control of decentralized operations becomes a reality. Painlessly. There are three grades of distinct Total Management Information Systems graded for businesses of varying size and complexity and known collectively as The Univac Modular 490 Real-Time Systems. For information about them, get in touch with the Univac Division of Sperry RAND Corporation."

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Univac could be reduced to a single node of control. It made the striking claim that, "distance, as a factor in management, becomes irrelevant."[538]

The airline reservation system SABRE, was aggressively promoted as proof of the applicability of real-time operation and the "systems approach" to corporate computing. As the first such system used for business purposes, SABRE was extremely widely reported and served as an apparent demonstration of the desirability of real-time access to business data. It provided some reports as a by-product of handling routine transactions, leading some to claim it as a management information system. In reality SABRE was operational rather than managerial – it allowed travel agents to use specially designed consoles to directly access a central computer to view flight availability and make reservations. The close relations between SABRE's custom designed operating system and its application logic (discussed earlier) made it both expensive and hard to use as a base on which to build managerial tools. In addition, reservation clerks had a more tangible and more economically justifiable need for instantly (as opposed to weekly or monthly) updated status information than senior managers, though most discussion of "on-line, real-time" systems in the mid-1960s ignored this entirely.[539]

The computer salesman's most potent weapon was the growing constituency of computer focused staff within their customer organizations. These people had tied their lives to computer technology, and generally identified more strongly with their occupations and skills than with their firms. For many computer enthusiasts, the concept of "third generation" went far beyond the hardware itself. The third generation concept was used to promote whatever reform or reorientation the writer considered necessary. For example, Arnold E. Keller, the influential and long-serving editor of Business Automation, used a 1967 article called, "The Third Generation,"

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[538] This second advertisement may be found in Datamation 13 (March 1967), pages 2-3.

[539] Gallagher, Management Information Systems and the Computer, the first full-length treatment of MIS, uses SABRE as a major case study and as proof of the workability of a large scale corporate system based on as-yet unproven technology.

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to make one of his many pleas for data processing staff to pay more attention to management thinking and less to technology. According to Keller, "a good number of firms are rushing into the third generation of computers with applications that have yet to prove profitable, or even practical, on their first and second generation of equipment. In such cases it would seem beyond reason to expect any more than an increase in problems." Nevertheless, the real-time capabilities of the new machines were soon bound together with grand ideas for an integrated management information system capable of running all the operations of the business. This was associated with another idea: that the computer department now deserved recognition as a top-level and independent managerial group, and that top management commitment to computer technology was vital to its effective use.[540]

At the more baroque end of the spectrum, W. Robert Widener, a consultant, promoted a vision of "Third Generation Management" that earnestly blended managerial and technological progress. Claiming that the installation of third generation computers was prompting management to "pay more attention to the computer as a 'strategic' tool" in support of "more rapid decisions," he explored the implications for interior design. Managers were about to trade in desks, papers and tables for comfortable padded chairs facing huge screens in the "information management facility." Application of the management by exception principle would, he promised, remove 95 percent of their current reading, and the rest could be shown in graphs. The result: "a more relaxed, leisurely management environment. The uneasiness will be replaced by a feeling of confidence in the completeness and timeliness of information and in the decisions based on that information.... If sufficient data has been included in the mathematical expressions placed inside the computer it will be increasingly possible to actually complete the decision process on major commitments in a single, relatively brief management meeting." Mankind, he gushed, had the

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[540] Arnold E. Keller, "The Third Generation", Business Automation 14, no. 1 (January 1967):32-36.

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chance to "return to a higher state of the human condition unknown since the Greek and Roman cultures."[541]

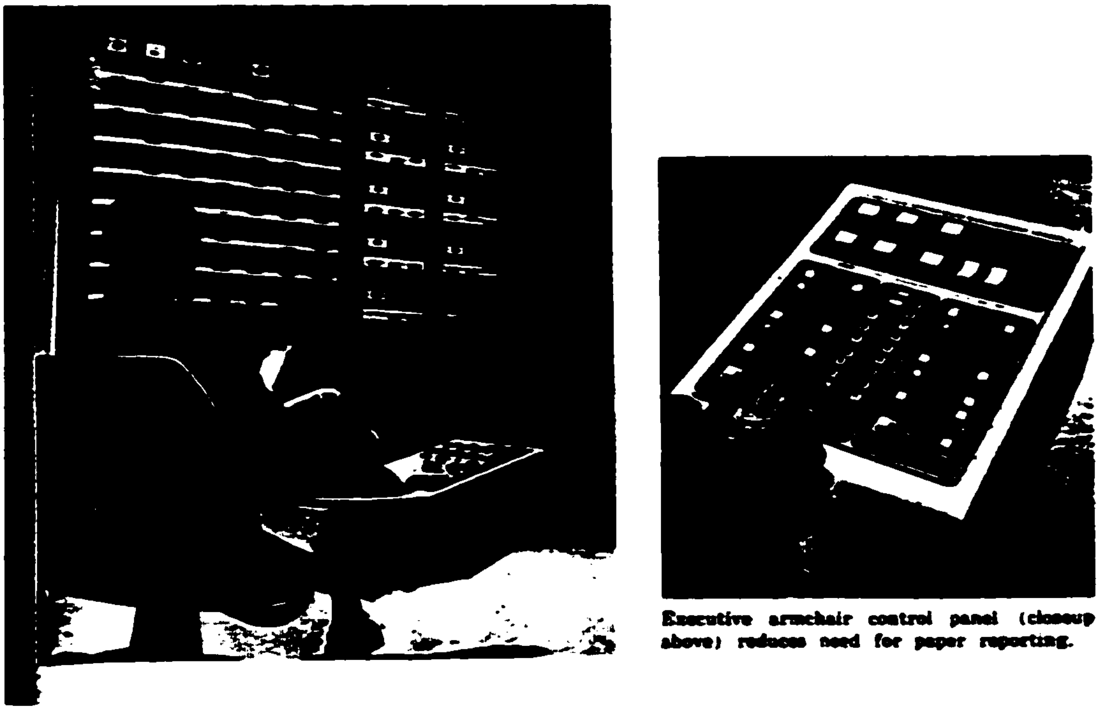


**Figure 29: Consultant W. Robert Weidner promoted the concept of management using screens and remote control units in his 1968 article "The Corporate Command Post."**

Widener admitted that his immediate inspiration was military rather than classical: the real-time control systems produced for Strategic Air Command and other control posts. Although he claimed that, "Experience has been shown that one by one, the same applications that are pioneered and proven in military use ultimately find their way into business," he offered no further justification for the applicability of the idea.[542]

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[541] W. Robert Widener, "New Concepts of Running a Business", Business Automation 13, no. 4 (April 1966):38-43, 63 His achievements were also profiled in Iris Poliski, "Mission Control at the First", Business Automation 17, no. 3 (March 1970):56-61 and Joel R. Weber, "The Corporate Command Post", Business Automation 15, no. 12 (December 1968) – suggesting that he managed to convince a number of companies to retain his firm to construct management control centers.

[542] W. Robert Widener, "New Management Concepts: Working and Profitable", Business Automation 15, no. 8 (August 1968):28-34.

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## Failure as a Cultural Resource

Given the increasingly apparent difficulty of saving money by using million dollar computers and expensive programmers and analysts to replace cheap clerical labor, one of the biggest appeals of MIS to computer salesmen was that its benefits would come in the overall performance of management – and therefore be impossible to measure. The author of an MIS textbook quoted with approval the "head of MIS for General Electric" as arguing, "If an MIS can be justified on the basis of cost savings, it isn't an MIS."[543]

Management information was promoted to corporate level executives as a tool for the control of far-flung divisions. Without leaving their desks, they could know more about the operations of their unruly divisional subordinates than those people knew themselves. This vision cast the systems men themselves as the indispensable servants of corporate control. No longer would they be called in to write reports that nobody read or to "fight fires," and fix pressing but trivial problems that operating managers could not be bothered to fix themselves. Addressing the problems of the firm's total information system meant reorganizing departments, merging redundant operations and slashing inefficiency and waste wherever they found it. The implicit bargain offered to corporate executives was: you put us in charge and we'll deliver to you more power over your firms than you've ever dreamed of.[544]

This rosy vision was inevitably contrasted with a dismal view of the present and dire warnings about the failure to act. These varied from individual bankruptcy through the threat of revived foreign competition to "enslavement as a result of losing an economic war" with the frighteningly efficient Soviets and their advanced planning and modeling techniques. Thus almost

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[543] The alleged quote from GE is in Robert G. Murdick, Introduction to Management Information Systems (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977), 212.
[544] For an example of the claim that corporate management would know more than divisional managers about their own operations see Forrest Hunter Kirkpatrick, "Partners for Tomorrow - Manager and Machine", Business Automation 14, no. 10 (October 1967):36-39, 54, page 37.

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every article written or paper delivered during the 1960s on the topic of general business experience with computers began with a denunciation of widespread failure to realize the anticipated economic benefits through simple clerical automation. Many of them cited a landmark 1963 McKinsey study published in the Harvard Business Review that found that two thirds of large companies were failing to achieve savings. The authors insisted that the reasons for this were managerial, not technical. Recommendations made in the study itself included extensive top management involvement, the aggressive application of computers to managerial rather than clerical matters and imposition of proper managerial discipline on the operations of the data processing operation itself. These findings were repeated until they became a kind of folk wisdom that real payoffs would come through computerization of reporting and other systems that crossed divisional lines.[545]

Other authors used similar condemnation of the status-quo to forward their own professional agendas. Machines themselves, or programming difficulties, were seldom blamed. Instead they invoked the idea of an inherent "true potential of computers," which was unfortunately being squandered due to mismanagement of one kind or another. This became such a cliché that it could be alluded to in a generic opening to one's article. While all agreeing on the general dismal situation, authors advocated a disparate range of cures including better communication, more attention to industrial psychology, improved training for analysts, and adoption of any one of a large number of technological fixes. Prescriptions could usually be traced to a speaker's own area of professional expertise. However, by presenting their measures as an unavoidable set of reforms needed to unleash the value locked inside an expensive and

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[545] The quote is from the conclusion to Marshall K. Evans and Lou R. Hague, "Master Plan for Information Systems", Harvard Business Review 40, no. 1 (January-February 1962):92-103, page 103. The 1963 survey was distributed widely to an executive audience as John T. Garrity, "Top Management and Computer Profits", Harvard Business Review 41, no. 4 (July-August 1963):6-8, 10, 12, 172, 74, John T. Garrity and John P. McNerney, "EDP: How to Ride the Tiger", Financial Executive 31(September 1963):19-26.

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uncooperative computer these different experts tried to turn their own ascent into a matter of urgent necessity.[546]

Like traditional systems groups and punched card departments, the computer departments of the 1960s were usually under the authority of the controller or another financial executive. While converts to the computer saw its potential for application to tasks within and across various operating divisions, they complained that their accountant superiors were conservative, distracted by other matters and preferred to guard the prestige of the new machine for themselves. Of course, others could deploy the same evidence and rhetoric of failure to draw the opposite conclusion. L.C. Guest, GTE's Controller, defined failure in much the same way, but attributed it to a lack of discipline and financial controls on the part of a "new class of management" seeking "total control" over data processing. Soon, when the controller reasserted his authority, "the word 'intangible' would be stricken from the vocabulary of all data-processing and systems groups" and the computer's true potential would appear.[547]

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[546] A nice example of the boiler-plate opening is "Many companies that have invested in the latest-model computers find themselves increasingly frustrated by the discrepancy between the fantastic potential of the machines and their own ability to use them with maximum effectiveness" from Bylinsky, "Help Wanted: 50,000 Programmers". For an example of industrial psychology as the key to MIS, written by an industrial psychologist, see M. Scott Meyers, "The Human Factor in Management Systems", Journal of Systems Management 22, no. 11 (November 1971):10-13. A management professor presents better academic education for systems men as the key to improving results in Frank Greenwood, "Education for Systems Analysis: Part One", Systems & Procedures Journal 17, no. 1 (January-February 1966):13-15. Better communication with management, to overcome "dysfunctional" and irrational resistance to management information systems is the key to progress in G. W. Dickinson and John K. Simmons, "The Behavioural Side of MIS: Some Aspects of the "People Problem"", Business Horizons 13, no. 4 (1970):59-71. Similar claims for packaged software and structured programming were made during the early 1970s and are discussed later.

[547] L. C. Guest, "A Temperate View of Data Processing Management and Management Information Systems", in Advances in EDP and Information Systems: AMA Management Report Number 62, ed. Administrative Services Division American Management Association (New York: American Management Association, 1961), 9. On "total systems" as a mandate for separation from the controller see George J. Bararb and Earl B. Hutchins, "Electronic Computers and Management Organization", California Management Review 6(Fall 1963):33-42.

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## The Information Pyramid: A Challenge to the Controller

By staking a claim to information as a general and flexible method of corporation-wide control, MIS made a direct challenge to the controller and his corporate accounting staff, whose ascent to corporate power was built on their unique ability to turn operating figures into financial reporting and control data. This attack on accounting was propelled large part by the desire of the systems men to "emancipate" systems and computer operations from the control of the financial function.

Savvy consultants were careful to make their pitch seem less threatening by pointing out that information was already the lifeblood of business, and so every firm by definition already had a management information system. The problem was that the current ad-hoc one was no good. As Alfred Chandler and contemporary theorists were then making clear, the hopes of a multidivisional firm to perform better than its more specialized competitors rested on its ability to coordinate operations and allocate resources more efficiently than classical market mechanisms. Enthusiasts promised to give managers of the biggest and most sprawling conglomerate an all-round view of the firm through "a tool used with facility by out forefathers during the era of small businesses, but pushed aside and all but forgotten with the advent of big business.... the total management information system."[548]

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[548] Chandler discusses the changing locus of decision making power and the importance of staff experts in Alfred D. Chandler, Jr., "Recent Developments in American Business Administration and their Conceptualization", Business History Review 35, no. 1 (Spring 1961):1-27. The quote is from Charles W. Neuendorf, "The Total Management Information System", Total Systems Letter 1, no. 1 (March 1965):1-8. For examples of the "MIS makes a big business work like a small business" mantra, see E.R. Dickey, Jr., "Management Information Systems--Opportunity and Challenge for the Data Processing Manager", in Data Processing Volume VIII: Proceedings of the 1965 International Data Processing Conference, DPMA, ed. Data Processing Management Association (Chicago: Data Processing Management Association, 1965), Herbert E. Martenson, "New Techniques Permit Old Solutions", Journal of Systems Management 21, no. 2 (February 1970):24-27, Theodore A. Smith, "From Burden to Opportunity: The Revolution in Data Processing", in The Changing Dimensions of Office Management, ed. American Management Association, Office Management Division. (New York: American Management Association, 1960).

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Systems men thus tried to turn the tables on accountants by arguing that it was traditional financial control, rather than computerized management, which was hopelessly technical, out of touch with the real world and fundamentally unmanagerial. They insisted that the worst thing about current information systems was their domination by accountants. MIS and accounting systems were both intended to take details of the smallest individual transactions (such as a single line on an invoice) and from these create a hierarchy of reports, summaries and totals. The systems men had little respect for the formalized and slowly developing practices of accountancy. They felt that accounting was, "only one major subsystem of the overall management information system" and that they were best placed to design the overall system. They criticized accountancy for being backward looking: delivering information on the past performance of a business rather than its current state or (via models and simulations) its future. They criticized it for being inflexible and ritualistic, more concerned with the observance of due process than the usefulness of its output. The challenge of MIS to accountants' dominant role as suppliers of control systems to management therefore hinged on its ability to do a better job by overcoming their alleged pedantry and historical fixation. As a result, a great amount of rhetoric was devoted the ability of an MIS to forecast future conditions and to highlight and interpret the important pieces of information in a sea of routine data (often called the "management by exception" principle).[549]

Perhaps the most comprehensive and damming criticism of controller's claims to power was made my Terrance Hanold, President of Pillsbury and himself an attorney with a financial

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[549] The quote is from A. T. Spaulding, Jr., "Is the Total System Concept Practical?" Systems & Procedures Journal 15, no. 1 (January-February 1964):28-32. Accountants and their control of management information are criticized in L. R. Fiock, Jr., "Seven Deadly Dangers in EDP", Harvard Business Review 40, no. 3 (May-June 1962):88-96, A. D. Bramson, "Unified Operations Management", Business Automation 7, no. 1 (January 1962):26-31, Enoch J. Haga, "The Systems Approach to Effective Management", in Total Systems, ed. Alan D. Meacham and Van B. Thompson (Detroit, MI: American Data Processing, Inc., 1962) and Field, "Management Information Systems: A Report on Techniques".

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background, in a speech to the Midwest Congress of the Financial Executives Institute. He charged that accounting was concerned with record keeping and was largely useless for modern management, because it was designed to serve the needs of accountants themselves (which it did "almost adequately"). Accountants had assumed that their command of the breakeven chart assured them a place, "at the right hand of the chairman almighty. But something unfunny happened on the way to the boardroom… the knowledge revolution."

> Fifteen years ago the controller had the only rational and continuing information system in the firm. Today every department in the firm is developing a business information suited to its function. And the general and executive managements are securing, by accretion if not be design, a management information system which is the composite sum of the lot, plus the contribution made by executive management themselves as required by their own function. Can the controller recapture the information monopoly he once embraced? Can he again become the croupier of the only game in town? I think not.[550]

By giving in to the "ancient urge toward aggrandizement of function," he charged that accountants had left their traditional areas of expertise for others where they could bring no special insight and only hindered the work of others. Driving home the stake, he suggested that explicit assumption of executive authority as Chief Financial Officer could only compromise the professional independence at heart of the profession's noble role as auditors.

This last point, at least, would enjoy substantial resonance within the accounting profession. "Managerial accounting" was booming, practiced by consulting firms and individuals within firms. The success of the "Management Advisory Services" offered by leading accounting practices threatened to put these firms in the position of auditing systems that they had designed, or of reporting to shareholders on the consequences of policies that their partners had recommended. While this ethical compromise was bad enough, what rankled traditionalists further was the professional fragmentation involved, as CPAs began to identify themselves

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[550] Terrance Hanold, "An Executive View of MIS", Datamation 18, no. 11 (1972):65-71. Hanold was well known among corporate computer managers.

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primarily with specialist and technical skills rather than a "coherent and consistent" image across the whole profession. Little wonder that some accountants were tempted to embrace a new and more glamorous life in MIS and leaving accounting behind forever. [551]

Corporate managers had long understood their firms as pyramids defined by supervisory relationships, where authority passed downward from a narrow apex to a broad base. The systems men borrowed this metaphor to describe another pyramid – what Paul R. Sanders, head of American Airline's failed attempt to turn SABRE into a total MIS, called the "Information Pyramid." Drawings of such pyramids eventually became a standard part of definitions of MIS. MIS was the whole of the pyramid, the skeleton of a new pyramid of automated information systems that would entirely subsume existing accounting and control functions. This pyramid had as its bottom level the mass of routine, operation systems such as payroll and invoicing that formed the mainstays of existing computer use. Information entered the pyramid at its base and was distilled and processed as it moved upward. In the middle level sat routine reporting and analysis for day-to-day control. But it was the topmost levels that seemed to support claims of a managerial revolution-- these usually included the automation of middle management decisions, constantly updated models of the firm's overall profitability and interactive facilities for

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[551] New technology and the rise of management science helped to revitalize the long neglected field of cost accounting. Pioneered by engineering contemporaries of Frederick Taylor, cost accounting was oriented towards the internal needs of management rather than the shareholders and eventual regulatory agencies served by financial accounting. The rise of the latter changed the focus of accounting toward standardized, externally focused systems. But during the 1960s, cost accounting was reborn as "Managerial Accounting" - effectively leading to a part of the accounting profession throwing in its lot with the MIS agenda. On the revitalization of cost accounting see Gary John Previts and Barbara Dubis Merino, A History of Accounting in the United States (Columbus, OH: Ohio State University Press, 1998), 323-25 and Johnson and Kaplan, Relevance Lost: The Rise and Fall of Managerial Accounting. On controversy over the mixing of advisory and audit work see Gary John Previts, The Scope of CPA Services: A Study of the Development of the Concept of Independence and the Profession's Role in Society (New York: John Wiley and Sons, Inc., 1985), 105-10. On the risk of professional fragmentation see ibid, 147.

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executives to manipulate data and ask "what-if?" questions. Into these levels of the system would be fed sales targets, economic information and other managerially relevant information.[552]

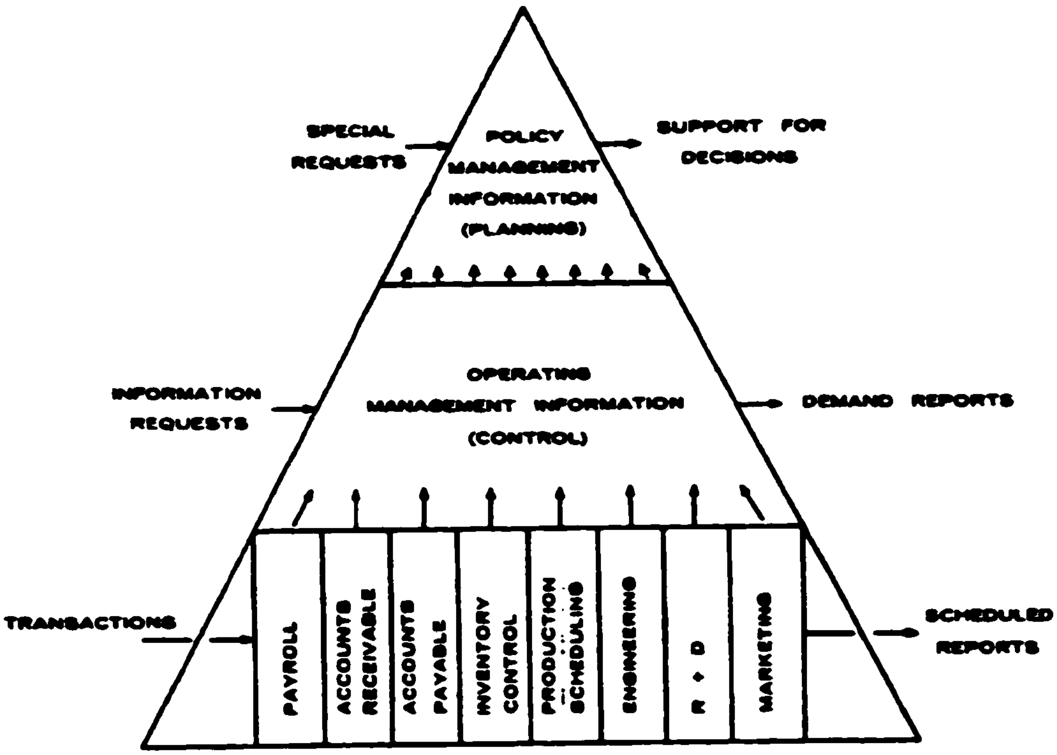


**Figure 30: A conceptual diagram of the "Management Information System", produced by Robert V. Head. Working from a single collection of shared data, the different levels of the system provided support for all levels of management.[553]**

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[552] See Paul R. Saunders, "Management Information Systems," in Systems and Procedures: A Handbook for Business and Industry, ed. Victor Lazzaro (Englewood Cliffs, NY, 1968). The idea that operational, tactical and strategic management were based on a common base of information was always inherent in the total MIS concept, but the illustration of this relationship as a pyramid seems to have suddenly emerged during the late 1960s. Pyramids are also drawn in Leroy L. Cook and Ronald J. Hastings, "Automated Management Information Systems", in Data Processing XIII: Proceedings of the 1968 International Data Processing Conference and Business Exposition, ed. Data Processing Management Association (Chicago: Data Processing Management Association, 1968), James A. McKeever, "Building a Computer-Based MIS", Journal of Systems Management 20, no. 9 (September 1969):1969 and Dorothy Anne Seesse, "Initiating a Total Information System", Journal of Systems Management 21, no. 4 (April 1970):33-38. For a definition of a "total" information system that makes serving of operational and strategic needs from the same data a key characteristic see Allan Harvey, "Are Total Systems Practical?" Business Automation 16, no. 6 (June 1969):72-76, 143.

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Only the new idea of "information" and the blue-sky technology of computing made this pyramid credible. Re-designating everything from payroll slips to strategic planning as part of a huge, interconnected realm of information gave credence to the systems men's insistence that it all formed a single system that must be planned and controlled as a whole. High-status strategic planning information could only be produced from the by-products of low-status routine data processing. As information experts the systems men would control this new system, and so assert their domination over more "narrow" specialists such as EDP staff, operations research analysts and accountants. Acceptance of information and systems techniques as a kind of universal expertise would give the systems men enormous managerial power.[554]

The systems men's claims to a generalized authority based on information acumen did not go unchallenged. Their most vociferous critic was John Dearden, an expert on financial controls at the Harvard Business School. From his 1964 warning that, "systems specialists have been developing an approach to management information systems which, if left unchecked, could cause serious problems to the companies that adopt it," to his 1972 insistence that, "no sane manufacturing or marketing executive would delegate the responsibility for his information system," he mounted a sustained challenge to the aspirations of the systems men. Dearden criticized management's willingness to be seduced by the scientific allure of the computer. He

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[553] Robert V. Head, "Management Information Systems: A Critical Appraisal", Datamation 13, no. 5 (May 1967):22-27, page 23. This appears to have been the first appearance of this pyramid concept, and reflected a shift in Head's thinking toward the imp‹‹tance of the "data base" in MIS development. It was widely influential.

[554] For an early example of the claim that Operations Research (OR) required a total information system to feed it useful information see William B. Worthington, "Total Command, Management and Administrative Systems", in Total Systems (Detroit, MI: American Data Processing, Inc., 1962), 43. Others argued against this, such as Ackoff, "Operations Research - Its Relationship to Data Processing" Stephen Falk, "AMF Sets EDP Payback Parameters", Business Automation 13, no. 9 (September 1966):24-29, page 29 argues that MIS will give managers the tools they need to make their own decisions, which the author expects them to do better than their "would-be successors" in OR who "have only the tools". On the eventual failure of OR to deal with most issues of concern to management and its eclipse by MIS see Herbert Halbrecht, "Through A Glass Darkly", Interfaces 2:4, no. August (1972):1-17, page 12 & 17.

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insisted that senior management had little real use for masses of logistical data on their company's operations, however conveniently and rapidly it could be delivered.[555]

The information pyramid, in Dearden's view, simply did not exist.His most fundamental challenge to MIS was his insistence that no generalized set of principles or practices tied together different kinds of management information. Dearden observed that the systems men had achieved some success in tackling the problems many corporations were experiencing in logistics, by tying together production, distribution and ordering procedures. This area had been an organizational vacuum in many firms, and he was willing to concede that it deserved to be one of a small number of firm-wide "vertical" information systems, joining better established systems for accounting and personnel. But he ridiculed the idea that such techniques could be applied to the provision of information and control systems in areas like finance or marketing, saying that the information needs of each main area were entirely separate. The "systems approach" he added, "is merely an elaborate phrase for good management." If companies were having problems with their financial control systems then the answer was to recruit better managers. The only thing that computerization could possibly offer would be lower administrative costs.[556]

Dearden questioned the very idea of a systems profession, decrying "a tendency to classify certain people as 'information systems specialists' and certain organization components as 'systems departments' and then to consider these people and departments as specialists in the entire continuum of the development of an information system." Only the technical work of

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[555] See John Dearden, "Can Management Information be Automated?" Harvard Business Review 42, no. 2 (March-April 1964):128-35, page 128, John Dearden, "MIS Is a Mirage", Harvard Business Review 50, no. 1 (1972):90-99, page 96.

[556] The quotation, and most of the précis in this paragraph, are taken from Dearden, "MIS Is a Mirage", page 96. Discussion of "vertical" information systems and the desirability of a logistics information system can be found in John Dearden, "How to Organize Information Systems", Harvard Business Review 43, no. 2 (March-April 1965):65-73, 69-70. See also John Dearden, "Myth of Real-Time Management Information", Harvard Business Review 44, no. 3 (May-June 1966):123-32, John Dearden, "Computers: No Impact on Divisional Control", Harvard Business Review 45, no. 1 (January-February 1967):99-104.

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programming, rather than the managerial work of system specification, could be given to a centralized staff group. During the mid-1960s Dearden was one of only a few critics publicly disputing the wisdom of the systems men's dreams, although many may have shared his views but expressed them through ignoring the topic. To the boosters of MIS he seemed like a lone reactionary who failed to understand what they were saying. But, as time went by and the promised breakthroughs failed to arrive, the tide began to turn.[557]

## The Fate of MIS

The biggest problem with the total management information system, as originally envisioned, turned out to be the impossibility of building one. MIS was, to borrow a term from the 1980s, perhaps the ultimate in vaporware; an exciting technology that never quite coalesced. While technical and managerial communities were flooded with materials describing the idea of such systems, practical guides explaining how to get to there from here were conspicuous by their absence. Those that did appear, in places like the low-circulation Total Systems Newsletter, offered platitudes on the need to carefully plan and manage the product, diagram the necessary procedures and test the resulting computer code. Shown below is one of the most serious attempts published during this period to provide a step-by-step guide to the creation of a total MIS. Read closely, the diagram shows just how daunting this task was. The inclusion of to-do items like "finish the design" or "establish management needs from new system (include long range plans)"

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[557] Dearden and McFarlan, Management Information Systems: Text and Cases, 41. Another early assault came in Dudley E. Browne, "Management Looks at Management Information Systems", in Advances in Management Information Sytems. AMA Management Bulletin No. 16., ed. American Management Association (New York: American Management Association, 1962). This criticizes misplaced "computopia" and warns that revolutionary change risks a "systems dictatorship" more suitable to the Soviet sphere.

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did little to bridge the enormous technological and organizational barriers standing between dream and reality.[558]

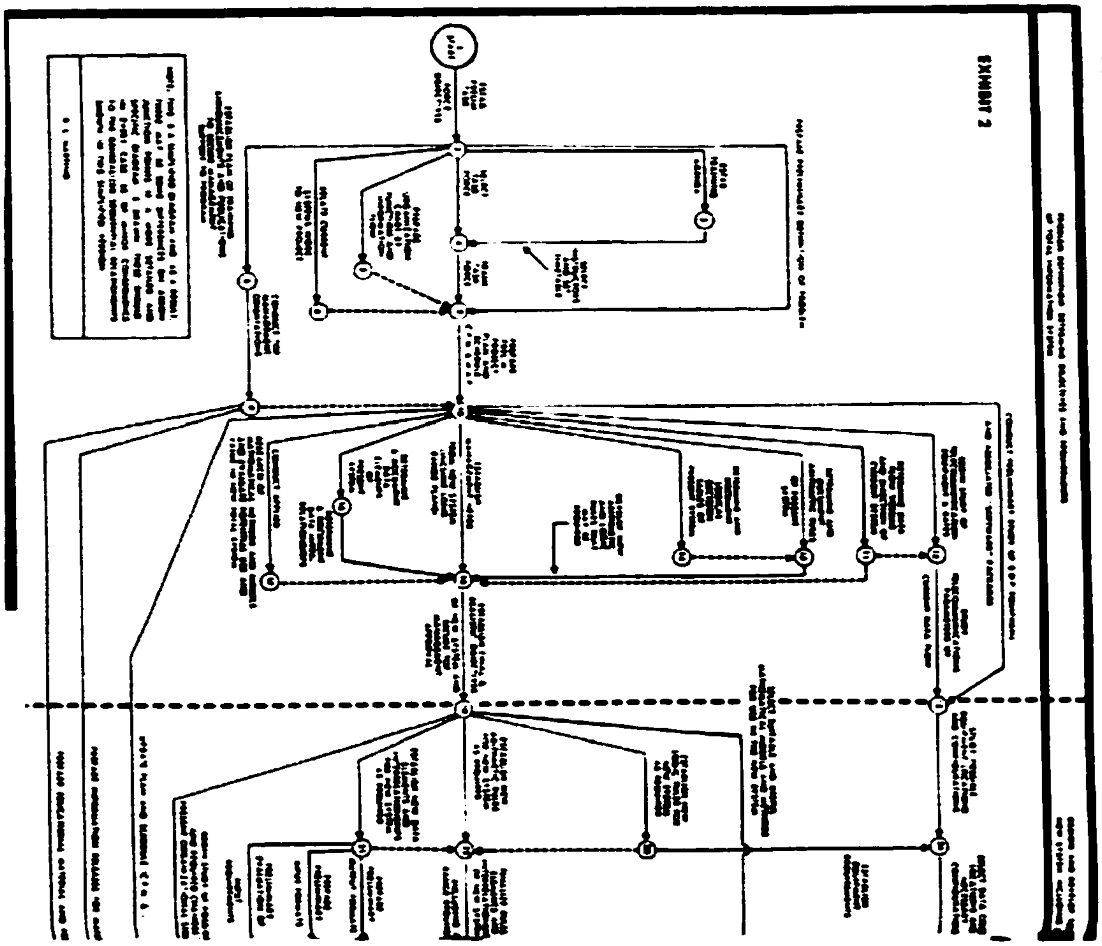


**Figure 31: Martino's 1966 attempt to produce "A Plan for Developing and Installing a Total Management Information System."**

[558] See, for example, R. L. Martino, "A Generalized Plan for Developing and Installing a Management Information System", Total Systems Letter 1, no. 2 (April 1965):1-6. This was one of the more visible attempts to formulate a structure for MIS - it appeared in an earlier version as Roco L. Martino, "Creating a Total System for Managment", in Case Studies in Computer-Based Management, ed. American Management Association - Administrative Services Division (New York: American Management Association, 1963) and was reprinted in the collection Peter P. Schoderbek, ed., Management Systems (New York: John Wiley & Sons, Inc., 1967)

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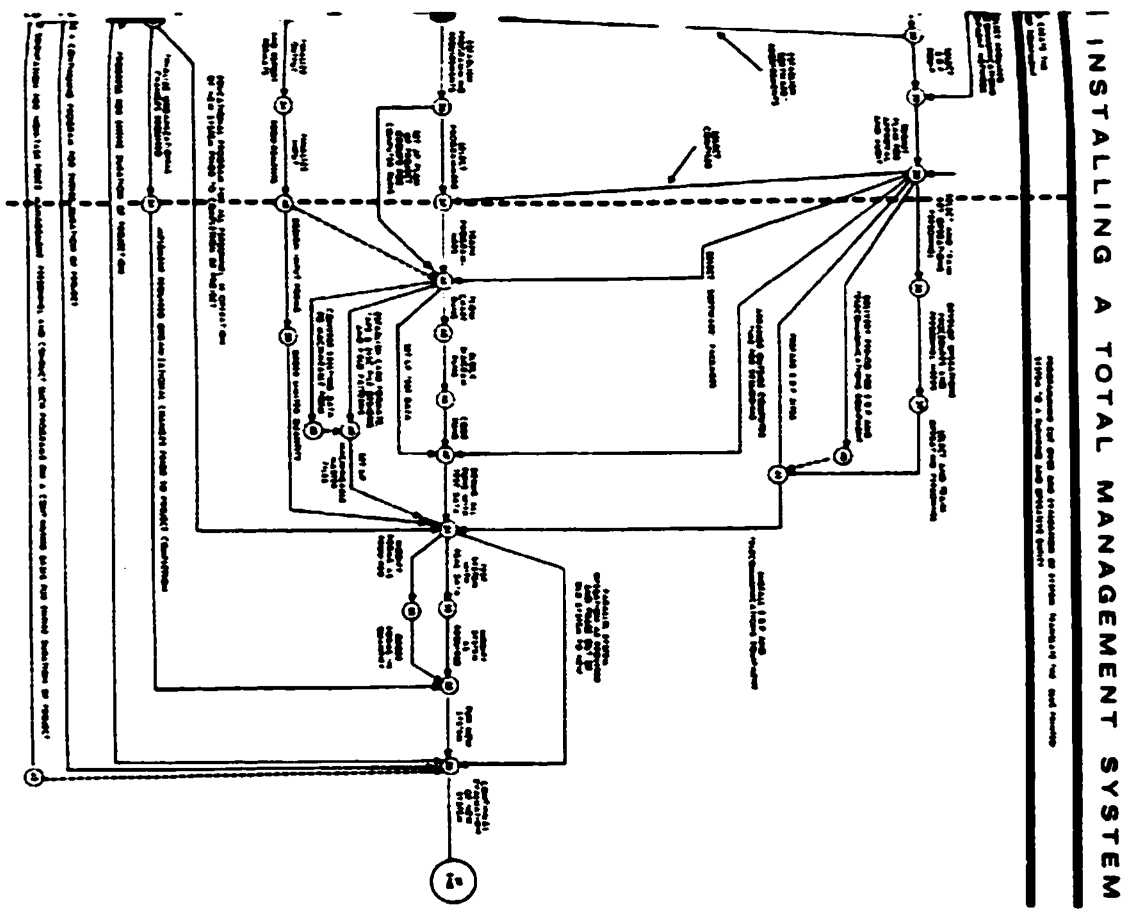


**Figure 32: Martino's diagram continued.**

One of the biggest problems was discovering what information managers actually needed. The original assumption had been that one could move down the company from the President, asking each manager in turn what information he needed to do his job. Then one could go away and design a system to deliver this, and only this, information to each person. Unfortunately, managers turned out to be rather bad at articulating in formal and complete terms exactly what they needed to know. And even by the most optimistic time scale, the effort would take years to deliver a system - by which point it would surely be out of date. Likewise, the programs themselves created a spider-web of interdependencies. Because they shared files and fed information backward and forward, the slightest change to the data format used by one could

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incapacitate all related operations (which according to the total systems concept meant everything in the company). Business information requirements changed constantly. Both these problems concerned the inflexibility of what was soon called a "monolithic" approach. The software tools, operating systems and project methodologies developed at this point could not begin to tackle the job.

Computer hardware of the era, though powerful enough to inspire enormous confidence when compared to earlier machines, was hopelessly inadequate to the task of building a total MIS. Systems men and management consultants tended to state as a matter of faith that business results achieved with computer hardware were constrained much more by poor management and unimaginative application than by technological limitations. While this may have been true, it did not follow that the computer hardware of the 1960s was powerful enough to support any conceivable system, still less that this could be achieved economically.

A 1966 survey of manufacturing firms conducted by the consulting firm Booz, Allen and Hamilton found that companies were beginning to follow their advice by using their computers for more than just routine administrative tasks and auditing the effectiveness of their computer effort. But although all the firms were working on "objectives for an ultimate total systems concept," essentially a plan to connect together the inputs and outputs of their computer programs, none took the idea seriously as an immediate goal or planned to put terminals into their board rooms. Two years later, Richard G. Canning used an issue of EDP Analyzer to ask, "What's the Status in MIS?" He concluded that the best currently deployed systems were limited but useful, producing scheduled reports of genuine use to top management but so far making little use of management science techniques. Little real interest existed among top management for

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graphical displays or personal interaction with the system. However, he expected increased use of models and information outside the firm during the years to come.[559]

During the mid-1960s many companies published eager boasts about their total systems under development. But most of the relatively rare articles referring to operational systems described the internal systems of firms like IBM, RCA and Univac. Even these followed the general pattern in starting with lofty plans for real-time operation and integration before the describing far less exotic creatures that they actually had working. For example, RCA applied the term to a spare parts inventory system that periodically issued accounting reports for management. Because the MIS was eventually supposed to include everything, pretty much any system could be called "phase I" of the much larger effort. This thinking was surely encouraged by the fact that data files for different jobs were already stored on the same computer - how difficult could it be to patch them together? But as actual experiences mounted this problem came into sharp relief.[560]

By 1968 a backlash against MIS was taking shape among the management elite. Tom Alexander of Fortune magazine claimed that business was computerizing faster than ever, but that

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[559] Results of the Booz Allen study were published in James W. Taylor and Neal J. Dean, "Managing to Manage the Computer", Harvard Business Review 44, no. 5 (September-October 1966):98-110, and a follow-up was presented as Neal J. Dean, "The Computer Comes of Age", Harvard Business Review 46, no. 1 (January-February 1968):83-91. Canning's article was Richard G. Canning, "What's the Status of MIS?" EDP Analyzer 7, no. 10 (October 1969):1-14. Canning devoted a number of issues of his newsletter to MIS, a term he initially rejected as ambiguous. He preferred the term "fast response" system as a description of on-line, interactive reporting tools – see Richard G. Canning, "Progress in Fast-Response Systems", Systems & Procedures Journal 18, no. 4 (July-August 1967):20-25 and Richard G. Canning, "Fast Response System Design", EDP Analyzer 5, no. 3 (March 1967). For his overview of third generation technologies see Richard G. Canning, "Trends in Corporate Data Systems", EDP Analyzer 4, no. 8 (August 1966).

[560] Trade journals regularly profiled modest systems as "Phase I" of a much larger effort, for example Anonymous, "Total System in the Mill", Business Automation 12, no. 7 (July 1965):22-29, Edward J. Menkhaus, "InterLoc: Control Where the Action Is", Business Automation 13, no. 7 (July 1966):46-53, Jr. William F. Cooke and William J. Rost, "Standard Cost System: A Module of a Management Information System", Journal of Systems Management 20, no. 3 (March 1969):11-16 and W. Norton Rosner, "Organizing for Management Information", Systems & Procedures Journal 19, no. 6 (November-December 1968):35-37. For RCA's spare parts system, see Henry M. Cohen, "A MIS That Scores As A Decision-Maker", Business Automation 14, no. 11 (November 1967):44-48.

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managers found their investments ever less productive as they moved further from clerical automation. "Most companies—even the most advanced—seem to agree that computers have been oversold—or at least overbought. It turns out that computers have rarely reduced the cost of operations, even in routine clerical work." He suggested that managers were losing faith in the ability of models and simulations to automate their work or to transform decision making into an exact science.[561]

Meanwhile accountants struck back against attempts by MIS enthusiast to present them as obsolete and hidebound. One author from Arthur Young and Company warned of looming danger in MIS driven by naïve managers and unscrupulous consultants. Sensitive to such criticism, the elite consulting firms pulled back from grand claims and reasserted their managerial credentials. A much quoted McKinsey report of 1968 dismissed almost in passing "the so-called total management information systems that have beguiled some computer theorists in recent years," and challenged the very idea that executives were ever going to use computer terminals directly. The report concluded that top management must take control of computing itself, it could not, "abdicate control to staff specialists" however gifted as technicians.[562]

The next year Ridley Rhind, a consultant with McKinsey, borrowed Dearden's view of computerized MIS as a useful but limited tool, best suited to operational management and logistics. "[T]he data that are collected to assist in the management of daily operations are," he wrote, "basically of very little interest, even in summary form, to the top management of the

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[561] Tom Alexander, "Computers Can't Solve Everything", Fortune 80, no. 4 (October 1969):126-29, 68, 71.

[562] McKinsey and Company, Unlocking the Computer's Profit Potential (New York: McKinsey & Company, Inc., 1968). The Arthur Young author is Robert G. Donkin, "Will the Real MIS Stand Up?" Business Automation 16, no. 50-53 (May 1969):5. Accountants had been warning for some time of the dangers of 'computeritis', eager computer salesmen and a romantic attachment to totality. See for example this article written by two members of Arthur Andersen -- J.W. Konvalinka and H.G. Trentin, "Management Information Systems", Management Services 2(September-October 1965):27-39. Leading consulting firm Booz, Allen and Hamilton continued to defend "total systems" as a framework and philosophy if not an attainable goal, see Patrick J. O'Harien, "Total Systems: Operating Objective or Planning Structure", Journal of Systems Management 21, no. 11 (November 1970):34-38.

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corporation." He went on to dismiss the "dreamlike" quality of most articles on total systems, insisting that, "promises that the computer can eliminate shortages, delays or inaccuracies in available information are made only be those who have a vested interest in computer development work and who believe that the more ambitious the system, the greater the status." Expertise in computer systems, he insisted, did not translate to expertise in management control systems.[563]

Even those in favor of modeling techniques began to retreat from the idea that a group of staff experts should produce an enormous model of the whole company to be used by the president in evaluating major decisions. Curtis H. Jones, another Harvard expert, suggested that such models gave only an illusion of optimality while freezing and hiding assumptions made by the model builders. Models should support management decision making, not automate it. Rejecting the systems men's idea of MIS as a tool to filter the information given to each manager, he argued that, "Staff personnel... should be charged with the responsibility of expanding, not reducing, the number and range of alternatives which the executives can evaluate easily."[564]

Companies had tended to add voluminous statistical output capabilities to their existing operational systems and call the result MIS. They hoped to join the pieces together with analysis and modeling tools at a later date. Those who continued to view MIS as a tool to redefine

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[563] Ridley Rhind, "Management Information Systems: Some Dreams Have Turned to Nightmares", Business Horizons (June 1968):37-46, page 44 & 42. A little later Edwin Tolliver, formerly a senior systems man for the Navy, delivered two articles comprehensively debunking every managerial article of faith held by the his fellows, from total systems to a top-level, autonomous computer department. Edward M. Tolliver, "Myths of Data Automation", Journal of Systems Management 21, no. 8 (August 1970):36-38, Edwin M. Tolliver, "Myths of Automated Management Systems", Journal of Systems Management 22, no. 3 (March 1971):29-32.

[564] Curtis H. Jones, "At Last: Real Computer Power For Decision Makers", Harvard Business Review 48, no. 5 (September-October 1970):75-89, page 89. Similar sentiments were presented in James B. Boulden and Elwood S. Buffa, "Corporate Models: On-Line, Real-Time Systems", Harvard Business Review 48, no. 4 (July-August 1970):65-83. The was not universally acknowledged though - for example one prominent management theorist held that executives were incapable of properly understanding information and so should rely on experts to guide them through its selection and application. Ackoff, "Management Misinformation Systems".

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managerial structures saw this as a disaster. William M. Zani attributed it to the failure of top management to decide what its strategic information needs were and to charter a suitably powerful systems team to deliver them. What had happened instead was the automation and recycling of existing systems, so that, "the so called 'management information system' is merely a mechanism for cluttering managers' desks with costly, voluminous, and probably irrelevant printouts." He concluded that, "No tool has ever aroused so much hope at its creation as MIS, and no tool has proved so disappointing in use."[565]

By the start of the 1970s, these doubts had spread beyond the elites of the Harvard Business School and into the mainstream of data processing. A 1972 article in the DPMA's Data Management reported that, "Top management got burned, but it will not happen again in the area of MIS. If nothing else good came from the abortive attempts, management is much wiser, and, perhaps even more meaningful, we (the data processing community) gained some much needed humility, maturity, and responsibility." A 1973 article in Infosystems (as Business Automation had become) reported that, "MIS is a dirty word in many EDP establishments." According to another piece, Univac (the same firm that had earlier sold its computers as "total management information systems") had finally succeeded in building itself a reasonably integrated on-line system, but "deliberately refrains from using the term MIS… not wanting to incur any of the prejudices or preconceptions that the term might trigger." A study of some of America's largest companies found that, "not one out of about 150 responding companies was pleased with the development of its MIS."[566]

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[565] William M. Zani, "Blueprint for MIS", Harvard Business Review 48, no. 6 (November-December 1970):95-100, page 95. The bottom-up nature of MIS efforts in practice is also discussed in F. Warren McFarlan, "Problems in Planning the Information System", Harvard Business Review 49, no. 2 (March-April 1971):75-89.

[566] Norman L Paul, "MIS...Are You Ready?" Data Management 10, no. 10 (October 1972):29-31. Anonymous, "...MIS, the Impossible Dream?" Infosystems 20, no. 2 (February 1973):70. Laton McCartney, "To MIS but not to MIS at Univac", Infosystems 20, no. 6 (June 1973):35-38. Roger Gupta,

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## MIS in the 1970s and Beyond

The term MIS by no means vanished at the end of the 1960s, despite the increasing sense of crisis that settled over attempts to build totally integrated systems. To the contrary, during the 1970s, the number of data processing departments redesignated as MIS departments, and the number of managers granted the title of Manager or Vice President of MIS, both increased sharply. Within the academic world, the use of the term MIS to describe university departments, courses, journals and associations was still rare in the late 1960s, and became far more common during the 1970s. What was lost, however, was the simple and widely shared idea of MIS as a computerized system spanning all departments of a company and delivering to each manager exactly the information he or she needed in real time. This idea, crucial to the mid-1960s MIS alliance of data processing experts, systems men, operations research specialists, and computer salesmen had crumbled by the end of the decade. Instead, members of each of these communities began to redefine MIS is different, more attainable terms – each concept spanning only a small part of the original shining vision.

As the table below shows, by the mid-1970s the term MIS (almost always in acronym form) had gained a number of additional meanings, quite apart from its original definition as a massive, totally integrated computerized system for administration and management. MIS was used:

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"Information Manager His Role in Corporate Management", Data Management 12, no. 6 (June 1974):24-25.

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|---|---|
| 1 | To describe an enormous, corporate-wide computerized system spitting out all reports. This was the original sense. This was increasingly identified with the idea of a data base. |
| 2 | As the name of departments, courses, and programs in business schools concerned with teaching business students, in a general way, about the use of computers for corporate administration. Such introductory courses were an increasingly common part of the core business school curriculum.[567] |
| 3 | As the name of an academic field (and associated journals, conferences etc.), whose practitioners conducted empirical and usually quantitative research on the construction and operation of computer systems for administrative and managerial use. |
| 4 | As the description of a field of academic research whose practitioners addressed the topic of how managers (generally top managers) actually make decisions, and the kinds of computerized information systems that could assist them in this activity. (Later renamed Decision Support or Executive Information Systems). |
| 5 | As a new name for the entire corporate computing department. Data processing now seemed passé, and as computer departments moved up the organizational ladder they and their managers were keen to receive the new title. Largely cosmetic. |

**Figure 33: Different meanings attached to MIS by the mid-1970s.**

In this gradual redefinition, the phrase "total systems" was the first thing to go. In the early 1960s its meaning, in corporate computing and management circles at least, had shifted from the original idea of imposing no artificial limits on the scope of a model to a bastardized sense of a computer system in which absolutely everything was included. As the practical limits on what could be built using even third-generation computer technology became all too painfully apparent, discussion of the total system dwindled to almost nothing. In contrast, discussion and advocacy of MIS were, if anything, more common during the 1970s than the 1960s, but its location and significance shifted. MIS was progressively less likely to be proposed in the Harvard Business Review or a McKinsey report as the next big thing for corporate management, and more

[567] For an IBM sponsored study of early efforts at 11 pioneering business schools, see J. Daniel Couger, "Producing a Computer-Oriented Manager", Journal of Systems Management 20, no. 5 (May 1969):22-27. A later survey revealed what Couger claimed were dramatic improvements. J Daniel Couger, "Turnabout in the Approach to Educating Future Managers About the Computer", Data Management 9, no. 6 (June 1971):34-40. For a rather negative view of the data processing awareness of business school graduates, see Barry Render and Ralph M Stair Jr., "Future Managers Need DP Training", Infosystems 22, no. 10 (October 1975):41-42.

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likely to be the new name for the main corporate computing department or the tag under which teaching of data processing gained acceptance in minor league business schools.

Indeed, MIS retained sufficient cachet among the elites of the corporate and business school computing world that in 1968 they chose to name a new, and more exclusive, professional association the "Society for Management Information Systems" (SMIS). Robert V. Head, originator of the visual representation of MIS as a pyramid of information systems, chaired its founding committee.[568] The society's first annual meeting, held at the University of Minnesota in 1969, was attended by more than three hundred people, including the board chairman of First National Bank of Chicago and Terrance Hanold, President of Pillsbury and the most vocal executive booster for the corporate potential of MIS. Technical papers were delivered by representatives of RCA, Texas Instruments, IBM, Standard Oil of Indiana and Arthur D. Little.[569]

As Head recalls today, his hope was for SMIS to "bring together members of top management, data processing management, and computer professionals into a common forum." He felt that the existing Association for Computing Machinery (ACM) and The Institute for Management Science (TIMS) were far too narrowly academic to fill this niche, while the Data Processing Management Association (DPMA) was "perceived by many as somewhat inferior professionally and intellectually." The new organization would be open to academics, several of whom were included on the founding committee, but he was keen to make sure that it was not, "taken over by computer scientists." [570]

As the Society for MIS, SMIS had a rather obvious stake in finding out what MIS was. Its leaders, drawn from industry, academia and consulting firms, soon found themselves haunted by the lack of agreement over the nature of their beast. Once chartered, one of the society's first

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[568] Ream, "The Need for Compact Management Intelligence".

[569] Anonymous, "New MIS Society Make Impressive Debut", Business Automation 16, no. 10 (October 1969):103.

[570] Private communication to author, Robert V. Head, January 31 2002.

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actions was to organize a panel discussion between its leading members provide a consensus definition of the term. This proved impossible. While ambiguity had always been vital to the ability of the MIS concept to support a broad coalition, as time went by it was to became more and more of a handicap. Transcripts of the panel discussion show that a gulf emerged between those who viewed the computer, video-terminals and third generation system capabilities as fundamental to MIS and those who saw the specific technology from which an MIS might be built as firmly secondary to the managerial principles it embodied. The former position reflected the actual use and origins of the MIS concept, while the latter reflected the eternal quest of systems specialists to present themselves as experts on managerial principles rather than and technological gizmos. In contrast, computer vendors and technology consultants tended to take the opposite (if predictable) position that that nothing less than the latest and most expensive technology could produce information of interest to executives.[571]

Head, then serving as President, hewed to the technological side when he drew on the blackboard a list of technological attributes essential to a true MIS including "information retrieval, data management, conversational processing, situation rooms, modeling" and the then-novel "graphics". Others demurred fundamentally, suggesting that MIS should be a more general approach, based on the requirements of management rather than technological commitments. The majority of the participants went far enough to agree that MIS, in practice at least, demanded the presence of a computer. Ned Chapin, a consultant and academic who had been publishing on the use of electronic computers for business since 1954, suggested that a glance at the material included in the society's own voluminous bibliography implied a minimum definition that MIS

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[571] The Society for Management Information Systems, Research Report One: What Is A Management Information System.

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must include a computer and cross organizational boundaries. But he also felt that none of Head's specific technologies were mandatory.[572]

It was Roger Wing, of Fred Landau and Company, who raised what was perhaps the most important objection: "We finally have to admit that whatever it is that top management does, it is not systematic. We must then conclude than an information system that is serving top management will itself be not very systematic." The whole MIS movement, he suggested, had been based on the assumption that top managers made strategic decisions rationally, on the basis of quantitative results derived from detailed, operational and primarily internal data. Or at least, that they should do so, or wanted to do so and would do so, if they only had a big enough computer and a sleek enough terminal. But, as Wing went on to note, 'We cannot change what a top manager thinks is management information to him at any given time.... It could be that the more vital information to management is something that could not possibly pop out of a computerized system."[573] This implied that executive information needs included external and qualitative information that could usefully be organized on computer but which was unlikely even in principle to flow from existing administrative data, the bottom level of the information pyramid.

Few of the others there were willing to endorse this almost heretical notion. Some suggested that MIS should be "parasitic" on the existing operational systems handling day to day transactions. Rather than being the whole system, MIS would be an additional layer that filtered and prepared data for the needs of executives. This rested on the assumption that, "[a]lmost all the information that management needs for long range planning comes from some source that gathered it for some other purpose." But even Head, who had promoted the pyramidal conception

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[572] Ibid, 24.
[573] Ibid. The quotation is from page 20.

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of MIS, disputed the wisdom of this parasitical approach, saying that current operational systems were bad that they needed to be replaced rather than build on.[574]

There were several elements on Head's list with which many of them felt uncomfortable. One fundamental disagreement was over whether the term MIS could be applied to any system that helped senior management to work with information. The "situation room" (the largely mythical executive war-room full of screens and terminals) came in for particular heckling, as a "sizzle" that ultimately distracted from the "steak." Robert Forrest, editor of Datamation, warned that this irresponsible salesmanship meant that, "...currently MIS has a very black name." Another bone of contention was whether MIS should serve the needs of all management or be specialized for top management and planning purposes. They concluded with the dispiriting thought that perhaps 90 percent of the SMIS members (a typical member, according to Head, was a "manager of MIS or systems in a medium to large company") were engaged in "technology-push" within their organizations, rather than management focused "need-pullers". While Head disliked these terms, even he admitted that, "it is perhaps the system designers who really want an MIS, and not the top management group."[575]

The cracks evident at the SMIS meeting etched in miniature some of the fault lines that would split MIS during the rest of the 1970s. But these fissures did not immediately shatter MIS, and in some ways they strengthened it. The enduring power of the term derived in part from its very vagueness. One could utterly repudiate any popular definition of MIS (perhaps one that stressed "totality" or seemed too fixated on executive use of computer terminals) without having to renounce a shared commitment to MIS, whatever it turned out to be. This interpretative

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[574] While Wing's critique did not seem to have much immediate impact, ideas of this kind were soon to reach a much broader audience when management scholar Henry Mintzberg used ethnographic analysis of managerial work to critique the concept of managerial work embedded in most MIS and OR analysis.

[575] The Society for Management Information Systems, Research Report One: What Is A Management Information System.

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flexibility, more than anything else, accounts for the endurance of MIS as a term even though its meaning was never agreed and always changing. As participants struggled to find an objective and universal definition of MIS, it fell to Milton Stone (a former Arthur D. Little consultant and Northrop systems man then working as an editor of Infosystems) to point out that MIS was more of a slogan than a well-formed concept. The concept of MIS, said Stone, had been shaped and spread through, "a struggle that went on in most companies for control of the whole process of developing systems and operating them." "The question," he continued, "was whether such systems were to be operated by broad gauge men or narrow specialists. I think it is useful for us to recall the origin of the term and to realize that it began as a merchandizing 'gimmick' and has been perpetuated to emphasize... the types of people who should control the design of such systems."[576]

While MIS had always worked as a kind of umbrella identity, by the early 1970s, many of its proponents were attempting to subsume its component parts into a single new profession or discipline. This was particularly apparent at business schools, where faculty members with an interest in the application of computers to business found Management Information Systems a much more attractive identity than Electronic Data Processing. After all, the title contained both management and system. And, as we have seen, information was a lot higher status than data. As departments, programs and groups dealing with the managerial application of computer technology sprang up, it was under the banner of MIS. The University of Minnesota pioneered this effort, and soon Wharton and MIT provided specialized training in the field.

The emergence of MIS as an academic specialty was supported by the efforts of SMIS, and by the ACM's Special Interest Group in Business Data Processing (SIGBDP), a group designed to bring both intellectual and managerial respectability to business data processing.

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[576] Ibid, 7.

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During George Glaser's period as its chair, SIGBDP had begun the publication of its glossy newsletter Data Base. Richard Canning was also deeply involved in the production of the magazine, and served for several years as SIGBDP chair during the early 1970s. Data Base became an important location for serious and academic discussion of MIS. SMIS, meanwhile, sponsored the publication of an exhaustive bibliography by the University of Minnesota's Gregory W. Dickinson, issued some other reports, and published its own newsletter. In 1977, SMIS worked with the MIS Research Center of the University of Minneapolis to produce the first issue of its journal, Management Information Systems Quarterly. Renamed MIS Quarterly, it remained the leading journal in its field through the 1980s and 1990s.[577]

Academic acceptance was, however, to prove far harder to square with practical relevance than pioneers such as Head and Canning had hoped. To capture the shifts taking place as MIS researchers sought to legitimate their work as an academically respectable and methodologically rigorous enterprise, we can turn to no better source than a 1973 conference on MIS held at the Wharton School of the University of Pennsylvania. Its organizer, Howard Lee Morgan, was director of research for SIGBDP. Its proceedings were published jointly by SIGBDP and SMIS, and its participants included pretty much everyone who had recently established, or was about to establish, a significant academic reputation in the MIS field.

The opening address was given by James C. Emery, a Wharton professor and founding member of the SMIS executive council. Emery was at this point one of the best known academic speakers on MIS, and had already published a book on the topic. In this talk, he addressed the problems involved in trying to produce an "MIS professional." The MIS manager, he suggested,

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[577] Aside from its newsletter, the other most notable SMIS publication of the period was Garry W. Dickson and Jeffrey A. Lasky, The SMIS President's Reading List (Minneapolis: School Of Business Administration, University of Minnesota, 1971). Data Base was not, confusingly enough, primarily about data bases or data base management systems – data base was used in an earlier, looser sense. Its full name was The Data Base for Advances in Information Systems.

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must know the academic principles of decision science, understand the functional areas of the business, know computer technology, and have an excellent grasp of managerial techniques. Yet Emery soon slipped, without apparently noticing, from the question of MIS as a profession to the challenge of establishing MIS as an academic discipline. He viewed the two processes as identical, arguing that, "one of the principal signs of maturity in a professional field is the extent to which it is based on a generally accepted theoretical foundation." Emery's choice of systems theory as the basis for "MIS as an intellectual discipline" was immediately challenged by one of the commentators who asked "why isn't the area of management (say, planning and control processes or the functional management areas) or management science a "conceptual foundation of MIS?" Similarly, continued the commentator, if 'knowledge of computer technology' is a skills subset of the intellectual discipline, why isn't the information sciences one conceptual foundation?" The commentator also mentioned "information economics and behavioral sciences" as two oft-neglected pillars of MIS. The answer, though Emery did not give it, would seem to have been that systems theory promised to provide a universal expertise which could tie everything else together. A little bit of everything might make for a good professional education (medicine lacks anything more profound), but it made for a lousy theoretical foundation.[578]

Emery did, at least, admit the need for a successful manager of MIS efforts to understand something about computer technology. "The point," he said, "is often made that an MIS manager should not be a computer technician.... On the other hand, good managers without sound technical insights have made colossal blunders because they did not understand the technology they were attempting to apply. The design of an MIS calls for some exceedingly complex

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[578] James C. Emery, "An Overview of Management Information Systems", Data Base 5, no. 2-3-4 (Winter 1973):1-15.

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technical tradeoffs. The manager without some computer experience places himself in the position of having to rely solely on the judgments of others."[579]

Emery was not alone in his difficulties relating a proposed "theoretical basis," in this case systems theory, to the enormously diverse educational needs of any "MIS professional" worthy of the name. However, to make the case for an MIS program as an essential part of any business school, it was thought necessary to define a coherent body of knowledge, research program, set of questions, collection of research methods and the other accoutrements of an academic discipline. They would also need text books, syllabi and the other apparatus of academic instruction. Many of these books were edited reading collections, intended to provide a convenient source of class assignments.

These MIS textbooks struggled in the attempt to move from the first principles of "universal system theory" through the complexities of computer hardware to explain practical applications of MIS in different areas of the firm. Their differing strategies betray the extent to which MIS remained a flag of convenience for different traditions rather than a truly unified field. To judge from their introductions, most texts were intended for a mixed audience of computer science students, accounting majors, and general management or public administration students. But their authors tended to privilege one aspect of the attempted hybrid.

Some books floated at a safe distance above the grittier elements of computer technology and organizational problems, glossing over any possible problems. Robert G. Murdick, author of a spate of MIS textbooks and readers, continually downplayed the need for technical knowledge of information processing, instead concentrating on general business skills and connection of MIS to formal planning and activities. The led to a certain glibness - as when his sample plan for MIS implementation included a discrete activity entitled "Find out the information needs of all

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[579] Ibid, page 2.

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managers", for which he budgeted a mere 22,300 dollars.[580] He was found of blanket statements such as "systems are likely to be less expensive and work better if you design them yourself", and that a company should find out how much it competitors spend on developing new applications and then aim to outspend most of them.[581] While insisting that MIS must move outside the organizational control of accounting, he seems to have seen it as an extension of the managerial side of accountancy to become the heart of a new approach to management. He presented embrace of MIS and the systems approach as the key to greater managerial professionalism. "Perhaps the future manager will put it this way: 'the synergistic/symbiotic relationship of a business and society will be optimized through a sophisticated total systems approach'."[582] In 1977, when this claim appeared, its "total systems" language was already ludicrously dated – and in general the textbook served as a haven for ideas and phrases largely abandoned by non-academics a decade earlier.

Murdick's was, then, was a highly schematic vision of MIS as a space-age, cybernetic variant of managerial accounting. Other authors betrayed different allegiances. In his 1972 Management Information Systems: Tools and Techniques, William A. Bocchino placed a similar stress on systems techniques, and made similarly broad claims for the development of the computer as the most important development in managerial history. Once past the obligatory first few chapters on systems theory, however, Bocchino provided much coverage of the more traditional techniques of the systems men such as forms control, charting tools and work

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[580] Murdick's introductory text is Murdick, Introduction to Management Information Systems. The quotation comes from a lengthier textbook he coauthored, Murdick, Introduction to Management Information Systems, 5. The centrality of MIS to managerial professionalism is discussed on pages 57-60.

[581] Murdick, Introduction to Management Information Systems, 114-5.

[582] Robert G. Murdick and Joel E. Ross, Information Systems for Modern Management (Englewood Cliffs, NJ: Prentice-Hall Inc., 1975), 4-5.

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simplification. He also included substantial discussion of computer hardware and operations research techniques.[583]

Others put a similar gloss on data processing. A 1971 text called Data Processing for Decision Making began with an unusually garbled version of the story. It informed its readers that, "Scientific decision making" was the key to modern management, and that this, "was more often referred to by its practitioners as operations research." But, after this whistle-stop tour of the attractions of linear programming, simulation, PERT, file handling and business records the authors reached their real topic: computer hardware and computer programming. The book devoted more than four hundred pages to these topics, including the operation of computer logic circuits, processor architecture, buffering systems, different methods of number representation and a seventy-four page guide to IBM assembly language programming. Few managers needed to know these things, yet the book undoubtedly captured much of what was actually taught and promoted as under the MIS label.[584]

As had many before them, the growing community of MIS researchers were able to turn general failure of earlier systems projects to deliver what they promised into a powerful support for their own authority. One widely discussed paper, "Understanding MIS Failures," was quite scathing. Its authors Howard L. Morgan (a Wharton researcher) and John V. Soden (a McKinsey consultant) argued that, "many MIS are merely computer-based carbon copies of historically derived inefficiencies," and that the drive to use the latest technology came from the resume-building impulses of the system designer rather than the needs of the users. Simpler but more economically relevant designs were, they argued, often neglected. The focus of the paper, however, was a taxonomy of "MIS architect" types – based on a claim that, "almost all of the

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[583] William A. Bocchino, Management Information Systems: Tools and Techniques (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1972).

[584] Brightman, Luskin, and Tilton, Data Processing for Decision-Making: An Introduction to Third Generation Information Systems. The quotation is from page 22.

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failures were of management and personnel, rather than technology," coupled with the assumption that this could be reduced to the personal management style of the person in charge. According to Morgan and Soden, success required a mixture of managerial vision, expert project control and expert planning. Only one of their five types, "the fast tracker" would really succeed. The less capable "efficiency expert" ran a tight ship but focused on operational automation, while the "flamboyant conceptualizer" was good at selling ideas but bad at building systems. They implied that most MIS leaders of the 1960s fell into the latter category, because it was hard for management to tell the visionary from the charlatan. "The selection process for MIS executives is generally so clouded with technical jargon, emphasizing creative concepts rather than management tasks, that screening of candidate executives is particularly ineffective."[585] Warming to the theme, they concluded that the most important quality,

> for success of anyone in the MIS area is the ability to write good resumes. The definition of "good" varies from person to person, but generally involves a heavy dose of technological jargon and fluffy documentation of sophisticated equipment familiarity. Given the difficulty of communicating good guidelines for company executives to evaluate their MIS effort and the velocity of job switching in this field, an effective quality control device might well be a rigorously defined, generally accepted resume format—as simple as it may sound. One should be able to develop such a standard which focuses on appropriate measures of effectiveness and efficiency of management procedures (control, organization, and planning), the ability to develop concepts (to a limited extent), and other factors material to good management in general.

As with so many MIS papers of the 1960s, their attacks on current failures were far more compelling than the prescriptions for success that followed. Their cure was basically to apply good general management and project management techniques to the process. They proposed the establishment of standard techniques to estimate the cost and complexity of MIS efforts, monitor progress and compare the efforts of different companies against each other.

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[585] Howard L. Morgan and John V Soden, "Understanding MIS Failures", Data Base 5, no. 2-3-4 (Winter 1973):157-71. In a second version of the paper Morgan seemed to have dropped out of the picture. John V Soden, "Understanding MIS Failures", Data Management 13, no. 7 (July 1975):29-46.

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The more academically rigorous and scientifically inclined members of the conference were not impressed. Most of them were pushing for more rigorous, more quantitative explorations. As the paper's commentators observed, the Morgan and Soden had reduced the entire question of MIS failure down to a single variable, and presented hypotheses generalized from a minute sample of data as firm conclusions. Their actual data was never presented, even in summary form. After hearing another discursive paper, "Barriers to Progress in Information Systems Design: Technical or Not?" another commentator remarked "I believe a moratorium should be declared on opinion-based writings in the general area of computer-aided thinking. Viewed in the dim light of current knowledge, we should all talk less and do empirical research more."[586] Indeed, the field was to find its dominant method in the quantitative apparatus of the modern social sciences – testable hypotheses, carefully designed experiments, and statistical analyses. This push for methodological rigor produced an increasing divide between MIS researchers and practicing managers or computer people, paralleling the longer established separation of operations research from the culture of practicing managers. As time went on, the technical quality of MIS research papers rose, but the scope of the issues each addressed became narrower, and a thick fog of academic language made sure that only fellow academics would try to read them.[587]

The proper objectives of MIS research were just as controversial as the acceptable methods for pursuing them. Richard L. Van Horn, then of Carnegie Mellon University, presented a survey of empirical studies in the area. He observed that the most influential studies to date,

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[586] The commentators on the Morgan and Soden paper were notable MIS researchers Gary R. Dickinson (one of the leaders of SMIS) and MIT's John F. Rockart. Christopher R. Sprague, "Barriers to Progress in Information Systems Design: Technical or Not", Data Base 5, no. 2 (Winter 1973):115-20, page 119.

[587] This process has caused some recent debate within the MIS community. See Thomas H. Davenport and M. Lynne Markus, "Rigor vs. relevance revisited: response to Benbasat and Zmud", MIS Quarterly, March 1999.

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such as the McKinsey and Booz-Allen & Hamilton surveys of effective computer use, were mere case studies, rather than real research. As he summarized the field, "Many of the existing studies are oriented toward managers and lack statistical rigor. Other studies focus on descriptions of computer-organization impact. Studies that directly address questions of design, development, or implementation represent an area of great usefulness, high potential value, and little current attention." Van Horn's quest for scientific rigor threatened to draw its adherents out of real corporations entirely, as the would-be management researchers of SDC had earlier advocated. Having concluded that field tests would almost never produce usable results, he suggested that, "laboratory studies offer the only viable approach to reality for many aspects of MIS research." Indeed, as his comments betrayed, van Horn had previously worked in the lavishly funded surroundings of the RAND Systems Research Laboratory. His colleagues expressed their doubts that the experiences and prejudices acquired in this environment could serve as a model for the low-budget world of management research.[588]

Henry C. Lucas, another contributor to the 1973 conference, gave a fuller expression to his views in a 1975 book, provocatively entitled Why Information Systems Fail. It presented a model of MIS development and six detailed case studies, which given the conspicuous lack of hard data in earlier accounts seemed like something of a bonanza. Lucas argued for what would soon be called a "user centered" approach to system design, claiming that managers did not understand much of the output their received form computers, and were consequently liable "discount all the information provided by a system." Programs were inflexible, and the requests of users for changes were liable to be ignored. As a result, he said, "many feel that computer based information systems are not worth the time and cost to develop and that the organization would be better off without them." Lucas concluded that one must, "let the user be the source of

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[588] Richard L Van Horn, "Empirical Studies of Management Information Systems", Data Base 5, no. 2-3-4 (Winter 1973):172-82.

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systems wherever possible; if the user initiates a system he will have more commitment to design, implementation, and use." In addition, it was best to "[l]et the user design the system if possible. The information services staff should act as a catalyst and map the user's functional and logical design into manual procedures and computer systems." This implicit definition of managers and departments as "users" of the system, as a partners in its design, was something of a novelty in theoretical or academic discussion of MIS. Earlier, more cybernetic, theorists had tended to treat managers themselves as a part of the system rather than its external beneficiaries.[589]

Lucas acknowledged some of his predecessors, including Dearden – who had argued a decade earlier that the specification and design of systems belonged in the hands of the operating departments involved rather than those of power hungry corporate systems specialists. But his main tactic was to deny the explicitly managerial origins of the MIS concept, instead painting those who had gone before as technicians with no grasp of organizational issues. "The design and operation of information systems" had, according to Lucas, "long been considered primarily technical activities." He suggested that despite having, "adequate technology today to develop sophisticated information systems," this misplaced "concern over technology" had caused everyone to have, "ignored the fact that almost all information systems exist within the context of an organization." MIS and the very concept of an information systems had, of course, been managerially and organizationally oriented from their very invention. Given the reality of what has been promoted with those terms, however, Lucas was far from alone in wanting to bury this

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[589] Henry C. Lucas, Jr., Why Information Systems Fail (New York: Columbia University Press, 1975), 112. The earlier version was Henry C. Lucas, Jr., "A Descriptive Model of Information Systems in the Context of the Organization", Data Base 5, no. 2-3-4 (Winter 1973):27-39.

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fact and so restore a measure of novelty to the idea of approaching computer system development from an organizational viewpoint.[590]

The meaning of MIS was already beginning to shift. Its accepted meaning in the 1960s was literally as a system to inform management, generally an enormous, computerized and real-time total system knitting together the entire company. By the mid-1970s, however, it was frequently being used to refer to any corporate use of computers for administrative, managerial and operational purposes. Richard L. Nolan, a Harvard professor and the leading academic author on data processing and MIS management during the 1970s, used the terms "EDP", "MIS", "Data Resource" and "Computer Resource" interchangeably during 1973 and 1974.[591] In a single article, he wrote of the "EDP effort", "EDP function", "EDP department", "MIS unit" and "computer resource" – all meaning the same thing. Likewise, the "MIS manager" and the "EDP manager" were synonymous to him. MIS continued to be a very slippery concept, but it retained its managerial allure. By the late 1970s, at which point large numbers of companies had adopted MIS as the new name for their administrative computing departments, it was little more than a new name for EDP.

Likewise, academics stretched the MIS term to refer to anything concerning the corporate use of computers for managerial or operational purposes, including both computer-aided decision making and the best practices for running and structuring a computer department. By the 1980s, the "M" in MIS was often dropped, in practice at least. Business schools were more likely retain the term MIS, presumably because of the respect accorded to management in their culture, while

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[590] Lucas, Why Information Systems Fail, vii.

[591] Cyrus F. Gibson and Richard L. Nolan, "Organizational Issues in the Stages of EDP Growth", Data Base 5, no. 2 (Summer 1973):50-68, Cyrus F. Gibson and Richard L. Nolan, "Managing the Four Stages of EDP Growth", Harvard Business Review 52, no. 1 (1974):76-88, Richard L. Nolan, "Managing the Computer Resource: A Stage by Stage Hypothesis", Communications of the ACM 16, no. 7 (July 1973):339-405, Richard L. Nolan, ed., Managing the Data Resource Function (New York: West Publishing Co, 1974).

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library schools or computer science groups approaching the same territory were mostly called Information Systems (IS) groups. By the 1990s, even MIS Quarterly used IS rather than MIS in its editorial statements, and publicly defined its topic as research "concerning both the management of information technology and the use of information technology for managerial and organizational purposes."[592]

In response to this widening of scope, and to the failure of early MIS research to discover very much about the information needs and behaviors of managers, those interested in what managers actually did with information began to define their work in different ways.

Some followed Dearden in attacking the assumptions behind MIS. Henry Mintzberg established a reputation as one of the most practical and original management theorists simply by observing real managers at work. He found that they ignored detailed factual reports, refused to concentrate for long periods on in-depth analysis, relied on social networks and gossip for their information, put a premium on information from outside their own organization, and spent most of their time talking. From this, he concluded that neither MIS nor its rationalistic siblings of decision support and strategic planning were in a position to do much for real managers.[593]

Members of an influential MIT group, the Center for Information Systems Research (CISR), made a less dramatic break with MIS. MIT's Sloan School had ranked with Minnesota's Carlson school and Pennsylvania's Wharton school as a prominent center of MIS research in the early 1970s. The center was established in 1974. Michael Scott Morton, one of its leaders, pioneered the term "Decision Support Systems", a more specific term than MIS because it

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[592] Bob Zmund, "Editor's Comments: Nature of Topics", MIS Quarterly 19, no. 2 (June 1995).

[593] Mintzberg published his seminal enthnographic work as Henry Mintzberg, The nature of managerial work (New York: Harper & Row, 1973). The connections to MIS were made more explicit in Henry Mintzberg, Impediments to the Use of Management Information: A Study Carried Out on Behalf of the National Association of Accountants, New York, NY and the Society of Industrial Accountants of Canada, Hamilton, Ontario, Canada (New York: National Association of Accountants, 1975). The same basic findings and message remain standard reading in many management courses, often as Henry Mintzberg, "The Manager's Job: Folklore and Fact", Harvard Business Review 53, no. 3 (July-August 1975):49-61.

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emphasized the ability of the systems to help managers make better decisions. Back in the 1960s, Morton had been among the first academic researchers to experiment with the use of video terminals hooked up to a central database as a tool for financial analysis.[594] The work of his group placed a premium on interactivity, and the kind of "man-machine system" thinking common at MIT during that era, as it became a center for huge ARPA-funded projects on timesharing and networking. By 1971, his MIT group had emerged as a vocal critic of what I described earlier as the "information pyramid" concept of MIS – the idea that the information needed for strategic decision making could be obtained be integrating and summarizing the information gathered from operational control. Scott Morton suggested that routine, low-level processes accounted for "almost all of what has been called Management Information Systems in the literature – an area that has had almost nothing to do with real managers or information but has been largely routine data processing." He also suggested that, "the 'integrated' or 'company-wide' data base is a misleading notion, and even if it could be achieved would be exorbitantly expensive."[595]

Scott Morton argued that a true MIS would have little to do with data processing, or with the kinds of routine reporting carried out by existing systems. Indeed, he suggested that a successful effort should be, "virtually independent of the computer group." Managers did not lack information, but they did, "have need of new methods to understand and process the information already available to them."[596] Within a few years his group had jettisoned the MIS tag altogether, preferring first Decision Support Systems and then – influenced by Mintzberg and his critique of

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[594] Michael S. Morton and Andrew McCosh, "Terminal Costing for Better Decisions", Harvard Business Review 46, no. 3 (May-June 1968):147-56.

[595] G. Anthony Gorry and Michael S. Scott Morton, "A Framework for Management Information Systems", in Managing the Data Resource Function, ed. Richard L. Nolan (St. Paul: West Publishing Company, 1974).

[596] Ibid, 104.

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the idea of the manager as a disembodied decision maker – Executive Support Systems.[597] Meanwhile, the term Executive Information System (EIS) won general acceptance in the 1980s to describe systems that provided personalized information to executives – generally through an idiot-proof series of menus presented on a video terminal. Management Information System, although on its face meaning exactly the same thing, had become too broad, and too technical, a term.[598]

In the corporate world, the term MIS was to become, in a sense, a victim of its own success. Just as any system issuing reports that might be of interest to a manager was dubbed an MIS, so entire computer departments were renamed from EDP to MIS. But the work of these systems and departments remained primarily oriented towards the support of routine and administrative operations. The reputation of many computer departments with senior and line management as unreliable, technically focused and arrogant continued unabated. Thus by the 1980s MIS was a byword for out of touch and self-serving approaches to computing with little broad managerial relevance. By the late-1980s, those proposing a "Chief Information Officer", a "broad-gauge information executive of tomorrow" critiqued MIS as narrow and technical.

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[597] For a history of the group, see John F. Rockart and Christine V. Bullen, eds., The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology (Homewood, Illinois: Dow Jones-Irwin, 1986). For a good sample of its mid-period output see John F. Rockart, "Chief Executives Define their Own Data Needs", Harvard Business Review 57, no. 2 (March-April 1979):81-93.

[598] A recent report suggested that EIS had promised to revolutionize management during the early-1990s through its provision of a "magic button that would give you all the answers". It was to bring updated "information about the company's own trends in revenues, profits, products, and other performance measures -- so they could make better-informed decisions." However, it proved an expensive disappointment – inflexible, based on inconsistent information, slow, hard to use. As a result, the term EIS "got such a black eye that most software vendors stopped using it." The parallels with MIS itself could not be clearer. Doug Bartholomew, "When Will EIS Deliver?" Industry Week 1997.

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## 9. THE DATA PROCESSING DEPARTMENT IN THE 1970S

Despite the influx of new technologies and new machines between 1960 and 1975, the challenges faced by data processing staff in their day-to-day work changed far more slowly. As we have seen, the mere presence of an operating system, COBOL compiler, or third generation computer in a data processing installation did not dictate any fundamental shift in practice or reorientation of the department's activities. The single most noticeable thing about the history of data processing is its lack of abrupt change in anything except for the machines themselves.

That is not to say that everything stayed the same. The period did see a substantial growth in the number, size and organizational prestige of American data processing departments. In 1971, Robert V. Head published an article called, "What a Difference A Decade Makes." He looked back a ten years, to the adolescence of administrative computing. In those far off days, he recalled, a typical department had progressed little from the preliminary structure established during the feasibility study. The department included highly segregated analysis, programming and operations groups, and its manager reported low in the organization chart – probably to a controller.[599]

Head was confident that the emerging data processing department of the 1970s was a different beast altogether. New, larger computers and better communication facilities had let to a centralization of computing efforts. Whereas Head saw the data processing facilities of 1960 as isolated clusters of computing scattered through the divisions of a large company, by 1970 he considered the process of centralization of computing activity to be well advanced, propelled by a new interest in the sharing of data between applications and departments, coupled with a push for

[599] Robert V. Head, "What a Difference a Decade Makes", Journal of Systems Management 22, no. 11 (September 1971):16-21. Similar ideas were presented in dozens of other articles in the data processing press – DP managers remained extremely eager to discuss their status anxieties. See, for example, Clarke Newlin, Jr., "The Changing World of the Data Processing Administrator", Data Management 10, no. 2 (February 1972):34-40.

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operational economies of scale. The key factor was a new interest in management science, operations research and "quantitative approaches to decision making" – which Head believed to have resulted in the incorporation of operations research groups into the computer department. Their "inclusion in this chart," he argued, "reflects what is by now a well developed tendency to focus system development resources of management information systems..."[600]

[600] Head, "What a Difference a Decade Makes", page 19.

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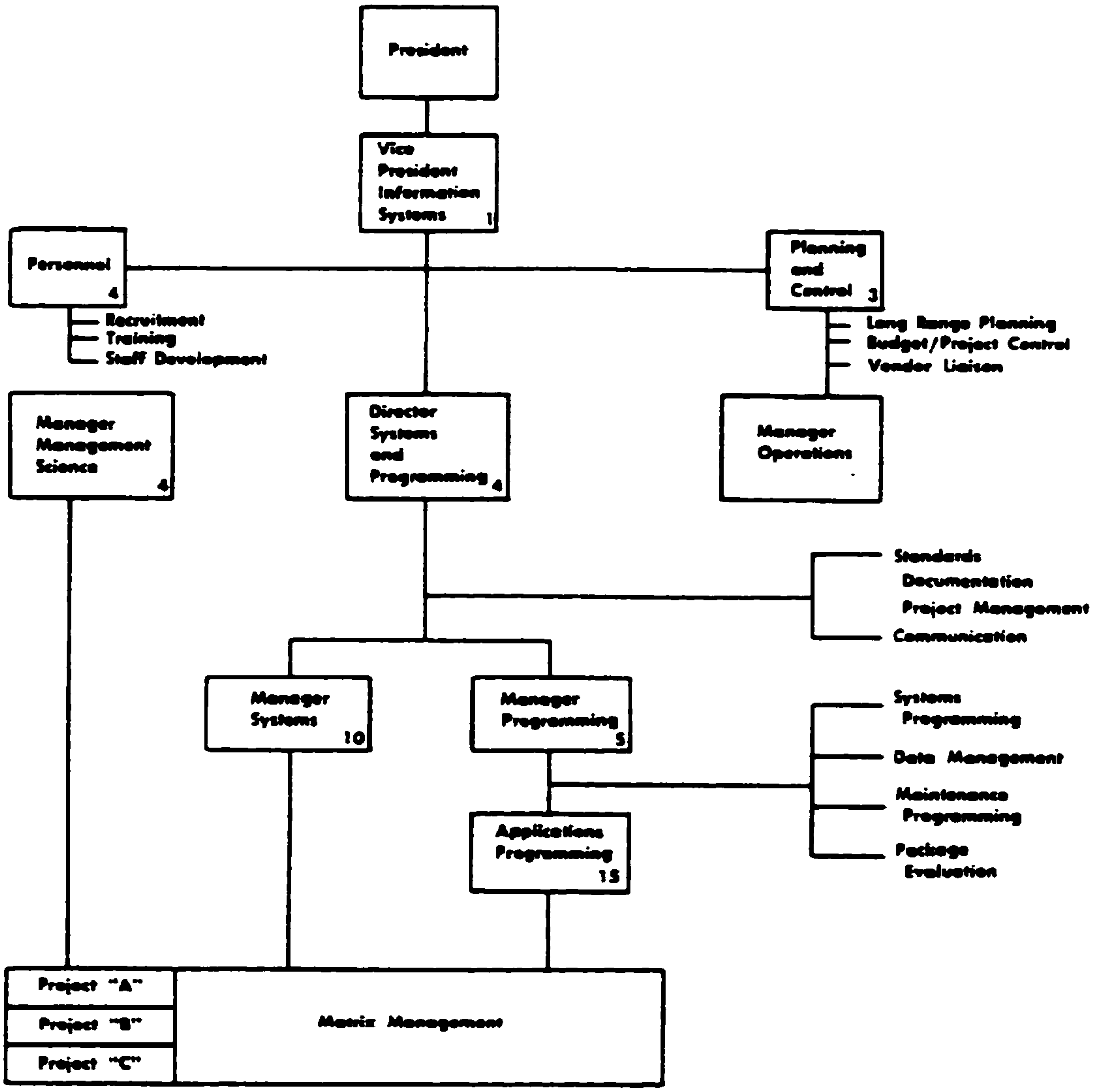


**Figure 34: Head's idealized 1971 diagram of the early-1970s corporate computer department. Note the use of matrix management for development teams, and the exalted position of the Vice President Information Systems.**[601]

Its chief, according to Head, was now likely to be a "Vice President for Information Systems" and report directly to the corporation's president. Assistants within the department specialized in long range planning, project and budgetary control and vendor relations.

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[601] Ibid.

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Applications programmers and analysts worked together far more closely than before, joined in teams to tackle particular projects. The increased use of software packages reduced the need for the internal programming of many applications. The new specialization of "systems programming" was now an important part of the department. Meanwhile, the profusion of on-line time-sharing services made it possible for users across the corporate to use terminals to bring in whatever computer time and specialized software capabilities (such as business forecasting models) they needed to tackle a problem. [602]

## "EDP: The Twenty Year Rip-Off?"

This was one view of data processing in 1971. Head's sweeping survey gathered together a lot of thinking on the proper nature of a state of the art data processing department and presented it as a done deed. His was thus a decidedly rosy vision, not entirely distorted but far from representative. The proverbial glass, in this perspective, was at least three quarters full. But despite Head's apparent confidence, fundamental tensions remained between the managerial aspirations of data processing leaders and the often troubled reality of many data processing operations. A few years later, the otherwise unknown Harry T. Larson gave powerful expression to the opposing view. His 1974 article "EDP: A 20 Year Rip-Off" stirred up months of controversy in usually placid letters pages of Infosystems (as Businesses Automation had renamed itself in search of a more up to date identity).

Its author, a former computer industry executive, urged his readers to end data processing as they knew it. It was, he believed, "the biggest rip-off that has been perpetrated upon business, industry and government over the past 20 years." He painted a grim picture of a field in which productivity was chronically low, many projects failed for no good reason, and sales pitches bore little correspondence to reality. Twenty years into administrative computing, "EDP developments

[602] Ibid, page 18.

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are still being completed much later than promised, at a much higher cost than portrayed at the outset." In addition, charged Larson, companies were wasting enormous amounts of time trying to keep on top of bug-ridden and incomplete operating systems and the never-ending flow of patches and revisions this necessitated.[603]

He did not hesitate to place the blame for this state of affairs on the "inadequate supervision and management" in most computer departments. "The EDP people have developed themselves into something of a caste… frankly, many of them see no need for acquiring management expertise from other departments.... The EDP people tend to be more oriented toward their profession than toward their company." Their concern was with the march of technology, not the application of managerial fundamentals. "The computer people," he wrote, "egged on by the computer companies, are forever dreaming up new applications. It's their life. Widening applications means widening empires and growing power. They believe, deep down, unquestioningly that they are doing good things, often with religious zeal."[604]

Larson attributed only one failing to executives: that they had allowed themselves to "accept the presumed sophistication and differences that are said to make EDP activities somehow immune from normal management demands." Even this did not really seem to be their fault, because according to Larson, "the 'gap' we so often refer to between top management and the computer people" was in fact "not so much a gap as a barrier--a barrier erected by the computer people and computer companies." As a result, executives who would hold other subordinates rigorously accountable for their performance "stumble to an uncertain halt, baffled by the snow job and the blizzard of computer jargon."[605]

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[603] Harry T. Larson, "EDP: A 20 Year Ripoff", Infosystems 21, no. 11 (November 1974):26-30, page 26.
[604] Ibid, page 27.
[605] Ibid.

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Larson's suggested solutions formed something a grab-bag. Managers from computer-using departments should be infused into the EDP department to shake things up. Companies should adopt the project management techniques found in high technology aerospace research and development projects. EDP managers at all levels should be held personally accountable for meeting schedule, budget and performance requirements, goals which, "EDP people are not, in general, imbued with a commitment to hit." Projects should be broken down into stages, with customer feed-back and "buy-off" required to proceed from one carefully demarcated milestone to the next. More controversially, he suggested that productivity could be raised by firing the least competent 10-20 percent of the current EDP staff, and that unnamed "knowledgeable and genuinely concerned people" felt that halving the size of the department would not decrease its useful output. Larson returned to this theme in a follow-up article, where he suggested that the surest way to be an "EDP Hero" was to cut costs. "Wire-brush your staff. Rank your people, including supervisors, and let the weakest ones go--they are pulling down on your performance anyway. Don't replace them."[606]

A flood of letters followed the publication of Larson's initial article. Almost all were highly favorable, suggesting that many data processing staff had experienced a shock of recognition. One respondent, apparently a computer consultant, wrote that it was, "the first article I have ever seen in my twenty years of experience in this business which... says something... meaningful... to the real problems we have been experiencing... As a result of this one article, I have a great deal more respect for your magazine." Others called it "long overdue," and seemed particularly in accord with Larson's suggestion that DP managers failed to identify closely with their employers.[607]

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[606] Henry T Larson, "How to Become an EDP Hero", Infosystems 22, no. 6 (June 1975):46-49.

[607] The first quote is from Milt Bryce, "Ripoff Reaction", Infosystems 22, no. 1 (January 1975):6. For other reactions to Larson, see C E Holmes, "That Was a Rebuttal?" Infosystems 22, no. 5 (May

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Despite this outpouring of self-criticism, many data processing managers were reluctant to espouse either the grand, executive ideas of Head or the angry cynicism of Larson. Instead they had a pride in their craft, feeling different from other managers yet still believing themselves charged with difficult and important work. A third article, published as a rebuttal of Larson, made explicit what many seem to appear to have assumed. Its author, an obscure Californian data processing manager named Marvin S. Ruth, pleaded that data processing was a special case and could not be managed according to standard principles – a position we might label as "data processing exceptionalism." According to Ruth, data processing was a world unto itself, in which regular hours, elaborately standardized documentation and petty disciplinary policies would work more harm than good. Data processing staff worked long hours, were constantly on call and took a pride in their work. "If the enthusiasm and dedication expressed by EDP programmers were extended through all the department of a company, that company's production, sales and profits would increase substantially."[608]

It was therefore EDP that was being ripped off by top management, rather than the reverse. Ruth argued that,

> EDP professionals are different from other professionals as well as from all other working-class people. Because of these differences and their constant struggle to remain abreast of the rapidly moving technology, EDP personnel are not subject to the standards of hard-line management. Hardliner business and

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1975):75, L. F. Wygant, "About your magazine...." Infosystems 22, no. 8 (September 1975):4 and Donald R Collins, "Ripoff Reactions Continue", Infosystems 22, no. 2 (February 1975):6. One data processing manager blamed this on top management's failure to free the DP department from the authority of the controller. This created such organization tensions that, "it should not be too surprising that an EDP person trying to install a non-financial system would become frustrated with the petty politics and sell his soul to the 'profession'." Thus, any company where data processing was not granted its freedom was liable to be "looked upon as stopping-off places for EDP people." This letter ingeniously acknowledged the incompetence of many data processing departments, while advancing the argument that only greater authority would suffice to interest data processing managers in true management. It demonstrated that many data processing commentators of the era could blame almost anything on a lack of top management involvement and an insufficiently elevated organizational position. Ludwig J. DeVito, "Ripoff Reaction", Infosystems 22, no. 1 (January 1975):6.

[608] Marvin S Ruth, "In Defense of EDP Management", Infosystems 22, no. 2 (February 1975):36-38.

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> industrial management policies and philosophies have no place in EDP. A data processing manager without in-depth knowledge of EDP applications, computer programming and hardware capabilities would equate to an airline pilot at the helm of a super tanker.

In an elaborate apportionment of blame, Ruth argued that the biggest problem lay with the "intermediate supervisory field" of senior analysts, project leaders and so on. These people lacked managerial skills, a rapport with users, or system design skills. But these problems proved fatal only when supervisors were unable to draw on their own reserves of technical knowledge to see through the posturing of incompetents. The root cause was thus the "EDP manager's inability to judge the performance of each individual." Only by restricting the management of administrative computing departments to those who had risen through the ranks could this be fixed. Yes, admitted Ruth, better management was needed, but "the management of EDP must be oriented toward those unique personnel and technical aspects that make EDP an entirely new and totally different challenge to modern management." Ruth went so far as to assert that "before you can set appropriate standards for programmers, you must have, at some time in the past, either been a programmer or worked very closely with one." The challenge was therefore to set programming standards that supported effective development and maintenance, while acknowledging the unique creativity involved in programming and analysis work.

Larson and Ruth both acknowledged the symptoms that ailed data processing, but made different diagnoses as to the underlying disease. Both positions were a retreat from the confident boosterism of the early 1960s in which any failure of computers to deliver on their promise could be attributed to the shortcomings of now obsolete hardware and methods, their misapplication to trivial administrative matters, and corporate failure to charter a sufficiently broad MIS program. Both, however, continued to blame top management apathy for many problems. According to Larson the failure was a failure to put technical specialists in their place and realize that the eternal and unchanging veracities of good management were as applicable to programmers,

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analysts and operators as to everyone else. To Ruth, data processing was a unique craft immune to traditional managerial remedies. In support of this he invoked the idea of programming as a unique blend of creativity and discipline – an idea little heard in data processing circles to this point. Top management's failure was therefore to be found in its insistence that data processing could be managed by conventional managers. This idea had strong parallels to calls made during the mid- and late-1970s for the creation of software engineering as a synthesis of improved programming methods and new project management techniques (a development discussed in a later chapter).

All three conceptions of corporate computing appeared frequently through the rest of the 1970s, and in the decades since then. They have surfaced with particular regularity in discussion of the ways in which computing projects should be managed and the background most appropriate for a head of the corporate computer department. These articles illuminate a set of crucial and interrelated questions facing data processing departments during this era. Was the computer department a managerial force in its own right, or an administrative group devoted to the service of others? Was the management of a computer department different in any important way from the management of any other staff group, or even from the management of an operating department? Where should the computer department and its manager sit on the organizational chart? Should a company use a small number of large computer centers or spread computer centers widely through its divisions? Should control of programming and analysis work be centralized or decentralized?

## Climbing the Ladder

Head's 1971 suggestion that the data processing department should be headed by an executive at the Vice President level was almost a truism amongst the data processing and systems communities of the late 1960s. The idea had deep roots, going all the way back to the

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1920s when Leffingwell had insisted on recognition for "the office" and its manager as the equal of the better established production, sales or financial operations. Similarly, many of the arguments advanced during the 1960s and 1970s in favor of a high level and autonomous computer department differed very little from those presented during the 1950s. Richard F. Neuschel had provided elegant arguments that the systems and procedures department should report directly to the top levels of corporate management. Punched card managers, though their sights were usually set a little lower, were also keen to raise their organizational standing.

As the offspring of the tabulating department and the systems and procedures group, data processing inherited this fascination with upward mobility from both sides of its family tree. Like its parents, the data processing department was generally to be found buried in the middle sections of the organizational chart, somewhere underneath the controller. In the memorable 1971 words of Victor Z. Brink, a Columbia business school professor and former financial manager at Ford, most of those involved in corporate computing felt that the data processing department deserved "emancipation from the finance group."[609]

[609] Victor Z. Brink, Computers and Management: The Executive Viewpoint (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971).

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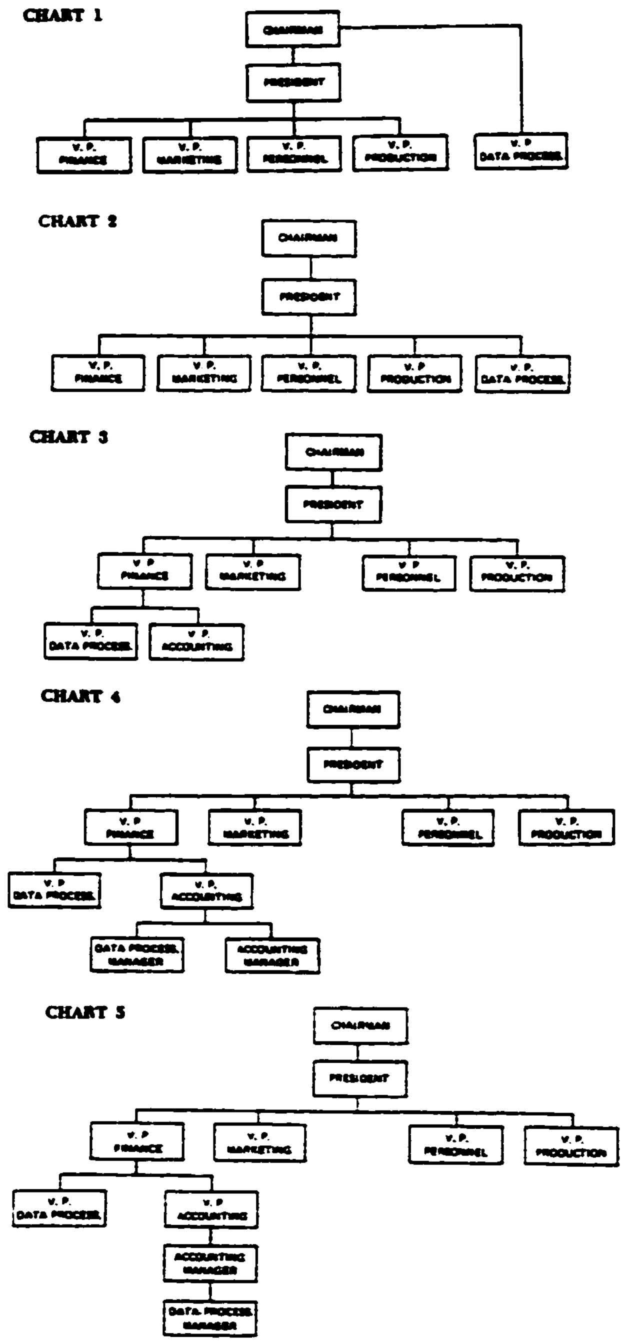


**Figure 35: History and destiny of the data processing department, as seen in 1969.[610]**

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[610] Taken from Stephen DiStefano, "The D.P. Manger and the Corporate Organization", in Data Processing 14: Proceedings of the 1969 International Data Processing Conference and Business Exposition, ed. Data Processing Management Association (Chicago: Data Processing Management Association, 1969).

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The theme received a classic demonstration in a presentation delivered at the 1969 Data Processing Management Association (DPMA) conference by Stephen DiStefano, a data processing manager at State Farm Mutual Auto Insurance and member of the DPMA Executive Committee. Using a series of organizational charts to illustrate the history and destiny of the profession, DiStefano suggested that data processing had come a long way in the past fifteen years but had much further to go. Presenting the five charts in what was essentially reverse order, he observed that progress had so far been uneven ("for some Chart #4 is tomorrow") but that, "for all of us, Chart #1 should be our goal." His presentation illustrated the extent to which data processing managers continued to endorse a doctrine of group mobility, according to which their collective importance was to be increased through a general redrawing of the standard organization chart. Rather than leave data processing to climb into another box on the existing chart, they would remain within the data processing department as it rose, elevator like, with them inside it. In support of this idea, DiStefano asked his audience to remember the punched card days in which computers were unknown and the department was, "relegated to the most hidden corner of the building," serving as, "the dumping ground for unsuccessful employees from other departments." Since then, and thanks to the "automation revolution," their "place within the corporate structure has changed with every generation of computers." "Our installations," he continued, "have been moved from the basement of the building to the best spot in the building and, naturally, we have also moved. From obscure supervisors we have suddenly found ourselves in the spotlight and become managers." Most installations, he believed, had reached the third chart, but further progress would demand a more managerial attitude and better education on behalf of the association's members.[611]

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[611] Ibid.

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DiStefano's final chart showed him to believe that the DP manager should by right be the only person in the firm (apart from the President) to report directly to the Chairman. His argument was very similar to that made earlier by Neuschel in support of the elevation of the systems and procedures department: that because administrative processes cut across all functional areas of the business, it was necessary for an any team investigating them to a manager with sufficient authority to reorganize the overall structure of the business.[612] Indeed, the alacrity with which systems men and the more managerially-oriented data processing managers had pounced on the application of computers to management and the need for "total systems" can therefore be attributed in large part to their desire for organizational elevation. This was apparent early on, when in 1959 National Machine Accountants Association (NMAA) conference when Leonard F. Vogt of the International Shoe Company gave a presentation on Integrated Data Processing (IDP).[613] IDP, according to Vogt, involved an integrated system, so that each transaction was recorded only once. By applying the computer "right at the heart of the business" to "look at the company as a whole," data processing staff could "flow information across

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[612] One importance difference in emphasis between Neuschel's position in the early 1950s and the data processing orthodoxies of the late-1960s was an increased stress on the MIS conception of the computer as a means of managerial control, capable of knitting together the information systems of the entire corporation into a seamless whole. Even this, however, was an extension of Neuschel's argument that the true calling of a systems and procedures group was the investigation and coordination of intradepartmental procedures.

[613] Leonard F. Vogt, "Advances in I.D.P." in Data Processing: 1959 Proceedings, ed. Charles H. Johnson (Chicago: National Machine Accountants Association, 1959). At this point, neither MIS not "total systems" had not yet been discussed within NMAA circles, but Vogt explored very similar ideas under the earlier rubric of IDP. Between 1958 and 1961, the terms Unified Operations Management (UOM) and Rational Data Processing (RDP) were also advanced to describe essentially the same idea, but in the end it was MIS that swept all before it. Very similar language, including a call for separation from the authority of financial management, a focus on "total information needs", a return to the values of small business and a "total systems approach" is to be found in A. D. Branson, "A Primary Goal of the Total Systems Concept", in Ideas for Management: 14th International Systems Meeting, ed. Anonymous (Detroit: Systems and Procedures Association, 1961). Branson, however, uses Unified Operations Management (UOM) rather than IDP or MIS as the name for this approach. Rational Data Processing appears, again with the same key characteristics of a "broad concept of over-all, functionally integrated, unified, simplified, and machine-oriented paperwork handling which encompasses all phases of a business." as MIS, in John H. Strube, "Rational Data Processing", Systems and Procedures 9, no. 4 (November 1958):12-15. The author was a systems man at General Electric.

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department lines and pierce the organizational chart." With an integrated system, "a large business can be handled more like a small business." This would, he recognized, inevitably transfer direct, line authority over operations into the hands of the computer department:

> As you get into decision making and do something other than add, subtract, and sort information you've brought about a change in the function of data processing. ... [The] very fact that the data has been altered brings the computer and the system into a line position.... [T]his is no longer a service department area and you can't make a service department out of it.[614]

This was good news for the computer department and the person in charge of it. Its leader must, at a minimum, report to someone with company-wide authority. Vogt made the claim, then strikingly bold, that "as this thing gets bigger, it is not inconceivable that there could be vice presidents in charge of data processing." The right man for the job would be powerful and expensive. Vogt wrote that you, "need a man in your business who knows your business, who is well acquainted with it and most of its functions, who also understands the technology of the computer.... He is the liaison man, the bridge. He is a very skilled man and should be a very high paid man."[615]

Vogt's description proved prescient in at least once sense – while never quite coming true, it captured perfectly the rhetoric and aspirations that were to dominate discussion of data processing through the 1960s. Throughout the period, many of the presentations at systems and data processing conferences included organizational charts with which the converted preached to each other that their departments deserved the right to report directly to the corporate president or chairman rather than to the controller. During the 1950s this was suggested tentatively and debated, but it soon became an article of faith among systems enthusiasts. By 1961, two years after Vogt's suggestion that the eventual creation of a VP of data processing was "not inconceivable," an IBM speaker assured NMAA delegates that they could "look forward to the

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[614] Vogt, "Advances in I.D.P.".
[615] Ibid, 104-5

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day, which we know is rapidly approaching, that as well as Vice-Presidents of Finance and Vice-Presidents of Production there will be Vice-Presidents of Data-Processing System." So entrenched was the idea that in 1963, the Systems & Procedures Journal had to remind its readership that, "Statements to the effect that the systems functions should report to a top executive level have been made so many times that it is not surprising the impression exists that this idea is generally accepted. It is, however, very doubtful that anything approaching a majority of top management people hold this idea acceptable for their own companies."[616]

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[616] Carl Corocran, "Management of a Data Processing Department: Part 2", in Data Processing 4: Proceedings of the 1961 International Conference of the National Machine Accountants Association (Chicago: National Machine Accountants Association, 1961). Pomeroy, "The ? Box".

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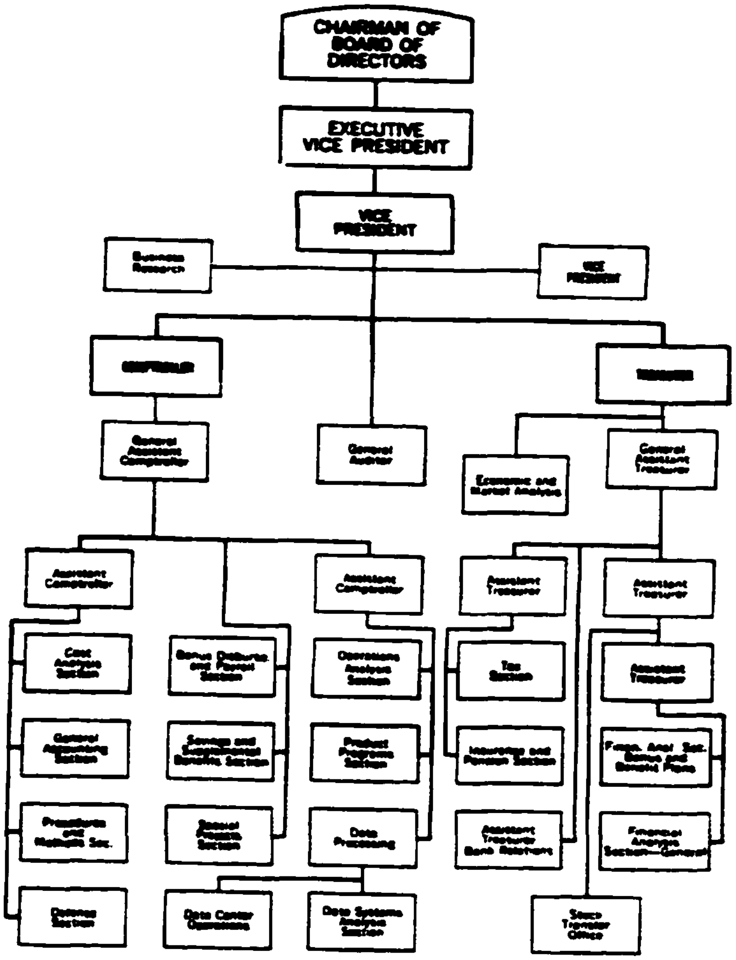


**Figure 36: Part of the General Motors organizational chart in 1963. The Data Processing and Procedures and Methods departments are in separate parts of the finance organization, each separated from the chairman by five intervening managers.**[617]

This caution was well placed. Despite the enormous publicity given to the idea of the computer as a management information system, the major uses of the computer still lay elsewhere. The organizational rise of the data processing department appears resulted more from pragmatic acquiescence on the part of senior management to the new scope of computer operations than any particular endorsement of the arguments made by data processing enthusiasts.

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[617] Alfred P Sloan, Jr, My Years with General Motors (New York: Macfadden-Bartell, 1965), 446.

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Rather than a careful rethinking, in which structure followed strategy, the improved formal position of the computer department was the default response to its ever growing numbers of staff and its ballooning budget.

In 1969, the Wall Street Journal conducted a survey of almost eight hundred executives with responsibility for computer procurement. This gave an idea of how far things had come in practice. On one hand, things were bleak for data processing manager's quest for top management status. The title of Vice President, EDP (or equivalent) had been accorded to the head of computer operations in just 3 percent of firms with computer operations. However, 48.8 percent had granted the lesser title of Manager or Director of EDP. This was a substantial improvement over the organizational heft accorded to the tabulating head of the decade before, who was more commonly accorded a supervisory title than a managerial one. The computer department had, however, gone some way toward achieving its emancipation from the accountants. About 38 percent of computer bosses reported to a financial officer. 20 percent reported to non-financial vice presidents. While most firms had a full-time, specialist executive in charge of data processing, a full 27 percent of companies left responsibility for computer operations with a non-specialist Vice President or other corporate officer. [618]

A 1975 survey for Infosystems shows a continuation of these gradual but real trends toward higher status and increased autonomy for data processing managers. Of more than two thousand companies surveyed, more than half (54 percent) called their head of data processing a manager, supervisor or coordinator. Almost 7 percent had created a vice president of data processing, while 9 percent gave what the survey called only "corporate management titles." The dream of reporting to the very top had begun to come true: in 27 percent of the companies, the head of data processing reported directly to the president, general manager or owner. In a further

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[618] Wall Street Journal, Management and the Computer.

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24 percent, the data processing manager reported to a vice president, while in 31 percent of firms the data processing organization remained beholden to a financial manager. [619]

The need to report directly to the chief executive remained one of the most discussed, regularly affirmed, and emotionally charged topics among senior computer managers through the 1980s and into the 1990s. Journalists, management writers, and academics who supported this concept usually presented it as a new idea, created during the last few years in response to new technologies and new business challenges. In fact, as we have seen, it was as old as the computer itself. Judged against the pace of change in computers themselves, and the forecasts made by enthusiasts, the ascent of the computer manager was a slow and fitful process. Yet judged on the slower timescales of organizational evolution, it remains an impressive and steady elevation: for a typical large firm this represented just two decades to rise from an obscure sub-division of accounting during the early-1950s to report to the top executive either directly or through one level of intervening management.

## The Computer Department as an Efficient Factory

Advocates of MIS and the managerial importance of the computer were invariably quick to point to all evidence of failure as proof that computers had been applied to the wrong things. This bolstered calls for the elevation and empowerment of the computer department. If the MIS manager were only granted a place at the executive table, able to look his fellows in the eye and to apply the computer to the problems of the business as a whole, then these problems would disappear. But the continuing inability of computer departments to handle even routine administrative jobs in an efficient and timely manner gave ammunition to proponents of an

[619] Anonymous, "1975 Salary Survey: Recession Holds EDP Wages to an Overall Average Gain of 4.9%".

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alternative view: that computer managers should put their own house in order and learn the basics of effective managerial and financial control before aspiring to reorganize the affairs of others.

This was not an entirely novel observation. In the early 1950s, the need for efficient day-to-day management of the punched card department had been a staple subject for the articles published in The Hopper. Even in 1961, as the sun began to set on large scale punched card machine operations, an IBM representative at the NMAA conference still had to tell data processing managers that, "[d]istasteful as job cards might seem to you and your operators, they are a must." He warned that the tab room itself often lacked utilization records, scheduling charts or any of the other hallmarks of a well planned operation. Their acceptance by top managers, he suggested, would require them to impose true managerial discipline. "They want these Tab departments run be men who are on the first line management team. They want them run like any other key department. They do not want them to be secret departments or cults."[620]

In some ways, very little changed. Even as data processing managers lectured each other on their right to report directly to the CEO, their conferences and journals continued to include pleas to pay attention to the basics of management. A 1972 article in the Data Processing Management Association [DPMA] journal Data Management "You Want To Be Part of Management" expressed ideas that had not evolved far beyond those a 1956 article in its precursor publication, "So, You Want to be a Manager." (The most unwittingly revealing title, however, must be that of a 1975 article on the need for the data processing manager to be aware of personnel issues, "People: Hidden Asset or Liability?")[621]

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[620] Corocran, "Management of a Data Processing Department: Part 2".

[621] Leonard J Hawkins, "You Want to be Part of Management", Data Management 11, no. 3 (March 1973):14-16, 21. Wilkinson, "So, You Want to Be a Manager". Robert A Fleck, Jr., "People: Hidden Asset or Liability?" Data Management 13, no. 4 (April 1975):14-16. See also Elanor H Irvine, "Wanted: A Future", Data Management 11, no. 6 (June 1973):22-25.

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By the late 1960s, however, the computer department had already achieved an enormously greater organizational importance in terms of budget and number of staff. It seemed poised to escape altogether from the authority of the controller and his financially trained colleagues. In response, financial managers were eager to suggest that better financial oversight and control was exactly what the data processing department needed. This tied in with the criticism, made within the data processing press, that data processing managers were incapable of mastering the basic skills needed to run a service operation effectively.

Such criticisms implied that a well run computer department was like a well run factory, in that expensive equipment was kept running continually, scheduled production jobs were dealt with promptly, and costs were squeezed to a minimum. The idea of the computer as a piece of expensive industrial machinery was present from the very beginning in the first feasibility studies. In 1956, the first computer study sponsored by The Controllership Foundation had found that, a "computer should be regarded as a factory with a very high capital investment and fixed costs, and very low variable costs. As a result its economics are based on maximum productivity." Jobs were queued and fed through the computer, just as production jobs were passed through the machines of the shop floor. Yet in practice, throughput was always lower than expected, costs higher and programs took longer to become operational. Attempts to impose cost-benefit analysis and production controls on computer operations had never been entirely successful.[622]

As the size of the computer budget increased and computers were increasingly applied to the support of operational procedures, similar arguments began to support the idea that the costs of running the data processing center should no longer be hidden, along with the costs of running

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[622] Wallace, Appraising the Economics of Electronic Computers, 59. The problems of quantifying "intangible" benefit were as severe in the 1960s and 1970s as they had been in the 1950s. See John Plummer, "Will Your Computer Pay Its Way?" Business Horizons, no. April (1969):31-36 and Edward J. Menkhaus, "EDP: What's It Worth", Business Automation 16, no. 11 (November 1969):48-54 for examples.

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the accounting operations, in general administrative overhead. The failure of expensive MIS projects to deliver general benefits gave ammunitions to critics of indiscriminate spending. Another problem was that the user departments whose tasks (order processing, sales statistics, and so on) were being run on the computer often had little direct interest in minimizing their consumption of this expensive new resource. In principle, managers could improve the financial control metrics for their operation (and hence, in the corporate climate of the era, their chances of promotion) by having a job automated, even if the automated procedure cost the firm as a whole twice as much as the manual version. Having an automated process might also bring some prestige, perhaps even an article or two in the trade press, for the manager concerned. It was also hard for a DP manager to say "no" to a request from a politically well-connected manager. As a result, costs spiraled inexorably upward as job after job was submitted for automation.

The apparent solution lay in the creation of a market-based mechanism, whereby the department on whose behalf a job was being run would carry the costs involved. If the true costs of using the computer were apportioned correctly amongst the user departments then there would be no need for a centrally placed manager to sort the wheat from the chaff. Each line manager would make the decision themselves, and see the implications of this decision in the financial results of their groups. In 1969, for example, the Photo Products Group of Bell & Howell constructed a computerized system to measure the actual and estimated costs of each computer program developed by its forty strong systems and programming group. The system showed time spent on each authorized project, compiled total for each customer department and flagged backlogs and cost overruns. To make sure that reduced costs in user departments materialized

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"where savings are estimated as a result of the project, the requesting department manager must agree to reduce his expense budget accordingly."[623]

The 1970s saw a great deal of interest in "chargeout," as this process of calculation and billing was dubbed. It was at root an exercise in cost accounting. During the development phases, each job would incur a certain number of programmer and analyst hours and consume a certain amount of machine time. Each time the job was run, it would consume more resources. In a multiprogramming environment, separate charges might be made for memory usage, storage usage, processor usage and so on. The overhead costs of operators, systems programming, administration and so on could be apportioned between the different jobs or absorbed as a corporate expense. Yet this demoted the internal computer department to something like a service bureau – accepting individual jobs according to the amount a department was ready to pay for them. Applications in which no department had a particular interest would languish, whatever their benefits for corporate control. Conversely, the department with the fattest pockets could pay for systems with little or no compelling benefits, motivated in part by the continuing prestige of the appearance of automation. Members of the data processing department would remain machine men as they had in the days of punched card machines, with a managerial mandate to run an efficient shop and stay out of the way of real managers.[624]

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[623] Arnold E. Keller, "You CAN Control Computer Costs", Business Automation 16, no. 4 (April 1969):46-51. That was the policy, at least. The exercise seemed, in part, an extension of pre-computer clerical monitoring techniques – the head of the operation had been doing systems work since 1942, and went so far as to monitor the performance of each keypunch operator. It is unclear how well this particular system actually worked, though it had won the endorsement of the controller, who praised it for demystifying EDP and allowing oversight.

[624] Arnold E. Keller, "Editorial: Computing for Profit", Business Automation 19, no. 3 (March 1972):56. Chargeout is discussed in F. Warren McFarlan, "EDP Management Audit", in Managing the Data Resource Function, ed. Richard L. Nolan (St. Paul: West Publishing Company, 1974) and explored in Richard L. Nolan, "Effects of Chargeout on User/Management Attitudes", Communications of the ACM 20, no. 3 (March 1977):177-85. For a good summary of the issues as perceived at the end of the decade, see James A. Cortada, EDP Costs and charges: Finance, Budgets and Cost Control in Data Processing (New Jersey: Prentice-Hall, 1980).

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The chargeout concept reached its logical extreme in the idea that a data processing department should not just run like a separate business but actually be one. There were two ways of accomplishing this – either transfer management of the computer facility to a specialist company on a contract basis (known as "facilities management") or spin off the computer department as a new division and encourage it to look for work from other companies. Both approaches were a reaction to the ever increasing cost and complexity of running a good computer operation, and to the problem that the computer department appeared to develop a culture and set of priorities quite distinct from that of the rest of management. Both claimed the advantage that the computer operations would then be run by specialists, keen to make a profit and able to lower costs by spreading overhead and technology costs across a number of customers.

Facilities management began to attract a great deal of attention in the trade press from 1970, driven in part by the stock-market bubble for software and services firms and the "unbundling" of software, hardware and services by IBM that took place in 1969. A number of companies expressed their willingness to take over some or all of a firm's computer operations, with options from specialized programming services, through the management of computer operations on the customer's site, to the complete closure of the internal data processing department and its replacement with a communal facility. Facilities management firms claimed that they could attract the best and most experienced people, in an environment in which good data processing managers were hard to hire and, given the strictures of corporate pay structures, even harder to hold on to. They claimed that their specialist knowledge allowed them to estimate and control costs better than existing data processing managers, and that low utilization rates of much expensive equipment could be best addressed by bringing in additional users to balance the

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load. In some cases, the services offered included full programming services and standardized packages as well as machine time.[625]

Longtime Business Automation editor, Arnold E. Keller, reported in 1970 that in the marketplace for facilities management "the sellers outnumber the buyers by far" but thought that the idea had promise. This was mainly because of the "desperation" that executives had with their own computer operations – meaning that

> [facilities management] may appear to be a welcome escape from the many problems that seem to characterize the average data processing installation. Plagued with personnel shortages and turnover, extravagant wage demands that destroy the company salary structures, constant increases in operating costs, and a lack of identifiable contributions to profitability, many a top executive will be tempter to sweep the whole mess away with one stroke of a pen on an FM contract.[626]

Keller repeated this point in a later editorial, where he explicitly blamed the appeal of facilities management on the failure of data processing management. The appeal of facilities management, he warned, was primarily in its chance to get rid of the existing DP department. He wrote that, "the average data processing manager is, in reality, not a manager at all, but a technical specialist whose interest is much more in machines than in management skills." As a result, "when [facilities management] moves in, the data processing manager, in most cases, will move out."[627]

Keller also criticized the limited goals set for existing data processing departments. He believed that specialist firms were more likely to be able to attract talented managers, tired of working in conservative departments -- "a large number of installations are still looked upon as

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[625] For the facilities management sales pitch, see Eugene Bellin, "Facilities Management, An Approach to Successful Data Processing Management", Journal of Systems Management 22, no. 1 (January 1971):18-20.

[626] Arnold E. Keller, "Editorial: Facilities Management", Business Automation 17, no. 4 (April 1970):152.

[627] Arnold E. Keller, "Editorial: Few Members, Better Managers", Business Automation 17, no. 5 (May 1970):84.

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an extension of the accounting or financial operation, and are doomed, under present thinking, to be forever under the watchful eye of the corporate controller." One facilities management executive agreed, claiming that only a specialized firm could lend DP chiefs a plausible career path into senior management. "The top computer manager in a user company is generally not regarded as a member of the management team. He does not see a path by which he can continue to pursue an advancing path within his company..."[628]

Nevertheless, a 1971 report found that relatively few facilities management deals had actually been made. Despite a very crowded field, only two firms (Computer Technology, Inc. and Ross Perot's EDS) yet had revenues of more than $30 million. The report suggested two reasons for this. One of these was emotional – even if the logical move was to get rid of the computer room, the installation might still command symbolic resonance far beyond its economic contribution. "It is difficult, in some cases, for management to let go of all the expensive equipment which (1) took so long to decide on, (2) was agonizingly difficult to make operational and (3) has such a terrifically professional look about it--the temperature control, the raised floor, the glass partitions and the responsible-sounding murmur of the machines." The same symbolic factors that inspired many computer installations in the first place conspired to make the machines hard to get rid of.[629]

The other reason was more fundamental, cutting to the core question of what computers were really supposed to be for. Shifting the work of the computer operation to the lowest bidder reflected an assumption that it was, and must remain, a source of overhead expenses rather than a potential competitive advantage for the corporation as a whole. If computing really was just a way of handling paperwork faster and cheaper than it could be done manually, then it made sense

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[628] ibid, Iris Poliski, "Facilities Management: Cure-All for DP Headaches", Business Automation 18, no. 5 (March 1 1971):26-31, 34.
[629] Ibid.

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to negotiate a service contract and outsource the whole thing. But, as we have seen, administrative specialists since Leffingwell had been complaining that executives saw the office as only a source of costs, rather than as a crucial tool or a core activity of the business. Those who believed in the computer as a managerial weapon, able to transform decision making, set up entirely new kinds of control system, and usher in a new age of management science, were therefore deeply critical of the claims made for facilities management. The report quoted the Management Information Services Head of Itek Business Productions as complaining that, "a facilities management company would eliminate any chance an executive might have to deal with and learn his company's information system."[630]

Both facilities management and the possible spin-off of the computer department as a separate business were made more appealing by new attention given to the idea of software. Firms hoped that the programs, expertise and tools they had already developed could be packaged and sold outside the corporation to improve returns on these investments. Likewise, facilities management operations promised to lower costs by sharing software tools and even applications programs between different firms. During the 1960s the idea of software was a new, and initially rather vague, one.

## Decentralization, Time-sharing, and the Minicomputer

As one might expect, suggestions that the data processing department should forced into a more responsive and service-oriented role were closely tied to the eternal questions of who should control the computer and to what extent it should be used to centralize administration. In 1972, Massey-Ferguson's comptroller, a man named Ward A. Fredericks, published an article in which he boasted of his success in using a chargeout system to bring the firm's data processing

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[630] Ibid

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and systems operations to heel. The secret, he suggested, was to make the structure of the data processing operation match that of the larger organization it was intended to serve. A misguided push for total systems had, he believed, overridden interest in "good management practice."[631]

He was quick to condemn those "systems and EDP organizations" that had wreaked unnecessary havoc by "attempting the development of a so called 'total' system" without adapting it to the realities of organizational power. The same techniques that had successfully automated and centralized routine jobs like payroll and inventory reporting could not be expected to work here. "In most cases it is, from a human relations viewpoint, operational suicide to think that major parts of an organization will willingly accept change of a major magnitude simultaneously. The single great leap, rather than the slow escalation to the large integrated system, has, in most instances, resulted in dismal failure in the implementation of computer applications."[632]

While Fredericks was not opposed to the centralization of data processing operations per se (he was, after all, a corporate financial manager in charge of data processing), he was opposed to any attempt to separate control of computer systems from the normal give and take of organizational politics. Centralized data processing in a decentralized organization could work only through the establishment of "useful compromises on all sides." The "centralized management services or management information services function" he favored would appear to be an extension of the existing power of financial management, cemented by the augmentation of existing control systems and the imposition of financial discipline on data processing itself.[633]

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[631] Ward A. Fredericks, "A Case For Centralized EDP", Business Automation 19, no. 1 (January 1972):20-24.
[632] Ibid.
[633] Ibid.

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In fact, discussion of the merits of the centralization and decentralization of EDP were as inconclusive during the early 1970s as the endless discussion given by the systems men of the 1950s to their own organizational position. Most data processing commentators saw centralization as the inevitable future trend – an opinion bolstered by the promise of timesharing to permit the centralization of computer hardware (discussed below). But when George Glaser weighed the matter in 1970 he acknowledged that these advantages were sometimes offset by the difficulties of reorganization and the loss of local knowledge and responsiveness provided by decentralized computer operations. While centralization might improve the load figures prepared to determine how efficiently the computer's capacity was being used, this would not necessarily correspond to greater organizational effectiveness. Large development teams might not be more efficient than small ones, and might actually be less effective at holding onto their members. Glaser found a pragmatic mix of centralization and decentralization the best approach, with decentralization as the default assumption where no compelling reason for centralization could be demonstrated.[634]

Centralization or decentralization was not a simple issue. Some commentators pointed out that programming, analysis and operations could in theory be separated. This argument could be used to undermine suggestions that the expected efficiency benefits of centralizing computer operations on large computers necessarily implied the centralize of control over the jobs to be run in these mammoth computer centers. Back in 1965, Dearden had argued that programming work could be centralized, but analysis work must remain under the control of the departments involved.[635] Others suggested that programming itself could be decentralized. Yet these arguments did not seem to have gained much ground in practice. According to the Wall Street

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[634] George Glaser, "The Centralization vs. Decentralization Issue: Arguments, Alternatives and Guidelines", Data Base 2, no. 3 (1970):1-7.
[635] Dearden, "How to Organize Information Systems".

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Journal survey, in 1966 a full 66 percent of large (more than one thousand employees) companies with computers claimed that the trend in their computer operations was towards increased centralization. Just 9.6 percent were decentralizing.[636]

Two new technologies were beginning to reshape the balance between centralization and decentralization: timesharing, and the minicomputer. Although it was ultimately less important to administrative computing, timesharing received far more attention than minicomputers in the data processing literature of the late 1960s and early 1970s. Like the push to replace a host of smaller second generation computers with a single large third generation model, the appeal of timesharing relied on the assumption (formalized as Grosch's law) that the most powerful computers would always provide the best value for money. The challenge, therefore, was to find a way of putting enough work onto a single computer to achieve these economies of scale. Through timesharing, a company could centralize its computers and reap economies of scale in their physical operation while decentralizing programming and analysis work. Improved timesharing might also lead to that elusive goal: the executive who used a terminal personally.

The conventional wisdom was that most companies would eventually have no more need to maintain their own computer than to generate their own electrical power. Bigger economies of scale, and better balancing of loads, would come from massive shared computer systems. Time-sharing was promoted as the basis upon which these "computer utilities" would be built. Under this model, thousands of users would subscribe to giant networks, using terminals to access hardware and software running on remote computers. Well over a hundred companies rushed to enter the time-sharing business. In the late 1960s, timesharing, rather than the handing over of reels of computer tape holding program code, was seen by many as the best way to make money out of standardized application programs. From the very early days of computing, firms such as

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[636] Wall Street Journal, Management and the Computer.

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the payroll processing giant ADP sold bundles of services based on proprietary software. As interest in networking and remote access to computers increased, many expected these models to become the norm. [637]

Timesharing services were initially popular with scientists and engineers, who liked the convenience of interactive computer use. The services offered libraries of useful programs and subroutines to assist with calculations. As the market became crowded toward the end of the 1960s, and timesharing companies targeted the potentially larger administrative computing market, they sought to differentiate themselves by offering applications packages rather than just computer time. A firm would effectively lease the applications they required as a package, with all the computer hardware, software and services they needed thrown in. General Electric (the market leader) offered a package to banks, BBN (a computer services firm now best known for its contract work on the development of what became the Internet) a package for architects, and Univac had ambitious plans to build nationwide networks to serve specific industries. Its integrated package of billing, accounting, inventory and other operations was to be offered initially to the wholesale wine and liquor industry.[638]

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[637] Although the computer utility concept is generally believed to have originated with Martin Greenberger, "The Computers of Tomorrow", The Atlantic Monthly, May 1964, it goes back at least five years earlier, to the 1959 conference presentation published as Alan O. Mann, "A Publicly Regulated System of Management Control Services", in Management Control Systems, ed. Donald G. Malcolm and Alan J. Rowe (New York: John Wiley & Sons, Inc., 1960). For an early discussion of its relevance to data processing, see Richard E Sprague, "The Information Utilities", Business Automation 12, no. 3 (March 1965):42-47.

[638] Edward J Menkhaus, "Time Sharing is Everybody's Thing", Business Automation 16, no. 9 (September 1969):26-35, 38 and Robert V Head, A Guide to Packaged Systems (New York: Wiley-Interscience, 1971). Others believed that the crucial advantage of the computer utility would come with the automatic interchange of orders, payments and other information between firms that would follow once different businesses used shared computers to hold their information. These feelings were only reinforced in 1970, as a collapse in the stock market bubble for software and timesharing firms led to the unraveling of scores of startup firms. As Business Automation reported then, the future of timesharing was then seen to lie not in the general-purpose computer utility but in the provision of "industry-oriented software on a national basis.... Timesharing has become an information transfer business and not a computation or calculation business." Edward J. Menkhaus, "Time Sharing: More Glitter than Gold", Business Automation 17, no. 11 (November 1970):36-42. For a catalog of the applications offered by Pillsbury in its brief

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Amid all the attention given to the commercial potential of timesharing, the arrival of the minicomputer in administrative computer passed almost unheralded. The minicomputer industry was well established by the early 1970s. The market was pioneered by Massachusetts based DEC (Digital Equipment Corporation), which had already produced tens of thousands of its smaller PDP series machines. These machines found a ready market among scientists and engineers, used for calculations and to control experimental equipment. Whereas administrative applications relied on the support of an array of printers, tape drives and other peripherals to speed data through the system as effectively as possible, DEC focused on the provision of a versatile and robust CPU (central processing unit). While data processing equipment was worked by specialist operators, the minicomputer was often programmed and operated by laboratory staff. And while IBM devoted ever more attention to the construction of elaborate programming tools, and operating systems, the early DEC machines continued to rely on their users to control and program them directly. While the many firms attempting to sell "small" administrative computers during the 1950s had rapidly vanished, DEC found a lucrative niche in the scientific world.[639]

During the 1960s, however, the minicomputer seemed to have nothing to do with data processing. Only in the early 1970s did data processing managers realize, sometimes with a shock, that the minicomputer was maturing into a powerful machine capable of handling many administrative computing tasks. Faster processors, more aggressive use of new technologies (such as the integrated circuit) and improved software support had greatly broadened their appeal. In addition, many minicomputers were already in use to control video terminals or operate

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attempt to launch a commercial timesharing business, see Pillsbury Occidental file, Computer Product Literature Collection (CBI 12), Charles Babbage Institute, University of Minnesota, Minneapolis.

[639] Minicomputers have received neither the historical attention lavished on the early mainframes nor the journalistic attention lavished on the origins of the personal computer. A good summary of DEC and the place of the minicomputer in the evolution of the computer industry is given in Ceruzzi, A History of Modern Computing, 127-41, 93-200, 43-47, 81-89.

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communication links on behalf of larger computers.[640] By 1972, an estimated 65,000 minicomputers were used world wide, and DEC was the world's third largest computer company. As Business Automation's editor Arnold E. Keller wrote that year, "Minicomputers and mini skirts have one thing in common. They have both proved to be management eye openers." [641]

The minicomputer appeared to present a technological alternative to those frustrated with centralized data processing. Its significance was made apparent in another 1972 article, "Maxi-Empire, No! Mini-empire, Maybe?" Its author, a programmer called Henry Oswald, used the potential of the minicomputer to challenge the traditional order things in corporate computing. His incitement was as scathing as it was broad. He characterized corporate computing staff as clinically paranoid, building elaborate defensive structures to exert total control over the computer and isolate themselves from the external world and its unpredictable challenges. Even internally,

> the computer group is broken into totally disjointed cliques. For example, the COBOL applications programmers and the systems maintenance people effectively live on different planets. Members of these cliques continually disparage members of the other cliques.... useful work must play a secondary role.... What they can't understand is why other groups keep complaining about their performance, for the EDP people are very busy all the time.... When a

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[640] In 1969, one author suggested that minicomputer represented a "quiet revolution" in hardware choice that would allow some existing systems (particularly for communications) to be replaced by much cheaper hardware, and would also open up new possibilities in the provision of custom systems complete with hardware. Francis A. Frank, "Software Services: An Outside Outlook", Business Automation 16, no. 11 (November 1969):55-61.

[641] Arnold E. Keller, "Overview: The Publisher Comments", Business Automation 19, no. 1 (January 1972):4. The figures on minicomputer sales and DEC are taken from the discussion in Campbell-Kelly and Aspray, Computer, 222-29. Business Automation's first serious examination of the penetration of minicomputers into business was been made in Anonymous, "The Mini's Are Moving", Business Automation 17, no. 2 (February 1970):46-51. According to this article, "Once confined mostly to islands of scientific and engineering applications, these decidedly small computers have been discovered, and because of certain specific advantages, are now firmly established on the business mainland." On early users of minicomputers, including their role in communications systems, see Virginia Bender, "More Mini Power for Management", Business Automation 19, no. 1 (January 1972):30-34.

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> paranoid tries to sell, he usually doesn't hear the customer too well and says, "Don't worry, I know what's best for you."[642]

Many of these criticisms had been made before, if not with such verve. What made them compelling here was the presence of a technological alternative: the minicomputer. Oswald characterized existing mainframes as dinosaurs in comparison to the new technology. It was now be possible to centralize only those pieces of computer work that truly needed to be centralized, while retaining control of departmental matters, so as to "get the processing power to the people who use it and get those people involved." He even speculated that a network of minicomputers might be able to split up big jobs between them, removing the need for mainframes altogether.[643]

Oswald's words resonated with at least some of the magazine's readers. One of them criticized EDP staff as a "priesthood" standing between users and the computer and asserted that, "the useful work done by EDP is strikingly small. Having a massive central EDP facility is as ludicrous as having a central facility in a company 100 years ago to do all of the writing!" He hoped that user departments would be able to tackle more of their own computer projects in years to come.[644]

By 1975, an Infosystems staff writer acknowledged that, "today you can find a mini in virtually every major area of business activity." The article, "Making the Mini-Move," suggested that the new interactive technology of terminals and menus was making minicomputers so easy to use that systems could be packaged for operation by non-specialists with minimal training. Companies could spread minicomputers through their branch offices.[645] A new idea of minicomputers and mainframes working side by side as elements of an integrated network was

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[642] Henry Oswald, "Maxi-Empire, No! Mini-empire, Maybe?" Business Automation 19, no. 6 (June 1972):34-36.

[643] Ibid.

[644] Joe Gaffney, "Reader Feedback: Whose Ox is Gored?" Business Automation 19, no. 10 (July 1972):34-36.

[645] Anonymous, "Making the Mini Move", Infosystems 22, no. 1 (January 1975):40-41.

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beginning to come into focus. Its appeal was considerable – cheap, local minicomputers would perform simple processing tasks and thus reduce the load on the larger computers. Big centralized computers would run batch jobs, maintain large databases and run complex tasks. A powerful network would switch data between them and somehow synchronize everything. The idea was referred to as "distributed computing" (or, in the Infosystems piece, "distributive processing.")

Articles such as these demonstrate a growing awareness of the minicomputer within the data processing community of the early 1970s. It was not, however, a primary concern. From 1968 to 1975, Business Automation/Infosystems paid substantially more attention to microfilm, then tipped as a major breakthrough in computer output and data distribution, than to the minicomputer.[646] While minicomputers gave data processing managers a taste of the issues they would be faced with when personal computers began to proliferate, the PC only began to pose a serious threat to corporate data processing departments during the 1980s.[647]

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[646] According to Cady, "Machine Tool of Management: A History of Microfilm Technology" around 2,500 Computer Output Microfilm systems were in use by 1975.After a flurry of publicity around 1970, boosters were frustrated by the slow rate of adoption. Anthony D. K. Carding, "Microfilm: EDP's Newest Ally", Administrative Management 31:4, no. April (1970):38-42, 44, 46-48; Anonymous, "A New Ally for Records Management", Business Automation 16, no. 7 (July 1969):51-54; Weber, "Microfilm Makes it Easier to Fly"; Menkhaus, "The Many New Images of Microfilm"; Anonymous, "Micropublishing: An Emerging Giant with Problems", Business Automation 18, no. 2 (January 15 1971):6-7; George B. Bernstein, "Are You Ready for Computer Image Processing?" Business Automation 18, no. 11 (September 1971):30-33; Edward J. Menkhaus, "Microfilm: New Power for Information Systems", Business Automation 18, no. 7 (May 1 1971):38-42; James A. Stone and James Clark, "Integrated Business Systems", Infosystems 19, no. 7 (July 1972):26-30; Anonymous, "After the Big Fiche", Infosystems 20, no. 11 (November 1973):40-41; Various, "Microfilm -- special issue", Infosystems 22, no. 4 (April 1975):13.

[647] This illustrates the extent to which useful administrative systems continued to combine computer technology with other, less elaborate, technologies. It also illustrates how far the concerns of data processing managers continued to diverge from those of technical computing users, or indeed from those subsequently adopted by historians of computing. The latter have tended to lose interest in data processing centers after the 1960s, focusing instead on minicomputer systems and microprocessors.

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## The Arrival of Packaged Software

Until the late 1960s, almost every application program used by an American corporation for administrative purposes had been specially written for the firm concerned, usually in assembly language or COBOL. The work was undertaken by the firm's own programmers and analysts, often with the assistance of consultants. Sometimes sample code supplied by the computer manufacturer was used as a basis, but even then it was usually heavily customized. By the end of that decade, however, a new idea was beginning to receive general discussion: packaged application software. The potential of this idea seems clear today – so clear, indeed, that it is hard for us to appreciate the initial marginality of packaged software suppliers. While a brief stock-market bubble in "software" stocks grew and burst during the late 1960s, a closer examination of the progression of packaged software again shows the importance of the existing institutions of data processing in shaping and regulating change.

Electronic data processing managers had always cared a great deal about programs. But only around 1960 would a well-informed data processing manager have been able to nod knowledgably if the word "software" came up during conversation. During the 1950s the term was not used at all, though "hardware" was already well known as a colloquial term for computer equipment. When the term did achieve currency it was as the complement to hardware – describing everything else that the computer manufacturer provided. Although the neatness of this reversal fuelled its spread, it also ensured that it lacked a specific definition.[648]

The earliest, and for much of the 1960s the most commonly accepted definition of software, included only what we would now call "systems software" – programs used to construct other programs, or operating systems to control computer hardware. A Honeywell advertisement

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[648] A much fuller version of this discussion, with attention to its historiographic implications, is given in Thomas Haigh, "Software in the 1960s as Concept, Service, and Product", IEEE Annals of the History of Computing 24, no. 1 (January-March 2002):5-13.

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of early 1962 boasted of the firm's expertise in the new field of software, defining this as "the automatic programming aids that simplify the task of telling the computer 'hardware' to do its job" and observing that the "three basic categories of software" were assembly systems, compilers and operating systems.[649] The other main implicit definition of software, broader than the first but equally unfamiliar to the modern reader, included not only systems tools, but also any package of tools, applications and services purchased from an outside vendor.

A very broad definition of software was endorsed as late as 1967 by EDP Analyzer, Richard Canning's authoritative newsletter. When it repeated a claim by Walter F. Bauer of Informatics that the share of the software market held by independents (i.e. purchased from companies that did not make computers) had risen from 1 percent in 1960 to 3 percent in 1965 and would reach 10 percent by 1970, it also quoted Bauer's definition of software as including "systems analysis and design, programming and computer-based services, accomplished by users, computer manufacturers and others." Bauer argued that independent producers were rapidly shifting away from an exclusive focus on systems software and toward applications programs, which he estimated would rise to account for about 50 percent of their revenues.[650]

This conflation of independently produced programs and independently offered programming, analysis and advice made considerable sense during the mid-1960s. There was, as yet, no such thing as a shrink-wrapped application package. Most application programs were still written in-house and from scratch, although firms were increasingly reliant on operating systems and programming tools from manufacturers. Early interest in packages stemmed from the reasonable and generally held idea that it might be more effective to take an existing skeleton program and modify it than to write a new one from scratch. Computer manufacturers supplied

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[649] Honeywell, "A Few Quick Facts on Software", Business Automation 7, no. 1 (January 1962):16-17.

[650] Bauer offered his definition during a Fall 1965 address to the Los Angeles chapter of the ACM. See Richard G. Canning, "Independent Software Companies", EDP Analyzer 5, no. 11 (November 1967).

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such "canned" applications free of charge for their machines. A few of these packages enjoyed considerable success – JoAnne Yates has shown that IBM's early integrated package '62 CFO eventually found hundreds of users among medium sized insurance companies. According to Yates, many of these companies would have been unlikely to order the relatively inexpensive IBM 1401 computer it ran on had the package not lifted most of the burden of programming from their data processing staff. [651]

The largest software companies (in this broad sense) included the Planning Research Corporation, the Computer Sciences Corporation, CEIR, Computer Applications Inc., and Informatics itself. These independent software companies did not, by and large, attempt to compete head-to-head with the support teams of IBM by selling their own skeleton application code for companies to adapt. They could, however, build up expertise by undertaking similar projects for a number of different customers. As they did so, they would naturally build up a library of shared routines and find themselves able to complete each additional project better and cheaper. After a certain point, custom applications with recycled code gradually evolved into something more like standard packages.[652]

By the mid-1960s, application packages were becoming better established. Richard G. Canning's EDP Analyzer reported that, the "change in interest in application packages became evident [in 1965]. While some interest had existed previously, it appeared to be quite local. The arrival of the general purpose inventory forecasting packages may have been the triggering influence for the growing popularity of packages." According to Canning, inventory management

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[651] Yates, "Application Software for Insurance in the 1960s and Early 1970s", 124-26.

[652] These firms were of very different character from Microsoft and the other firms that spring to mind when software is mentioned today. Their work was closer to the consulting and services tasks today undertaken by accounting firms, by independent specialists like AMS and EDS, and by computer vendors like IBM. Then, as now, small and flexible companies accounted for much of the market for computer services. Barriers to entry were low, and stock options lured skilled programmers to the startup firms. A spate of initial public offerings around 1966 led investors to pour money into the field, which was soon crowded by an estimated 2,000 companies.

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was one of the most popular applications for data processing departments looking to move beyond the simple automation of clerical jobs such as payroll – but the operations research aspects of this task posed challenges of their own to corporate programming staffs.[653]

The first independently produced programs to be licensed as standard packages appear to have been systems software such as file management and report generation utilities. These could fill niches left empty by the computer manufacturers' own software. Perhaps the most important early independent software package was Informatics' Mark IV file management system, which like many early packages was the evolution of work begun as a custom project. First offered in 1967, it helped to propel Informatics to become a leading software firm of the 1970s.[654]

In 1968, Robert V. Head was interviewed for Business Automation magazine. Head was by this point established as a leading expert on software. He had worked on the pioneering ERMA bank automation and SABRE airline reservation systems, in a career that had already involved stints working for GE, IBM, in the banking industry and in senior IT-related positions for consulting firms Touche, Ross, Bailey & Smart and the Computer Sciences Corporation. Head had briefly run his own company, the Software Resources Corporation. Head, who given the breadth of his own work experience was well placed to know, suggested that, "at this point virtually no one is making a substantial profit on packaged software, although the potential seems very great." He suggested that, "a sort of software explosion" had taken place in the past year, driven by a shift of emphasis towards more complex applications in the MIS area, a change that

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[653] For a contemporary report of unbundling, see Alan Dratell, "Unbundling: The User Will Pay for the Works", Business Automation 16, no. 8 (August 1969):36-41.

[654] For the Mark IV see, Martin Campbell-Kelly, "Development and Structure of the International Software Industry", Business and Economic History 24, no. 2 (Winter 1995):73-110, John A Postley, "Mark IV: Evolution of the Software Product, a Memoir", IEEE Annals of the History of Computing 20, no. 1 (January-March 1998):43-50 and Richard L. Forman, Fulfilling the Computer's Promise: The History of Informatics, 1962–1982 (Woodland-Hills, CA: Informatics General Corporation, 1984).

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demanded a level of programming and system design skills rarely present in corporate data processing departments. [655]

How did the corporate data processing managers of the 1960s feel about packaged software? A survey of the magazines and journals most closely associated with this community (Business Automation, Datamation, and EDP Analyzer) gives some hints. Their most important evidence is negative – akin to Sherlock Holmes' observation that a dog had failed to bark during the night. While a good number of articles appeared discussing the boom in the software industry and the revolutionary potential of timesharing, there were very few nuts and bolts treatments of how to purchase or evaluate application software packages. This is because such activities were, until about 1972, still rare.

Like anyone else with an eye on the business press and the stock market, data processing managers were exposed to an enthusiasm for the software industry which had quite outstripped its accomplishments. As Head observed in 1970, at the tail end of the first market bubble in software stocks, "For a long time now, the software industry has been a prime concept of interest on the part of investors, with resultant enormously inflated stock values. Price-earnings ratio of eighty to one seem normative, and infinity to one not unusual, in the case of numerous companies that have never turned a profit. There has been almost a compulsion to 'go public' on the part of many marginal firms, and millions of dollars have been obtained from the public though such offerings."[656]

The programming of administrative applications remained an activity performed largely by a company's own data processing staff. The 1969 Wall Street Journal survey found that 44

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[655] Anonymous, "The Software Explosion", Business Automation 15, no. 9 (September 1968):24-29. Head went on to help found SMIS, the Society of Management Information Systems (known today as SIM) and spent the latter part of his career in senior IT positions with the US Federal Government and as a consultant in the same area.

[656] Robert V. Head, "Twelve Crises -- Comments on the Future of the Software Industry", Datamation 16, no. 3 (March 1970):124-26.

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percent of firms claimed all programs used were written in-house, and another 38 percent said that many of them were. Even among the largest companies (the sector identified by the survey as the primary users of what it called "Programming (Software) Services") just 45 percent of those responding to this question reported any purchase of outside programming (a category including both packages and services). These same companies relied somewhat more heavily on the bundled programs supplied by the manufacturers of their computers, utilized by 80 percent of responding firms.[657]

Any software acquisition (whether packaged or custom, system or application) ultimately resolved itself into a set of make-or-buy questions. No package entirely removed the need to "make" some elements of the system, but it was sometimes possible to reduce this. In contrast to the hopeful schedules and fuzzy definitions associated with in-house development, packaged software was a known quantity. Its costs and capabilities could be measured. In addition, many companies found their programming and analysis teams were chronically overworked and buried under a large backlog of urgent tasks. The availability of packaged software promised to alleviate this.

The disruptive transition to third generation computers with many new technologies, which as we have seen often failed to live up to expectations, provided a welcome opportunity for software suppliers. Since it would take a major programming effort for firms to re-implement their existing systems for this new environment, the transition to the third generation systems was an obvious moment at which to consider the shift to packaged applications. This approach held the additional promise that different applications from the same vendor might be easier to integrate than in-house packages that had never been properly coordinated.[658]

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[657] Wall Street Journal, Management and the Computer.

[658] Computer Sciences Corporation, for example, was offering a number of generalized applications to banks to handle common applications such as payroll, personnel records, stockholder

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In 1968, Head used a Datamation article to give data processing managers what was then their most detailed and practical guide to packaged software acquisition. As sources of application packages he identified the manufacturer (in whose products he had little faith), user groups (some of which maintained extensive lists of user-submitted software) and software companies. Whatever the source, a package would likely require substantial modification. A well designed commercial package could easily pay for itself by lowering the overall cost of the project, especially if this would also lead to reduced maintenance costs. Head suggested that commercial applications generally cost between $2,000 and $20,000 – representing 10 or 20 percent of the original development cost. While acknowledging that, "[t]here may still be some resistance on the part of data processing managers accustomed to obtaining software 'free' from the computer manufacturers," he argued that such reliance might prove a false economy.[659]

Head's advice for the evaluation of software packages was more pragmatic. He suggested that data processing managers assign their own weights to each of the following factors and score packages under consideration accordingly:

- Package cost (including indirect costs for modifications, training, installation, conversion, running, maintenance, etc)
- Quality of package
- Design features (file organization, control and audit features, programming techniques, flexibility, etc)
- Generality ("among the most important package criteria")

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records and general ledger. Such applications packages were somewhat generalized – while modification and maintenance would still be necessary, they were more flexible than a typical program. While CSC charged each customer when new options and capabilities were delivered, bug fixes were free of charge and only a modest fee was levied for the basic updates to meet new legal regulations. As a result it was realistic to hope that use of a package would dramatically cut the cost of program maintenance. Richard G. Canning, "Application Packages: Coming Into Their Own", EDP Analyzer 5, no. 7 (July 1967).

[659] Robert V. Head and Evan F. Linick, "Software Package Acquisition", Datamation 14, no. 10 (October 1968):22-27.

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- Expandability (although an over generalized package might prove inefficient)
- Operational status (how extensively used and bug free a package is)
- Equipment configuration needed to run it
- Programming language it is written in
- Documentation (separate descriptions required on each of the system, program, operations and user level)
- Installation support (must be agreed in advance, may include file conversion and training assistance)
- Maintenance -- "the acquisition terms for a package should include some assurance of error-free operation for a reasonable period of time"[660]

The list demonstrates that software acquisition remained a complex process. The importance of the programming language used, the program documentation and its expandability illustrate that an application program was liable to be extensively customized. The programming techniques of the era made it hard to produce a program that would run on less powerful hardware while taking advantage of larger memories, disk drives and the like where available. Likewise, unnecessary features might slow down a program and make it harder to maintain. As Head warned in a later guide to the same topic, computer staff might not prove the most reliable judges of a package. While a manager was to some extent at the mercy of their judgments, he or she must also remember that their "professional pride" might lead them away from cost-benefit calculations and towards the conviction that they could produce a better package. "Experience," he wrote, "has shown that an outside package, no matter how estimable, can be torn asunder by an astute technician bent on ferreting out and magnifying all possible deficiencies."[661]

In a short book published in 1971, Head surveyed the state of the software industry at the opening of the 1970s. He found that some packaged application programs were supplied in

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[660] Ibid, 25-26.
[661] Head, A Guide to Packaged Systems.

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COBOL, for compilation on a range of machines from different manufacturers. Others were more closely tied to particular machines and operating systems.[662] Such programs continued to appeal primarily to companies without the staff, money, or time to develop a better system of their own. Head suggested that although "the potentially great profits" were associated with a "potential market for these systems in the tens of thousands.... even highly successful packages have at this point have sold only in the neighborhood of fifty systems with a mere handful of outstanding success stories claiming sales in the hundreds."[663]

IBM's decision, in 1969, to "unbundle" its software from its hardware is usually taken as a crucial moment in the establishment of a viable market for packaged application software.[664] While this was undoubtedly an important event, it appears to have reinforced shifts that were already underway, and its effects were not felt immediately. While the entrenchment of the System/360 architecture and the acceptance of standardized high level languages (most particularly COBOL) provided a larger potential market than ever before, this market remained largely untapped.

During the 1970s, firms such as Management Science of America and the University Computing Corporation finally managed to nurture a market for packaged applications software that grew steadily and proved profitable for many of the firms involved. The largest and most successful firms, however, still tended to specialize in systems software – the particular

[662] His analysis of the market for payroll programs, a leading application of the period, was particularly informative. Most such programs cost about $20,000. Two of the most successful appeared to have sold about seventy-five copies each. One of these, the Computer Science Corporation payroll system, was slow to run, and required a large (sixty-five kilobyte) memory. It was relatively easy to use and install, reducing the need for skilled computer personnel. However, this usability came at the expense of flexibility – there was, for example, no way of turning off reports that were not needed for a particular payroll run. Ibid, 41-43.

[663] Ibid, 66.

[664] For contemporary reaction to unbundling see Dratell, "Unbundling: The User Will Pay for the Works". For an historical treatment see Steven Usselman, "IBM and its Imitators: Organizational Capabilities and the Emergence of the International Computer Industry", Business History Review 22, no. 1 (Spring 1993):1-35.

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importance of data base management software is discussed later. Change in computer usage lagged expectations, as firms ported their applications from one machine to another and used emulation and continual patching to support ancient application code on new hardware.[665]

## The Death of the Programmer Was Much Exaggerated

One surprising constant in the history of administrative programming has been the insistence in much managerially-oriented discussion that explosive growth in the number of administrative application programmers will soon reverse itself. The outlandish claims made for packaged software in the early 1970s were just one small part of a much longer tradition. In retrospect, it is clear that from the 1950s onward the number of people employed as application programmers by corporations increased steadily for the rest of the century. There were a few minor slowdowns in growth during the early 1970s and early 1980s, but these barely registered on the overall trend.[666]

As we saw earlier, corporate managers initially had very little idea of the programming commitments they were incurring with the installation of a computer. Programming was often seen as a one-time expense of conversion. The Iowa-Illinois Gas and Electric Company created a Methods and Procedures department in 1955, explicitly to conduct a computer feasibility study. After its computer arrived, it expected to supplement these procedures analysts on a temporary basis with programmers "selected from the departments that would be involved in the processing.

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[665] For a critical discussion of the largest mainframe software companies at the start of the 1980s see Stephen T. McClellan, The Coming Computer Industry Shakeout: Winners, Losers, and Survivors (New York: John Wiley & Sons, 1984), 240-63.

[666] In 1971, the sudden slowdown in data processing growth led one manager of programming to claim that, "The days of an automatic 20-percent increase for job jumping and employers begging insufferable young men and women to take any salary and program for them may never come again." Tom Evslin, "Unemployment in Wonderland", Journal of Systems Management 22, no. 7 (July 1971):8-11. The persistent predictions of the death of the programmer have previously been noted in Friedman and Cornford, Computer Systems Development: History, Organization and Implementation, 321, complete with the famous quotation from Mark Twain. I can therefore take no credit for this clever phrase.

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These people became programmers with the understanding that they would return to their departments when the major portion of the programming job was completed."[667]

The task of programming was also the hardest to justify within the existing culture of business. Like any machine, the computer clearly needed some operators and supervisors to keep it fed with data and to tend to its needs. Analysis, too, made a institutive sense – someone had to examine the operations of business and decide how and where the computer could best be applied. But the scale, expense and complexity of programming made less sense. What were all these people doing, and why did they have to be paid year after year just to keep jobs running when they had already been converted to the computer? Narrow descriptions of the programmer's job -- as someone who took flowcharts prepared by the analysts and turned them into other, more detailed, flow charts – only added to the problem.

Perhaps because of the programmer's awkward role, promoters of computer technology have been only too willing to present the application programmer as a temporary figure, soon to be replaced by some combination of superior technologies. One of the first candidates for this job was the assembler or compiler (known during the 1950s as "automatic coding"). As a Datamation editorial admitted in 1961, it appeared during the preceding years that computer manufacturers had begun to believe their own advertisements – "the manufacturer worshipped the words of his advertising copywriter and fully expected programs to be written with whimsical ease."[668]

Robert Bosak, one of the participants in the 1959 SDC conference on Management Control Systems, suggested that, "The ultimate is to remove the programmer entirely from the process of writing operational programs. In effect, the manager would write and modify his own programs." While claims that managers would undertake their own programming were not taken

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[667] Anonymous, "Responsibility Accounting -- Fast and Precise", Business Automation 11, no. 8 (August 1964):32-33, 36-37.

[668] Anonymous, "Software on the Couch".

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seriously by many people with a close involvement in programming, the idea that a new programming system would soon allow analysts to go straight from flowchart to executable program code was widely endorsed. This was reflected in the names like "Flowmatic" given to some of the programming tools of the 1950s. When early "automatic coding" systems failed to achieve this goal, attention turned to the newer high level languages such as COBOL. In 1962, Fred Gruenberger observed that, "I've never seen a hot dog language come out ... that didn't have tied to it the claim in its brochure that this one will eliminate all programmers."[669] The idea, however, remained that application programmers would soon wither away in the face of technological advancement.

The concept had obvious appeal to computer salesmen, faced with a chronic shortage of trained programmers that threatened to limit the rate at which new computer installations could be established. It also seems to have been attractive to those who tried to establish that programming expertise was a firmly subordinate skill in the application of the computer to business. Systems men, in particular, were keen to argue that their skills were foundational and eternal, whereas the clever tricks of the programmer were merely transient. As du Pont's data processing manager suggested in 1965, "Coding skill, while still relatively important now, will rapidly diminish in importance over the next five years, but flow charting skill will always be required..."[670]

In a nice twist to this theme, the editor of Office Management used a 1960 presentation to hit back at data processing. "Prophets, in and out of print, have been predicting the disappearance of the office manger from the business scheme for some time now.... 'Automation' they say, nodding their heads very sadly.... According to these pundits, it is the technician, the specialist,

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[669] Bosak, "Implications of Computer Programming Research for Management Controls", 213. Anonymous, "The RAND Symposium: 1962. Part Two- On Programming Languages"
[670] Gregory M. Dillion, "The Evaluation of Programs and Programmers", in Data Processing Volume VIII: Proceedings of the 1965 International Data Processing Conference, DPMA, ed. Data Processing Management Association (Chicago: Data Processing Management Association, 1965)

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the computer expert who is the key figure in the modern office; and, if the office manger doesn't know he's had it, it's only because he hasn't looked in the mirror lately." Nothing, he rushed to assure his colleagues, could be further from the truth. "Actually it is the automation middleman-the programmer or coder, as he is variously called-who is the vanishing breed. The trend in automation is toward the elimination of the interpreters who have been required in the past to translate the language of management into the language of the machine. Indeed, true automation will become a reality only when the need for these middlemen has been obviated through automatic programming." At this point, the office manager would reclaim his rightful control over the office, but with much greater responsibility and authority than ever before. "The office will cease to be a facility inhabited by graduates of production, sales and finance; as the nerve center of the company, it will itself become a breeding ground of presidents."[671]

Richard G. Canning, publisher of EDP Analyzer, gave extensive coverage to new programming technologies – including high level languages and increasing use of generalized routines to perform input and output operations. One area he paid particular attention to was the use of "decision tables"—a technique that promised to further generalize program code. Early use of decisions tables occurred in tasks such as credit card application processing. Instead of burying the logic used to evaluate an applicant's worthiness deep within the inflexible program code, the rules to be applied were stored as data in the "decision table" and applied one by one by a generalized piece of code. A change in evaluation policy could thus be implemented without rewriting the program. By the mid-1960s, some data processing departments were hoping to extend this use of decision tables through "decision table compilers". Once decision rules of a new application had been specified, it would be written down and fed into this compiler – and out

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[671] Robert M. Smith, "New Horizons for the Office Manager", in The Changing Dimensions of Office Management, ed. American Management Association. Office Management Division. (New York: American Management Association, 1960).

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would come the code for the new program. As Canning wrote in 1967, "more and more of the functions of the applications programmer are being transferred to the computer. We expect this trend to continue to the point where the role of the applications programmer (as we know it today) is practically eliminated."[672].

Applications programmers were constantly warned that current high demand for their services was merely a temporary blip. This was generally accompanied by warning to seek great professionalism, a more managerial outlook, a systems perspective or a grounding in computer science (the exact cure depended, as always, on the perspective of the person doing the warning). A 1966 editorial in Datamation articulated this theme nicely, with its causation that,

> Higher level languages have helped to shove aside the programmer was middleman in the problem solving circle, and timesharing, when it gets here, may hasten that delightful day when T.C. Mits poses his prosaic problems directly to the computer in everyday English.... Programmers who expect to float effortlessly up into systems programming--and systems programmers who expect to stay there forever--may be disillusioned.[673]

The prize for the most absurd of these solutions, must go the attempts by a small programming group within the accounting group of the Southwestern Bell Telephone Company to improve data processing productivity through the use of dictating machines. "The boring, tedious task of program coding is being replaced by dictation," according to a report in Business Automation. In this firm, "[w]hen each of the five programmers has to write a program, he first roughs out the flowcharts, then picks up a microphone on his desk... his dictation in COBOL goes through the IBM remote microphone network into a magnetic belt recorder on the desk of the group's secretary." According to the instigator of the scheme, "[s]ystems analysis, coding and

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[672] The quotation is from Canning and Sisson, The Management of Data Processing, 49.

[673] Anonymous, "Editor's Readout: EDP's Wailing Wall." Datamation 12, no. 10 (October 1966):21.

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documentation all go much faster, more accurately, more completely and pleasantly via dictation."[674]

By the end of the 1960s, hopes for the elimination of application programmers had begun to turn toward the use of packaged application software. This had the additional advantage of reducing the need for systems analysts. Increased use of packages made a great deal of sense. Almost every company with a computer continued to require a payroll program, but from a management point of view it made very little sense for each firm to write its own program from scratch – however many decision tables and standardized file routines were used to assist in the task. On the other hand, no administrative task – even payroll – was conducted in a truly standard manner across American business. As we have seen, in practice the packaged software of the 1960s and early 1970s usually still required the use of a large team of application programmers to customize it, maintain it and keep it integrated with other systems.

One remarkable statement of enthusiasm for software packages came in 1970, from the data processing director of Pabst Brewing. The author claimed that the new generation of packaged applications were much better than the old, manufacturer supplied packages. As a result, "Low supply and high demand for in-house systems and programming talent may not be as long lived as many think." The entire analysis, programming and maintenance function of the data processing department could, he claimed, be replaced with three people: a data processing coordinator, a software/applications analyst to choose packages and a single package-modification programmer to configure them. This enthusiasm would appear to reflect a utopian dream rather than hard-won experience.[675]

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[674] Anonymous, "Talking Down a Program", Business Automation 19, no. 5 (May 1972):26-27.
[675] James E. Hackney and Norman L. Paul, "The Wheel Exists", Journal of Systems Management 21, no. 11 (November 1970):40-41.

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These predictions reached a crescendo in the early 1970s. In its turn-of-the-decade look forward to the "Supersonic Seventies," Business Automation magazine again suggested that the applications programmer was an endangered species. "By 1975, the programmer was we know him today will reach the final stage of obsolescence. Instead, programmer analysts will develop complete systems and specifications..." This opinion was soon seconded by George Glaser. According to Glaser, the severe programmer shortages and data processing management problems of 1970 were soon to be vanquished by new technologies. By 1975, "work loads in data processing will be much more stable and the influx of competent individuals from year to year will provide an adequate and stable workforce." "Systems analysis and programming," promised Glaser, "will be as routine as plant maintenance and accounting."[676]

An even stronger claim was made in 1973, when one exceptionally bold commentator claimed that, "The day in which the programmer was the king is rapidly fading. By the mid to late 1970s there will no longer be such a group as the application programmer. The user (for example an inventory clerk or other graded level person) will be writing short, unplanned query type programs in order to tap the data base."[677]

What had actually happened by 1975? To judge from a November, 1974 discussion between Fred Gruenberger and his old-timer friends at the "RAND Symposium" group, the answer was very little. The transcript of this meeting gives a remarkable opportunity to observe many of the most influential commentators on data processing engaged in frank and private discussion with each other. The programmer was more common than ever yet still slated for imminent extinction. The most vehement declaration of the theme belonged to Howard

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[676] Anonymous, "The Supersonic Seventies", Business Automation 17, no. 1 (January 1970):44-65.

[677] Ceil O. Smith, "Projecting Tomorrow's Information Systems", in MIS In Action, ed. Robert G. Murdick and Joel E. Ross (St. Paul: West Publishing Co., 1975). The article originally appeared in Automation in 1973.

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Bromberg, longtime expert on business computer languages, who insisted that, "[a]t least as far as application programmers are concerned, the future is dim. It is analogous to someone wanting to become, today, a telephone operator. We have no need for them, and we'll replace them... By 1980 we should get many things standardized and most of them hardwired." The applications programmer always seemed about five years from oblivion. Paul Armer, another RAND pioneer, suggested that, "I worry that if the universities believe these numbers and gear up to produce the indicated numbers of people who consider themselves programmers, that those people will be unemployed." Richard Hamming, long-time Bell Labs researcher and one of the founding fathers of American computer science, invoked the gradual replacement of the computer operator by the operating system when he suggested that, "I suggest that what has happened to console operators will happen to professional programmers."

Though most of this illustrious group agreed that current trends were about to end application programming as they knew it, they all seemed to have different theories as to why. Some felt that business would follow the model of scientific programming, in which scientists and engineers had become increasingly self reliant. Canning believed that with improved supervisory techniques, the need to recruit programmers would diminish. At present, he suggested, "the programming function is so horribly inefficient that, with some effort, significant improvements can be made in productivity. There might well be fewer programmers, but those few turning out much more working programs." Gruenberger, meanwhile, felt that data base management systems like Informatics Mark IV would, "if used properly will obviate the need to ever write another line of COBOL code".

At this point, Daniel D. McCracken stepped forward to ask the vital question. "Fred [Gruenberger] has stated some premises, on the basis of which he concludes that horrible things are going to happen to applications programmers. I contend that those premises have been true for a long while, and those things haven't changed. Why should they happen now?" Mortimer

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Bernstein, a RAND veteran still working for SDC, followed this up. ""Since 1960, I've heard predictions that programmers were going the way of the dodo birds. We keep inventing ways to put ourselves out of business, like the magic languages. It doesn't seem to come about, because I think we're stifled by our inability to imagine the next 25 things the computer is going to be applied to."

Gruenberger and the others were right in their belief that new technologies would soon make expert programmers more efficient and allow users to become more self-sufficient. Data base management systems, improved programming project control methodologies and special purpose programming systems helped to make programmers more productive. Software packages greatly reduced the need for custom programming, while new kinds of hardware and software – most particularly the microcomputer – finally allowed managers and business analysts to use standardized tools like spreadsheets to accomplish tasks that would previously have demanded custom programming work.

Despite this, it was McCracken who called the overall result correctly. The number of applications programmers went up and up for decades to come. This was in large part a matter of economics. When new tools made a given programming job cheaper, this fall in cost served to raise demand. The ever falling cost and ever rising performance of computer hardware also served to reduce overall costs. More companies were using computers, to do far more complex things. Overall demand for programmers thus rose – precisely because the number of programmers needed to tackle the same volume of work was falling. The challenge has always been to optimize the fit of a system to the requirements of a particular business while minimizing the amount of specially written code and lowering the cost of ongoing maintenance. Packaged applications played an important part in reconciling these goals, as did the other techniques discussed here, but none of them have killed the application programmer.

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As we shall see later, this trend continued though the 1990s. Despite the continuing predictions that corporate programming groups were about to be replaced by software packages and outside consultants, at the end of the twentieth-century, American corporations continued to rely on armies of in-house applications programmers, and most programming work was still performed by specialist corporate computing staff. Neither have more recent techniques, such as fourth generation languages, end-user programming, CASE tools and object orientation, fulfilled similar claims made on their behalf. Though both general managers and computing "visionaries" were only too willing to believe that the messy, laborious, and mundane work of custom application programming was merely a passing phase it has instead proven a permanent feature of the corporate landscape.

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# SECTION IV: PROFESSIONALISM IN ADMINISTRATIVE COMPUTING, 1959-1975

## 10. DATA PROCESSING AS PROFESSIONAL IDENTITY

This chapter explores the evolution of data processing as an occupational and putatively professional identity during the period from 1959 to 1967. During these years the computer progressed from an unfamiliar and unreliable piece of specialized equipment used by perhaps two thousand of the largest punched card installations into a replacement for traditional tabulating machines in tens of thousands of punched card installations. During this process, the administrative and managerial tasks to which computers were applied remained similar to those chosen by the pioneering firms of the mid-1950s, which in turn remained close to those formerly accomplished by use of electro-mechanical punched card machines.

In 1967, Richard Canning followed up his pioneering mid-1950s books on the establishment of data processing departments with an updated guide to the field intended for interested managers. He was hopeful that new technologies, particularly real-time and random access, would soon trigger a shift toward more complex systems, managerial approaches and the elevation of data processing, "alongside marketing, production, finance, and engineering as one of the major functions of the enterprise." This remained something of a leap, despite to his own earlier predictions and indeed a similar claim made by Leffingwell in the 1920s that, "the office" would soon be recognized as a top level department.[678]

The internal structure and hierarchy of the data processing department changed little and, although many data processing departments grew in size and stature, few saw a major alteration

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[678] Canning and Sisson, The Management of Data Processing, 43.

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in their organizational location or managerial mandate. Professional development was similarly incremental. Although the National Machine Accountants Association (NMAA) was renamed the Data Processing Management Association (DPMA), it remained the leading organization for senior tabulating staff as well as for the managers of the new administrative computing installations. As Canning himself admitted, "in many organizations, data processing is looked upon as simply 'the old tabulating operation with chromium plating'."[679]

It is not surprising, therefore, that data processing remained the dominant identity of corporate computing staff with aspirations to raise their status. Data processing was, as shown previously, a hybrid identity uniting computers with the existing culture, practices, suppliers and corporate departments of punched card work. During the 1960s, the spread of the computer brought with it an enormous expansion in the number, size and organizational importance of data processing. Yet data processing departments continued to be headed, for the most part, by former punched card supervisors whose background and educational credentials remained uncomfortably close to blue-collar.

We have also seen that a large number of other specialist groups, including office managers, systems men and operations researchers, were paying growing attention to the computer and were attempting to establish their own claims to hold the secrets of its power. The challenge faced by the senior data processing staff of the 1960s was therefore to maintain control of computer departments while winning respectability as managerial rather than technical specialists and boosting their education and professional credentials. As they had done in the 1950s, they continued in large part to address this on a collective basis – to improve the status of data processing as a profession, and standing of data processing departments in general, rather than leave their fellows behind. In addition, they strived to shape and strengthen a unified identity

[679] Ibid.

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of data processing across the different specialties (programming, operations, analysis and supervision), the various industries and the ever growing number of computer installations.

I focus therefore on the collective aspects of the process, and in particular on the efforts of the Data Processing Management Association (DPMA) to improve the professional standing of data processing, while assisting its existing membership of punched card supervisors to adjust themselves to the new technologies of electronic data processing. My aim here is not to give a comprehensive history of the DPMA, but rather to use the association's records to reconstruct exactly what data processing meant during this era, and to probe the private thinking of its leaders. The DPMA archives prove an exceptionally rich resource in this respect – for the years 1960-1972 they include a full transcript of almost every meeting of the association's Executive Committee (often reaching five hundred pages in length for each of its three annual meetings) and a wealth of reports and memos. In addition, the DPMA commanded the loyalties of far more senior data processing staff that any other organization, and was the most active of any of the societies discussed in this dissertation in its attempts to educate, certify and professionalize its membership.

During the 1960s, the DPMA's national activities included textbooks, films, a Boy Scout badge, courses for high school students, training seminars on new technologies and managerial techniques, presentations aimed at executives, a journal, and two annual conferences with published proceedings and trade exhibitions. Its most ambitious project, by far, was a certification scheme modeled on the Certified Public Accountant qualification called the Certificate in Data Processing. This was to have required a specialist college degree, several years practical experience and the passing of a special examination to prove knowledge of all the main areas of data processing. The story of certification begun in this chapter is concluded in a later section. Examining the successes and failures of these programs, and particularly the failure of the certification program to establish a true profession, tells us a great deal about the contradictions

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inherent in the role of managerial technician and the enduring paradoxes surrounding the application of machinery to management.

### "Ride the Fad into the Land of the Walnut Desk"

The machine accountants (or, as they increasingly called themselves, data processors) were by no means the only group attempting to harness the power of the computer. At the opening of the 1960s, the computer loomed large in the collective imaginations of a multitude of specialist corporate groups. The computer was a source of power, visibility, managerial status, job security and budgetary growth for the corporate occupations and departments with which it was associated. As such it formed a prize to be fought over vigorously. Because computer technology was poorly understood, highly flexible, and rapidly changing the different groups involved made their case primarily by defining the computer as a tool best suited to realize their existing aspirations. This process was well understood at the time. Speaking with a studied informality, systems man Roger W. Christian explained to an audience of novices at the 1961 meeting of the Systems and Procedures Association that, "the computer enjoys such prestige [that] the financial staff, the card sharks [punched card supervisors], the I.E.'s [industrial engineers] the S and P boys [systems men], and now even the office manager, are scrambling to ride this new fad into the Land of the Walnut Desk." Christian was critical of this profusion of feuding specialists, arguing that, "[c]ompany welfare has to take a back seat to 'professional' stature." Of course, he felt that this problem was best dealt with under the hegemony of his own tribe: the systems men.[680]

Nowhere can this marking of territory be seen more clearly than in the January 1960 issue of The Office. 1960 was not just the beginning of the new decade, but also marked the

[680] Christian, "The Total Systems Concept".

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twenty-fifty anniversary of publication for the magazine. To celebrate these happy events, the editors put together a special issue in which the presidents of more than 30 professional and trade associations tied to office administration supplied short articles dealing with their own views of the challenges and opportunities ahead. Contributors included the best known associations for administrative specialists, such as the NMAA, National Office Management Association (NOMA), the Office Management Division of the American Management Association (AMA), and the Systems and Procedures Association (SPA). The authors also included industry oriented groups such as the Association of American Railroads, the Life Office Management Association and the National Association of Hospital Purchasing Agents. Financially oriented associations such as the National Association of Accountants, the Municipal Finance Officers Association and the Association of Internal Auditors jostled for position with the office equipment groups such as the Office Appliance & Business Equipment Trades Association of Great Britain, and other managerial specialties like the American Society for Personnel Association. Even the more obscure professional groups were represented, such as the Association of Records Executives and Administrators, the Association of Consulting Management Engineers (a consortium of management consultants) and Leslie Matthies' Foundation for Administrative Research.[681]

The mere existence of this panoply of associations, let alone their presence in the single issue of a magazine, might be expected to present the historian with an embarrassment of riches; if not to drown all hope of a coherent and manageable story beneath a cacophony of diverging voices and concerns. Judged, however, from their submissions to the magazine the officers of these various groups were concerned with one question above all others as they pondered the decade to come: the computer. One need do no more than to read the titles they chose for their

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[681] Notable by their absence were the associations most commonly associated with the computer by historians: the Association for Computing Machinery and the computer groups of the IRE and the AIEE.

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articles to come away with a good idea of where most stood. The industry groups were keen to claim familiarity with the new technology. Hence "Life Insurance Companies Have Long Used Computers" and the ponderous but unequivocal "Railroads Have Personnel Who Understand Computers." The accounting and finance groups wanted to make it clear that they were the rightful masters of computer technology. Hence "Importance of CPA Will Increase in the Electronic Age," "The Internal Auditor Must Maintain Controls in EDP," and the no-nonsense "Finance Officers Should Direct ADP Installations." On the other hand, office equipment vendors aimed to make sure that the new machines were seen as an extension of their existing product lines. Hence "Changes are Evolutionary, Not Revolutionary" and "The Computer Is Just One of Many Managerial Tools." In a similar metaphor, the National Microfilm Association asked "Why Leave This World to Search for Space" when it predictably bucked the trend to promote microfilm, rather than electronics, as the key to office automation.

By 1960 the electronic computer and the future were essentially synonymous in the minds of the leadership of a wide range of professional, occupational, trade, and industry associations. The manifest destiny of corporate administration lay somewhere over the horizon and into the new frontier of high technology, whether it was called EDP, ADP, Office Automation or simply "computer operations." In the never-ending games the associations played for respect, members and corporate authority, the stakes represented by the computer could not have been higher.

## "Three Parts Office Manager to One Part Mr. Einstein": Office Management in the Electronic Era

The office managers were the largest, and longest established, body of managerial technicians during the 1950s. Despite this apparently sturdy base, their bid for domination of administrative computing quickly collapsed during the early 1960s. Remarkably little changed in

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the literature of office management from the 1930s to the 1950s – the field appeared intellectually ossified. Its dominant concern remained the measurement of clerical work output, and methods by which it could be improved. Discussions of job analysis, employee testing and work simplification were perpetual interests since the days of Leffingwell, suggesting both a lack of professional development and that these techniques remained far from ubiquitous in practice. The main development was that at least some of this discussion had shifted away from an emphasis on piecework and incentive pay as a means of driving individual workers to increase output. Instead, many specialists discussed the use of sampling techniques and the monitoring of overall output from particular work groups. This reflected the somewhat more psychologically oriented Human Relations approach to industrial relations which gained ground during the 1940s and 50s.[682]

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[682] For discussion of office management in the immediate post-World War Two years, see Hedstrom, "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970", 121-28&45-53. The clearest illustration of the continuing fixation of office management on issues of clerical output, testing, and work simplification comes from examining the articles indexed under the heading of "Office Management" in the Industrial Arts Index and its successor the Business Periodicals Index. In 1950, for example, fifteen articles are listed. Four of these promise in their titles to simplify work or "prune motion." Another five promised to "cut costs," "increase office efficiency" or productivity. One promised to save space. Leffingwell himself (then dead for some time) was listed as the primary author of one paper. The only departure from the classic office management issues came in one article called "Selling office procedures to employees." See Anonymous, Industrial Arts Index, Vol. 38 (New York: H W Wilson Co., 1950), 1177-778. Similar patterns were maintained in later volumes through the 1950s and into the early 1960s.

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**Figure 37: National Office Management Association logo, as used in 1940.**

In part because of its enduring association with improving the output of clerical work, office management remained strongly associated with office machines. Office management periodicals continued to feature advertisements for furniture, files, office supplies and mechanical bookkeeping machines. As interest in the use of "electronics" in the office built during the first half of the 1950s, some office managers were keen to explore the potential of the new technology to automate their office routines and improve their own standing. "Office Managers: They Move Sideways into the Electronic Era," the heading of a 1954 article in Dun's Review and Modern Industry, nicely captures this mix of technological anticipation and professional stagnation. The article was based on discussions with office managers and systems experts. Its main findings were summarized as follows: "They have little top-executive interest or support. Their methods and standards are far from being scientific or comprehensive. They aren't happy with their equipment or the way it was sold to them." At least some of those interviewed for the article believed that electronics might finally lead to the long-awaited upgrading of the office manager, and the emergence of a truly scientific profession. One remarked that, "[w]e're just beginning to talk about office engineers now, and up to this point that's been a fancy title some character took

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on because it sounded scientific." Again the magazine's headline writer seemed to say it best: the electronic office would demand a figure "three parts office manager, one part Mr. Einstein."[683]

In a companion article, suppliers of office equipment spoke anonymously about the problems they faced in selling their machinery. One complained that the worth of office managers was gauged by the size of their staff, and so "He isn't too interested in cutting down what people he's going to supervise, because in that respect he makes himself less valuable." They complained that the low status and limited ability of office managers made them poor customers because they lacked the ability to persuade their own companies of the need for change or the possibility of real savings. The job fell to those with seniority, and held little appeal for ambitious young college graduates. "He... is not his own boss," said one office equipment representative of the office manager. "He has to consult with about everyone who uses his equipment, and his decisions fall into a small area--the area that is left after everyone else exercises his. I think he is basically a personnel man who has to meet a production schedule. He is certainly not a manager in the usual sense of that word..."[684]

NOMA began the new decade optimistically. In 1960 its president, Walter Emmerling, Manager of General Office Services for Procter and Gamble, summarized the history of the association and laid out its plans for the future. His hopes were high, if rather vague. "1960's office executives," he boasted, "will study the progress of such current developments as the steel negotiation, the trade discussions with the Soviet bloc, the effect of possible political 'peace' on our economy, the place of smaller business in our economic order and abstracts such as job creation.... [O]ffice executives will be discussing, with reasonable fluency, such precepts as

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[683] Anonymous, "Office Managers: They Move Sideways into the Electronic Era", Dun's Review and Modern Industry 64, no. 2317 (September 1954):82-97.

[684] Anonymous, "The Office Equipment Industry: They Sell Answers to Problems that Executives Don't Know Exist", 103-05.

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management science and sociology, psychoanalytic processes, long-range managerial planning and operations research." Like Leffingwell, forty years earlier, he discerned "signs of an emerging professional status" and "consequent reappraisal of the work of the office executive by those who constitute top management." He invited his readers to join NOMA and this "crusade for professionalization of the office executive."[685]

As the 1960s progressed, NOMA played an ever more peripheral role within the data processing community. In 1960 the association boasted 177 chapters and more than 17,000 members – up from a few hundred members in the mid-1930s. It remained larger than the NMAA, and much larger than the ACM or SPA. But the rise of more managerially and technically focused associations left NOMA unable to command the loyalties of systems and data processing personnel. Even its existing members seem to have weakened their ties as they became more heavily involved with the computer. Recognizing, as Leffingwell had done by the early 1930s, that the term "office management" was no longer compatible with executive aspirations, NOMA changed its name in 1964 to the Administrative Management Society. This new group endured into the 1980s, but was best known for its surveys of clerical pay rather than the executive credentials of its membership, and its claim to leadership in the field of corporate computing withered rapidly. Like the first generation of office management reformers, it found its niche in the low-level supervision of clerical personnel rather than the higher status world of corporate systems. Anyone called an office manager during the final decades of the twentieth century was probably a direct supervisor of clerical employees, probably a woman, and probably not very well paid.[686]

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[685] Walter Emmerling, "Milestones on Our Road to Professional Status", The Office 51, no. 1 (1960):90-92.

[686] For office management today, see Bureau of Labor Statistics, "Office and Administrative Support Worker Supervisors and Managers", in Occupational Outlook Handbook (Washington, DC: 2002).

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Harry L. Wylie, a leading figure in the renamed society and the author of a 1930s textbook on office management, discussed this development in a 1965 article aptly entitled, "The Office Manager in a 'Systems' World." While conceding that office managers had lost their once exclusive control over systems and procedures analysis to the systems men, he argued that their remaining strength was in their rapport with employees. The analyst, he suggested, had greater analytical rigor, but without the office manager's more human insights the benefits of work simplification were unlikely to translate into lasting improvements in productivity. "The office manager," he wrote, "never underestimates the employees' capacity to understand and contribute." This represents an undeniable departure from the deskilling and routinization of work associated with Taylor and Leffingwell, though not a radical or surprising one. It was the culmination of an increased focus on more cooperative attitudes to personnel management within the office management community from the 1920s onward, and reflected the now-dominant "Human Relations Movement" within management theory, with its concern with the psychological well being of workers as a tool of productivity enhancement.[687]

Rapidly emerging status differences between electronic data processing and office work undoubtedly played a part in this gradual loss of involvement. So did the growing strength of more specialist societies. But the most important factor was probably the physical and cultural separation of the computer center, and its personnel, from the traditional office. The term office automation enjoyed a brief vogue during the early 1950s. In 1953, before a single computer in the US was routinely processing administrative tasks, Remington Rand's Vice President of Sales penned an article called "Advances in Office Automation." He promised that, "In view of what has been accomplished in the plant through scientific management, we can assume the same benefits can be brought to the office." By intelligent mechanization to provide management with

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[687] Harry L Wylie, "The Office Manager in a "Systems" World", Systems & Procedures Journal 16, no. 5 (September-October 1965):40-45.

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computer-generated records and reports, office automation would roll back the growth in the number of clerical workers.[688]

As computers became a corporate reality, rather than an object of speculation, they were increasingly separated from more traditional forms of office equipment (except, of course, mechanical punched card machines). Both "electronics for the office" and "office automation" were mentioned much less frequently during the 1960s than the 1950s. Despite its strong early showing, office automation had fallen from favor by the early 1960s and scarcely a peep was heard about it until the end of the 1970s. One reason for this was its registration as a trademark by R. Hunt Brown and his small consulting firm Automation Consultants, founded in 1953. Brown was a former engineer and communications consultant with Ernst & Ernst. He saw office automation as the broadest term for the application of machinery to administrative processes, making EDP, IDP and office electronics more restrictive categories.[689]

Other companies may have been deterred from promoting office automation by Brown's trademark, but its fall from favor probably reflects something more fundamental. By the early 1960s, the use of the computer to automate existing clerical jobs had come under fire, as had the idea that it could pay for itself by reducing the number of clerical workers employed. The computer was expected to support managerial decision making and improve the efficiency of corporate operations. In the climate of the early 1960s, the "office" part of office automation sounded too low-level and clerical, while the "automation" part sounded dated and too concerned with means rather than ends.

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[688] Seares, "Advancements in Office Automation".

[689] His main accomplishment appears to have been the issuing of a series of comprehensive and frequently updated loose-leaf guides to data processing technology, its concepts, and its applications. The guides themselves outlived both Brown's company and the early appeal of office automation, and were absorbed into the leading trade publication Business Automation by the 1970s.

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While the computers of the 1950s and 1960s certainly performed a lot of administrative work they were rarely referred to as office equipment. The data processing center or computer room was a very distinct place, physically and culturally, from the office itself. Its banks of electronic machinery, air conditioning, dust-free cleanness, raised floors, hanging ceilings and glass observation panels set it aside from the less formal, and more familiar, rows of files, typewriters and desks of the typical office. While by the 1950s the corporate clerical office was an overwhelmingly female place, the computer room proper was overwhelmingly male. The work of data processing specialists was technical, mysterious, increasingly well paid and futuristic. The work of clerks was mundane, increasingly badly paid compared to skilled manual occupations, and usually failed to provide a chance of real promotion.

Thus the computer existed outside the office itself. When the computer automated a clerical task it moved it away from the office. Inside the office, most remaining clerical work continued much as before. No clerical worker of this era would ever control a computer directly. Even programmers did not directly operate the computer. Teams of specialist operators maintained the machine, configured it for each job, fed punched cards and tapes into its accoutrements, and returned bearing printouts and new files. This further distanced the computer from most office staff, as even the input data or query requests they entered on forms was punched onto cards by a specialist key-punch operators. These last were, of course, women – though they were more likely to be placed in an annex or down the corridor somewhere than in the main computer room.

These keypunch operators played a crucial role in tying the work of the data processing department into the procedures of the office – a role that persisted almost unchanged through the 1960s and much of the 1970s. Despite high initial hopes, optical character recognition technology found very few users during this period. Technical ingenuity was lavished on alternatives, such portable punched cards with pre-perforated chads for use by salesmen to log the results of their

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calls from the field, or cash registers that encoded sales as holes punched in paper tape. Despite the enduring search for such methods of "source data entry," most clerical data had to be reentered before the computer could process it. By the early 1970s traditional keypunch machines were increasingly replaced by buffered keypunch machines (able to punch one card from a tiny internal memory while the next was typed), key-to-tape machines which wrote keystrokes directly to magnetic tape, and sometimes even by key-to-disk machines where a single disk drive and associated microprocessor stored and validated input from several keyboards. These new technologies let keypunch operators work faster, but did not change the essential character of the job.[690]

Had office automation remained in the office, office managers might have had a chance to claim the computer for their own. But because automated work moved out of the office, and into the data processing center, it was the punched card staff who were best placed to define the new culture and institutions of electronic data processing. Data processing had, in the end, relatively little to do with the office managers who remained behind in the stubbornly manual office of the 1960s. Only the keypunch women remained to bridge the electronic and masculine world of the computer center with the feminized and low technology world of the office proper. To understand the development of administrative computing during the 1960s we must therefore return to the craft of the tab men, as they strived during the late 1950s and early 1960s to lift themselves by tying their bootstraps to the computer.

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[690] Data entry methods are discussed in Raymond Ferrara and Richard L. Nolan, "New Look At Computer Data Entry", Journal of Systems Management 24, no. 2 (1973):24-33 and Stankey Greenblatt, "Delete Delays and Dollars with Direct Data Entry", Infosystems 19, no. 9 (September 1972):20-25. In 1970, an estimated 1,000 optical input machines were handling just 2.5 percent of America's data input volume. Albert L.C. Chu, "Data Entry", Business Automation 18, no. 9 (July 1971):18-22, 26-27 Most of the rest remained on the keypunch.

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**Machine Accounting to Data Processing**

In 1962, the National Machine Accountants Association became the Data Processing Management Association. As we have seen, the most professionally minded punched card staff of the 1950s were keen to "better themselves". This involved a series of transitions: from technician to professional, from supervisor to manager, from machine orientation to system orientation, and from punched card to computer. These transitions were neither quick nor painless, and so the association's shift from machine accounting to data processing was not an easy one.

Machine accounting had soon begun to appear too constraining a title for the association's more ambitious members. By the mid-1950s, just a few years after its founding, many had begun to refer to themselves as data processors. As computers arrived, many companies created data processing departments responsible for both kinds of machinery. The NMAA itself moved less quickly. As early as 1956 the NMAA's Executive Committee appointed a special committee "to consider the possibility of a change in the name of the Association."[691] In 1958 the first attempt to change the name of the association to the "Association of Data Processing and Management" was defeated by the Executive Committee itself.[692] But on its next meeting the committee approved "Data Processing Management Association" as a new name and sent it to the NMAA Board of Directors for approval.[693] The proposal was rejected by the board which was, as you will recall, more of a legislative chamber (and, indeed, one full of men viewed

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[691] National Machine Accountants Association, Executive Committee Minutes, 27-29 June, 1956, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[692] National Machine Accountants Association, Executive Committee Minutes, 5-6 Dec., 1958, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[693] National Machine Accountants Association, Executive Committee Minutes, 18-20 Feb., 1959, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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by the executive committee as grandstanding rabble rousers) than the small and clubby group of grandees one might expect from its title.

Resistance to the Data Processing tag was in part an attempt by more traditionally oriented punched card staff to maintain their relevance. But the main reason the change took so long was not a groundswell of support for the machine accounting name but a lack of consensus for any alternative. As Elmer Judge, an early president, remarked "[Machine Accounting] was never an overwhelming name at any time and never was a good name for the things we do."[694] Again and again, plans to change the name foundered on lack of enthusiasm for alternatives such as International Data Processing Systems Association, and Data Processing Management Association. The eventual selection of the latter was based on logic such as, "I am in favor of a name change and this is the best one that has come along."[695]

The association's logo also proved contentious. In 1959 it accepted a new emblem depicting a set of tape reels and a punched card. The emblem symbolized the coexistence of traditional punched card work with the new technologies of electronic data processing. But critics, including Dick Irwin, then the association's Executive Secretary, faulted its unfortunate resemblance to a stylized "death's head" and complained that even this attempt at a more modern image emphasized the "importance of the machine rather than the man behind the machine – our member." Irwin noted that the association's attempts to tie its image more closely to the computer promised to raise its status through association with the romance and modernity of EDP, it also risked undermining its hopes of being seen as an association of accountants or managerial specialists. At least its current name contained the word "accountants." He observed that both

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[694] National Machine Accountants Association, Executive Committee Meeting Minutes, 20th June – Verbatim, 1960, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[695] National Machine Accountants Association, Executive Committee Meeting Minutes, 17 February, 1960, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 3.

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tape reels and punched cards were both liable to be outmoded "within the next eight to ten years." Irwin also noted that much opposition to the new logo came from its association in the mind of the membership with the recently defeated attempt to change the association's name.[696]

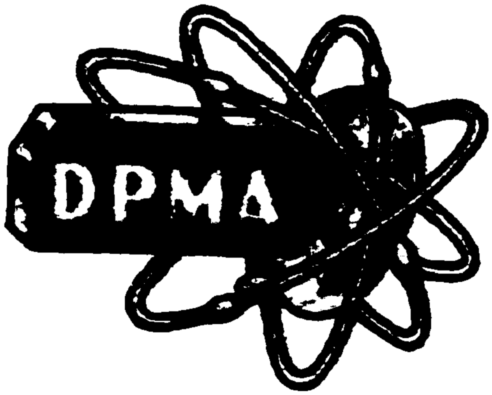


**Figure 38: DPMA logo used in early 1960s, symbolizing the union of computer tape and punched card.**

Irwin left the association shortly afterwards. His career, which had already taken him from work as an IBM time-clock repairman to the inner circles of the NMAA, was soon to lead him to the position of executive director of the SPA. While the minutes do not record the cause of his departure, they do mention his "problems" with the association, and it seems likely that these included the eagerness of its leaders to redefine it as a data processing group. By the time the NMAA finally became the DPMA in 1962 it had a new and increasingly powerful executive director, R. Calvin Elliot. Elliot had privately opposed the choice of name, but once the change was made he lost little time in using it as an opportunity to re-launch the association. According to an article he placed in Datamation, "the NMAA was no longer merely an organization of Tab Supervisors. A new professional data processor was being created.... requiring strong technical

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[696] National Machine Accountants Association, Executive Committee Minutes, 18-19 Sept., 1959, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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know-how as well as managerial abilities." In practice the status of its members rose more slowly: they remained supervisors rather than managers and few had college degrees. [697]

## Building a Profession Through Education

Despite its new name, the DPMA remained an association of punched card machine supervisors, many of whom were becoming computer supervisors. But despite, or perhaps because, of the low status of its membership and the weakness of its claims to be seen as a truly professional or managerial association, the DPMA (and the NMAA before it) paid more attention to the education and what it sometimes called the "upgrading" of its rank-and-file members than did any other computer-related society of the era. Education and certification programs were a primary concern of its national leadership and headquarters staff from the mid-1950s onward, though action was usually slow, and neither the financial resources nor the skills were in place to turn most of their hopes into realities. (The lifeblood of the association remained in its numerous and vibrant chapters, where members organized their own events, swapped technical information and built personal and professional relationships).

Since their inception, local NMAA chapters had been involved in exhorting their members to better themselves. Some had set up special arrangements for courses to be taught at local universities. During the last few years of the 1950s and the early years of the 1960s the national association became increasingly involved in the sponsorship and coordination of these efforts. Its education agenda, pursued as part of this broader drive for professionalism, led it slowly but surely to the creation and administration of the Certificate in Data Processing (CDP), offered for the first time in 1962. The certificate represented the association's boldest attempt to

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[697] A verbatim transcript of the meeting at which the name was changed is National Machine Accountants Association, Board of Directors Meeting, 19 June, 1962, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 35-49. The quote comes from an article published shortly after the shift - Elliott, "DPMA: Its Function & Future".

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assert its control over the data processing field as a whole. It was intended to foster professional standards for supervisors and would-be supervisors, coax its membership toward improving its education, and broadening its horizons, and promote the NMAA as a vital force in the new field of EDP.

The attainment of professional status was not something that anyone argued against. Yet it was not altogether clear what professionalism should mean in practice. In the 1950s, two professions served as paradigm cases: doctors and lawyers. Both academics studying professionalism and members of other occupations seeking to be more professional looked to these professions and tried to distill from them an essential set of professional features. The primary responsibility of a professional, they discovered, was to society: he or she was bound by an ethical code privileging the general good over personal interest or profit. In a kind of social charter, government enforced this monopoly and delegated jurisdiction over the activities of the profession to a strong professional society. Professionals were thus self-policing – their professional societies were the sole judges of what professional standards were and who met them. The work of a professional could only be evaluated by another member of the same profession. Professionals required extensive education and were required to pass comprehensive and difficult examinations. Unlike mere employees, professionals worked autonomously in small practices run by other professionals. They had clients, not bosses. Professionals were well paid and enjoyed high social status.[698]

Though somewhat lower in public estimation, the comparatively newly arrived profession of accounting was also very important as a model to the punched card staff. Their selection of "machine accountant" as the name of their association and their preferred term for

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[698] Many academics of the era believed that the qualities of a profession could be itemized, and used to demarcate real professions from occupations with affectations. For a strict, and influential, discussion of this see H L Wilensky, "The Professionalization of Everyone?" American Journal of Sociology 70, no. 2 (September 1964):137-58.

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their occupation reflects this. Given the organizational location of punched card departments within the firm's accounting operations, accountants were the only established professional group that most of them ever worked with. Accounting had attained professional status within living memory, adding to its value as a model. By the 1910s accountants had achieved considerable success in the promotion of model CPA licensing legislation passed on a state-by-state basis. In practice accounting was tied more strongly to the interests of business than to the public good, and an increasing number of certified accountants worked for corporations rather than auditing firms, and provided advice rather than audits. Yet accountants built their professional identity as certified public accountants around the role of auditing – an activity that supported claims to professional autonomy and to be fulfilling a vital social function.[699]

Despite the influence of accounting, law and medicine retained their paradigmatic status in discussion of professionalism among data processors. Confused and historically inaccurate accounts of how and why doctors had attained their special position surfaced frequently in these debates. And within the corporate hierarchy, senior managers appeared remote and powerful to the machine accountants. Surely, they thought, these men must be professionals. So whenever members of the NMAA or DPMA discussed the nature of professionalism and steps that might be taken to realize it, characteristics of accounting, management and medicine tended to get mixed up.

The most fundamental problem was that nobody really knew what a machine accountant or data processor was, still less what a professional specimen might look like. Though they recognized the need for a code of ethics, it was far from obvious what it should say. They were equally sure that data processing had a vital role to play in the service of the public interest, though few suggested that this might ever conflict with their own interests or those of their

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[699] Miranti, Accountancy Comes of Age: The Development of an American Profession, 1886-1940.

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corporate masters. These were the uncontroversial and entirely ceremonial aspects of professionalism. Other aspects, however, proved harder to deal with. The questions of certification and licensing were a chronic source of disagreement. On the one hand, many within the association recognized that professions all involved some kind of certification and specialist education. Yet few in the membership were willing to support a certificate which might act against their own personal interests. The same argument applied with still greater force to the idea of mandatory and state enforced licensing of data processors or data processing managers. Most associated this with unions and closed shop agreements. Yet, despite these disagreements, by the time the NMAA became the DPMA education and certification were closely linked in the minds of its leaders.

Discussion of certification sprang out of early attempts to improve the education of the membership and to award tangible recognition to members who had worked toward this. Its first brush with certification came early in its history. In 1954, Education Committee chairman Gene Murphy designed a certificate, sent a questionnaire to chapters and began plans for a textbook. His idea was to provide three levels of recognition, which in ascending order of professional merit were "tabulating machine operator," "tabulating machine supervisor," and "certified machine accountant." Many of the association's local chapters had requested certificates of some kind and wished to issue them to their members. Dick Irwin had authorized the printing of these certificates, only to find himself "chastised very thoroughly" and overruled by the executive committee. Another member appeared to speak for the committee as a whole when he said that, "I do not think we are ready to go into certified machine accounting probably at this time. I don't think we are old enough.... there are too many factors involved as to who should get the certificate, what the qualifications should be, what the people must have in common, not just that

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they use tabulating. It is a big subject and it is important. If we take it too soon, the certificate may mean nothing."[700]

Irwin defended his role in authorizing the printing of the certificates and argued that their intent had been misunderstood. He saw them not as part of a plan to create a certified machine accountant but "purely a token gift to people who complete any type of course in machine accounting.... It would make them feel a little bit a part of our association." These certificates could be issued in bulk to instructors, to distribute to their students at their own discretion. "We review the course," said Irwin, "and if we think the course is a good course, give him the certificates and let him hand them out."[701] But, countered Perrin, another committee member, "the word certificate does really imply in business something pretty strong." Perrin's implicit association of certificate was with certified, as in Certified Public Accountant and other sets of letters to be found on business cards and brass name plates. Irwin, however, thought primarily of the certificate itself – a pleasant and inexpensive thing to hang on the wall (he may have had in mind something like the certificate given to someone who had successfully completed an elementary first-aid course or other short vocational program).[702]

The certificate plan contained its own problems. While Irwin felt that the association could not stipulate what should be taught, but would essentially know a good course when it saw one, Perrin held that, "We have to have certain things that are required." Should a certain amount of practical "laboratory" time with the machines, or conversely a certain amount of accounting theory be required? While they felt the need for the involvement of a professional educator, they were unable to name a single one who might prove suitable. The one man suggested was disparaged by others as a tab operator who merely happened to teach a course at night. They

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[700] National Machine Accountants Association, Executive Committee Meeting Minutes, 15 June -- Verbatim, 1954, contained in Data Processing Management Association Records, Minneapolis, 190.
[701] ibid, 199-200.
[702] ibid, 197.

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resolved to survey colleges to determine what courses were being taught and how large student numbers were. They were also keen to safeguard the NMAA name and logo for uses approved by the national association in general, and the executive committee in particular. While rejecting Murphy's plans for the certification of machine accountants, they passed a resolution authorizing the Executive Secretary to issue certificates for distribution by the instructors of college courses that had been approved by the education committee and the executive committee of the national association. This kept the certificates out of the hands of chapters, but began to involve the highest levels of the national association in the definition of what did and did not belong in the education of a machine accountant.[703]

The issue of certification emerged as part of the broader question of the relationship of the association with college education. Crouch, the association's president, favored the idea of closer involvement with schools and felt that, "The textbook for my money is a very important thing. There has never been a good textbook." Like the other members of the committee, though, he was offended that Murphy had proposed his own textbook plan to McGraw-Hill and sought ten thousand dollars and the endorsement of the NMAA to promote it. They agreed that while the NMAA should produce its own textbook, Murphy should be allowed no part in the activity. They also wondered what format might be appropriate – suggesting that the rapid advances in punched card technology meant that anything other than a loose-leaf binder might be obsolete before it could be finished. A concern that they were likely, "to put $10,000 in something that is going to be obsolete," underlines the extent to which they were not confident that they possessed a core of more abstract knowledge likely to stay relevant for many years. Indeed, the textbook project collapsed in the end. The association did not succeed in producing a textbook until 1966.[704]

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[703] ibid, 216.
[704] ibid, 204-212.

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Despite interest in other schemes, such as the textbook idea, the national association's main direct involvement with professional education during the 1950s was through its distribution of these "certificates of completion." In 1958, the executive committee resolved to assign a vice president to develop a program of tighter controls on their issuance. By 1960, increasing demand for the certificates forced the committee to take a hard look at the program. Its members had to decide whether to issue certificates for courses taught by private technical schools, which raised the broader question of how to certify these schools. When the committee refused to give certificates for a course offered by the Automation Institute in Rochester, it "got a howl back that you could have heard across the country." Local chapters felt this refusal to certify private courses as a kind of arbitrary discrimination. The Seattle and Vancouver chapters were reported to be giving away their own certificates, in defiance of national guidelines. Meanwhile pressure was mounting from business colleges to "get back to [our] original ideas on levels of certification." The certificates of completion had become unworkable, and on the recommendation of James Hunt, by then national Vice President for Education, the association discontinued them.[705]

## A New Certificate Is Born

By the time it eliminated the certificates of completion, the national association was already at work on a more rigorously defined and broader replacement, perhaps following its 1958 decision to explore alternatives. The effort to conceptualize, develop and test the new professional qualification in data processing lasted from its approval by the executive committee

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[705] National Machine Accountants Association, Education Committee Meeting Minutes, 26 June, 1961, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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in 1959 to its public launch in 1962. It was eventually to be known as the CDP, or Certificate in Data Processing – though the name was actually one of the last things about it to be fixed.

An "implementation meeting" in January 1960 brought the leaders of the DPMA together with a number of prominent people in the field (including past-presidents of the ACM and SPA) to discuss the shape of the new program.[706] When work began in earnest during March 1960, the new program was seen primarily as a way to provide a more formal set of educational requirements. These were to include both an overall curriculum and rules on the content of required courses. The association engaged George S. Conomikes, formerly of the University of Chicago, and then part of a private firm called Management Development Associates, to get the ball rolling. In June 1960 Conomikes reported that it would include education requirements, experience requirements and some form of testing. The applicant would also have to present evidence of "good moral character" in a review by the local chapter. The content and form of each of these was unclear.[707]

The influence of the accounting CPA qualification on the embryonic certification program was unmistakable. But given the much less advanced state of data processing education, the requirements for college courses posed a particular problem for any attempt to mirror accounting education. By August 1960 Conomikes had already realized that, "it will be almost impossible except in about five communities in the United States, for a man to get all the courses we are laying out as the data processing courses within our certificate." As a result, the association also committed itself to the production of self-study guides and course materials on the assumption that its members might not have access to suitable commercial or academic

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[706] Anderson, "The Data Processing Management Association", 116-17.
[707] National Machine Accountants Association, Executive Committee Meeting Minutes, 20th June – Verbatim.

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instruction. Still more importantly, because no specific courses could be stipulated, the association would be forced to devise its own testing program to cover all the required areas of knowledge. Administering the test nationwide was also a formidable and potentially expensive challenge. While this was what the DPMA finished up doing, it is important to realize that the certificate was originally intended more as an academic accreditation program than as a self contained examination.[708]

The new certificate was conceived as a rigorous, valuable qualification. It was supposed to skim the cream of data processing personnel, set high standards for ambitious staff to strive toward and raise the profile of the association among the consultants, systems men and other relatively high status individuals drawn into data processing by the spread of the computer. But any attempt to establish such a demanding professional qualification posed enormous political and practical problems for the association. One problem was the low education level and conservative nature of its existing punched card membership base. Conomikes suggested that, "the certificate will probably be attainable by about 10 to 15 percent of our members." He believed it would provide a direction that the more ambitious members would follow. But he did not think it realistic to make it a requirement for membership in the association, admitting that, "we have different sets of members wanting different things." He was also adamant it would not be a job requirement (or "union card") for employment in data processing, saying "this is a certificate of knowledge only."[709]

Yet even a voluntary certificate would prove hard to justify if, as Conomikes had suggested, 85 percent of the membership could never hope to attain it. How could the certificate help the progress of those qualified, by virtue of academic background, to receive it without

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[708] National Machine Accountants Association, Executive Committee Meeting Minutes, 5-6 August -- Verbatim, 1960, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.
[709] ibid, 109-111.

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simultaneously hurting the craft-oriented, uneducated men who made up the bulk of the NMAA? The most enthusiastic supporters of certification were happy to place the interests of the future profession over the interests of the current membership. As former NMAA president Elmer Judge observed, the goal of the certificate program, "is to raise the knowledge and prestige of the members of the profession. The main way we can promote the certificate is by more education for the people who are coming into the profession."[710] Conomikes himself admitted that, "[i]t is the same thing as when they put the rabbit in front of the racing dogs -- they feel it is unattainable... it has very threatening implications for people.... It means those who do not have it might be discriminated against at some future time."[711]

As another committee member put it, "The objections I heard voiced appeared to me to come from people who felt academically they could not pass and might have a reflection on their own job. Here we have a man who started out as a machine operator and progressed and becomes the floor supervisor and now manager, and he doesn't have the academic background and the result is that he may not get the certificate and that this in turn may reflect on his particular job." Conomikes acknowledged that rank and file membership in chapters had given "a lot of criticisms, to be frank about it," but that from his viewpoint, "the criticism... seems to imply, give me the certificate but make it tough on everybody else...." He reported with disdain that the members had asked him, "Why not a man that has been in the field for 20 years, who knows more than somebody else, why not just give him the certificate?"[712] Charles H. Johnson, another long-serving member of the association's executive committee, went so far as to suggest that members should get what was good for them rather than what they wanted. "Regardless of what the

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[710] National Machine Accountants Association, Executive Committee Meeting Minutes 1-2, Dec -- Verbatim, 1961, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 53.

[711] First quote is ibid, 171. Conomikes is ibid, 173-4.

[712] National Machine Accountants Association, "Executive Committee Meeting Minutes, 15 June -- Verbatim," 1954, Data Processing Management Association Records, Minneapolis.

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majority views, our by-laws state that we are trying to pull them up by their own boot straps. We are committed to it." This view was supported by Andrews, another long-time supporter of professionalism, who argued "They want professional recognition, a professional status, and they have to meet these requirements if they are going to get this recognition." [713]

The other qualifications for certification also raised difficult questions. The "moral qualifications" were not unduly onerous – the applicant merely had to send three references testifying that he or she was "of professional caliber." But as 1962 rolled around and the committee was forced to confront the issue, it became apparent that none of them could actually define what would qualify as three years data processing experience. This required them to confront for the first time a fundamental issue: what was and was not data processing? Was it necessary, when inspecting the jobs of prospective applicants, to adopt what one committee member called "the purest attitude… that it has to be a data processing installation"? Could someone employed by IBM, or by a consulting firm, qualify? Still more importantly, did a systems analyst qualify? Some felt that to loosen the definition would be to effectively abolish the requirement. But Alfonso S. Pia, the association's president, said that he had been unable to interest the analysts who worked for him in joining the NMAA, because "the local chapter has nothing at this point in can offer these people." He thought these men to be of higher quality than the NMAA members who currently worked for him, and so welcomed the prospect of enticing them into the association. Thus Pia implicitly favored a definition of data processing much wider than the previous scope of machine accounting.[714]

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[713] National Machine Accountants Association, Executive Committee Meeting Minutes, 5-6 August -- Verbatim, 168-70.

[714] National Machine Accountants Association, Executive Committee Meeting Minutes, 21 Feb -- Verbatim, 1962, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 60-62.

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Not all of the committee members were eager to dismiss the interests of the association's current members. At the 1960 meeting where the program was seriously discussed for the first time by the executive, one observed that, "It seems to me that we stop stuffing down the throats of the members things they do not wish… I think we are heading for trouble… we should be doing what our members wish us to."[715] As work on the new certificate continued, these tensions became still harder to ignore. In December 1961, after consulting with members of the association, Pia reported them to be extremely hostile to the idea of testing. "I was amazed," he said, "at how strongly they felt about this thing. They thought it should go from letting them buy a certificate, to letting members of the association get by with 50 percent of the score."[716] Pia himself was to torn between his hopes for a broad, challenging qualification attractive to ambitious analysts and his responsibilities to the membership. He suggested that, given the membership were the ones paying to develop the test, it might be wise to follow this suggestion and pass them with a lower score.[717] Elmer Judge argued that the test should be kept short because "anyone who has been out of school five to ten years would be overwhelmed by a three hour test."[718] Many of the committee admitted that they would currently be unable to pass the test, owing to their own lack of formal education. Clyde DuVall, the treasurer, suggested that, "a lot of questions in there that are related to algebra and calculus, some us won't even get started."[719] Another committee member went so far as to suggest that the discussion was pointless. "I don't think we should be concerned about this.... I haven't met any association members that would want to take the examination."[720]

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[715] ibid, 168-170.

[716] National Machine Accountants Association, Executive Committee Meeting Minutes 1-2, Dec – Verbatim, 49.

[717] Ibid, 52.

[718] Ibid, 55

[719] Ibid, 65.

[720] Ibid, 52.

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Over the next decade and a half, one man was to be more closely associated with the certification program than any other: John Swearingen. Swearingen was involved from the early planning stages, as chairman of the education committee and national vice president. He served as president of the association from 1964 to 1965, and retained control of the certification program when it was finally spun off to a separate organization during the 1970s – by which point he was director of Information Services for the US Senate. This was in some ways a return to his roots. Swearingen first worked with punched cards in the Army in 1945 and helped bring punched card machines to the CIA in 1950. His involvement with computers stretched all the way back to 1953, when he had been hired to work on General Electric's first Univac installation in Louisville. He played an important part in its early payroll and inventory control applications. Perhaps because of this long familiarity with computers and diverse experience, his outlook was less parochial than that of most DPMA leaders of the era. His was usually a voice in favor of greater engagement with other associations in the computing field, and in favor of a greater commitment to professionalism and rigor. When others suggested allowing association members to attain the certificate on special terms he had rejected this saying, "I don't think we can do anything to water it down for anyone and not have it noticed."[721]

Yet Swearingen was close enough to the mood of the association's membership to recognize the realities of the situation. The certification program was being pulled in two directions simultaneously. On the one hand, modernizers within the association wanted to make it a stringent, truly professional qualification with demanding requirements for college education and work experience. On the other hand, so few of the association's current members would have been able to attain such a qualification that it was politically impossible to spend their membership dues to create an elite professional class they would forever be excluded from. These

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[721] Ibid, 53.

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issues were to haunt the certificate. They could never be resolved – the same debates which gripped the executive committee as it planned the CDP program were still raging a decade later. As early as 1962 Swearingen clearly recognized the quandary, when he asked, "Will our membership continue to support a program that does more for outsiders than members." The answer, ultimately, was to be "no."[722]

## The CDP In Practice

By creating a need for a well defined course of study in data processing, and forcing the question of what constituted eligible work experience in data processing, the CDP forced the association to define for the first time exactly what data processing was, and what might constitute professional knowledge in the field. Work on the test progressed slowly through 1961 under the general direction of Swearingen. A staff member was hired to work on this and other education matters, while another contractor performed the specialist aspects of test development in return for payment of $8,750. This sum alone represented an appreciable chunk of the national association's budget. Conomikes was retained as a consultant for a transition period, working with members and chapters to promote the certificate. As work continued it became apparent that the test questions were focused more on technical than managerial matters, to the concern of some on the executive committee who saw the test as a managerial qualification. It was during this process that the executive committee succumbed to the inevitable practical and political pressures and decided to waive the education requirement completely "for the time being." At this point the certificate and the examination became, to most people, pretty much the same thing, a state of affairs which proved very hard to change later on.[723]

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[722] National Machine Accountants Association, Executive Committee Meeting Minutes, 21 Feb – Verbatim, 59.

[723] National Machine Accountants Association, Education Committee Meeting Minutes, 26 June, 1-4.

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The cost and complexity of developing a test, plus a set of study materials, proved daunting. The executive committee was reluctant to use an existing home study course, since this might constitute an endorsement of the institute providing it. (Here, as in many other places, the association's leaders showed a conviction that any hint of commercialism would irredeemably taint their professional aspirations). The NMAA also faced the challenge of developing a technical test which evaluated knowledge of both computers and punched card machines but somehow did not assume familiarity with the hardware of any given machine or the proprietary technology and vocabulary of any manufacturer. Swearingen had hoped to contract the work out to a university and "have it done in a few months," but as his enquiries became more serious, "all of a sudden, the interest waned and the contacts dried up."

In 1961 there were few teachers of business computing or punched card techniques working at reputable universities. Having failed with the University of California, Swearingen was investigating possibilities in Alabama. The committee also considered hiring an experienced author to produce a study guide, but realized that anyone who could do a good job would make much more money by offering the same material as a book. Commercial institutes charged hundreds of dollars for a course, which the committee feared would generate royalties large enough to make it hard to compete with them for the loyalty of authors. At the end of that year, Swearingen was still trying to negotiate a low cost deal of some kind. Conomikes, meanwhile, had failed to interest any universities in providing suitable preparation courses. Neither the University of Chicago (graduate education only in business) nor the University of Minnesota (no suitable faculty) were viable prospects. The University of Wisconsin had reportedly offered to provide courses for $3,000 each – but Conomikes claimed to have rejected them on finding they

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had only one teacher, who specialized in science and engineering rather than business data processing.[724]

After discovering the cost of using professionals to develop and run the test (a quote of $14,000 per year from the Psychological Corporation struck them as prohibitively expensive) they decided instead to develop questions themselves, while retaining the less expensive services of one Dr. Herman Roemmich to assist in overall test design, and to perform some statistical analysis of the test results and the applicant pool. The relevance of academic knowledge to data processing remained sufficiently controversial that Adams was actually able to turn this lack of university involved in question setting into a positive point, saying – "a lot of people will… say a university directed examination is unrealistic. They haven't had the experience to know what is proper to ask." The association also saved money by printing and mailing test papers itself. It was so successful at keeping down costs that proceeds from the $35 paid by each applicant came rapidly to exceed the costs of running the certification program (a happy, if as it turned out temporary, situation).[725]

In June 1962, the initial version of the test was ready. It was administered to 340 people at the association's national meeting. Its three main subject areas were punched cards, computers and "systems" (a grab-bag category that included design and management as well as "systems machines" such as optical scanners and data transmission), which between them counted for about 80 percent of the marks. The final 20 percent were split between knowledge of paper tape

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[724] National Machine Accountants Association, Executive Committee Meeting Minutes, 8-9 Sept -- Verbatim, 1961, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 112-21, National Machine Accountants Association, Executive Committee Meeting Minutes 1-2, Dec -- Verbatim, 65.

[725] For discussion of costs, see Data Processing Management Association, Executive Committee Minutes, 30 Nov & 1 Dec, 1962, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 286-87. For the Adams quote, see National Machine Accountants Association, Executive Committee Meeting Minutes , 31 Aug & 1 Sept -- Verbatim, 1962, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 289.

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(used to transfer data between telex machines, mechanical office machines and electronic systems) and some very elementary questions on statistics. Following this internal offering, the test was made available nationally at forty-five university testing sites in December of the same year. After complaints during the initial offering of the test, the paper tape section was reduced in size. Other questions were revised to make them applicable to Remington Rand as well as IBM machines. [726]

To obtain the certificate one had to achieve a passing grade in all three main sections. This was intended to insure that anyone who received the certificate had demonstrated familiarity with key concepts in all areas of the hybrid field of data processing. The composition of the certificate reflected two forms of social mobility its designers hoped to bestow on data processing staff. The first was to allow punched card supervisors to strengthen their professional and technical credentials for the new age of electronic data processing. The second was to reinforce the idea of a ladder of advancement within data processing, placing together the different jobs within data processing departments as part of a single career trajectory. Punched card machine operators and computer programmers would aspire to achieve professional status by becoming supervisors and department heads – not by strengthening their craft skills. While business application programmers were data processors (though not at the professional level), so were punched card machine operators, systems and procedures analysts, keypunch supervisors (if not keypunch operators) and data processing managers of all ranks. The certificate ensured that its holder knew something of all these areas – meaning that to pass it a programmer or punched card expert had, in theory, to look beyond these specialist activities to the broader profession of data processing.

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[726] National Machine Accountants Association, Executive Committee Meeting Minutes , 31 Aug & 1 Sept -- Verbatim, 123 and Data Processing Management Association, Exec Comm, 30 Nov-1 Dec, 1962, 279. Anonymous, "DPMA Gives Nationwide Examination", Business Automation 8, no. 4 (October 1962):66.

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The concept of the "data processor" embedded in the test was thus wide but exceedingly shallow. While its breath was striking, the statistical and managerial content was so rudimentary that the test did little to further the transition from technical to managerial status. (Swearingen hoped that in time questions would become less machine-oriented and that more managerial topics could be included).

The absurdly diverse range of topics squeezed into a single short, multiple choice test was a result of its origins. As we saw, the test was intended as a supplement to a specialized program of interdisciplinary study in data processing. These academic course requirements had merely been suspended, not abolished. In 1963, shortly after its public debut, Jim Adams stated in an interview with Datamation that, "if you will look them over, you will find that in terms of units the academic requirements are the basis for a Batchelor's degree in data processing." They courses included accounting, business, statistics, mathematics, and effective writing as well as the still elusive technical courses in the application of punched card and computer technology to business. This was a bold ambition indeed: to use the certificate to trigger the establishment of data processing as a new major in American universities. During the interim period, the test was being asked to stand in place of academic courses in these areas, and as a result it contained a little bit of everything.[727]

The DPMA's leaders hoped to push its existing membership toward professional education and to entice computer specialists and analysts into the association. Both these goals depended on its ability to build a critical mass of certificate holders as soon as possible. Only through the involvement of a sizable, and competent, segment of the overall population of supervisors and specialists in administrative computing and punched card work could the

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[727] R. Calvin Elliot, Questions and Answers for Datamation, 1963, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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certificate become an item of aspiration for their more junior and less accomplished colleagues. There was something of the chicken and the egg about this situation.

The urgency of this was not lost on the association's leadership. Swearingen expressed the challenge most clearly. "This year [1963] and the next is rather critical for us," he reported. "We have to have a lot of people with the certificate before it will mean a lot. We have to have some percent of the profession certified, 50 percent or 75 percent or something like that. There has to be a large number." The exact size of the "profession" imagined by Swearingen was hard to define, but at this point there were something like 35,000 punched card installations, several thousand computer installations and about 16,000 members of the association. Swearingen must therefore have been hoping to certify at least 10,000 data processing staff, and probably substantially more. The need for haste was compounded by the looming introduction of the temporarily waived college education requirement, which Swearingen realized might cause the number of applications to fall dramatically, giving a only short window of opportunity in which to achieve this critical mass. He considered it vital to get 4,000 applicants during 1963. To achieve this, he suggested, it was vital for the association to unite and do everything it could to promote the test.[728]

For the first full offering of the test, in December 1962, 1070 people applied. The largest concentrations were for the testing centers in Los Angeles and Chicago, each of which attracted more than one hundred hopefuls. With its public unveiling came an attempt to drum up interest beyond the association, among other groups concerned with computers and office administration. Press coverage was initially quite limited, though Datamation and Business Automation both reported on the certificate.

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[728] Data Processing Management Association, Executive Committee Minutes, 24 June, 1963, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 68-69.

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Who actually took the examination? The DPMA was very interested in this question – not only to discover how far beyond its own membership the appeal of the CDP extended, but also to gather its best information to date on its own members. Of the 2,398 people who sat the test in 1963, just 100 were women.

| Percentage of applicants | Job Title Reported |
|---|---|
| 21% | Data Processing Manager |
| 17% | Computer Programmer or Coder |
| 9% | EDP or Computing Systems Analyst |
| 7% | IBM, EAM (Tab) Manager or Supervisor |
| 6% | Systems and Procedures Analyst |
| 41% | All Others |

**Table 4: Job titles held by 1963 examinees for the Certificate in Data Processing.**[729]

The broad range of job titles reported suggests that the DPMA had been reasonably successful in attracting applicants from all the core areas of what it considered data processing. The top five categories included managers (both data processing and plain old punched card), programmers, and systems analysts of both computer and non-computer varieties. No other job title was held by more than 3 percent of the applicants. Just 2 percent were tabulator operators and 1 percent computer operators – clearly those at the lowest end of the DP ladder were not as yet seeking this route. On the other hand, the certificate held even less appeal for those with existing and independent claims to managerial or professional status. Operations researchers, accountants and engineers together made up less than 1 percent of the applicant pool.[730]

[729] Herman Roemmich, A Descriptive Analysis of the 1963 DPMA Certification Applicants and the Selection of a Punch Card Criterion Population, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis. Selected results were published as Herman Roemmich, "1963 CDP Breakdown", Journal of Data Management 3, no. 1 (January 1965):50-51.

[730] Roemmich, A Descriptive Analysis of the 1963 DPMA Certification Applicants and the Selection of a Punch Card Criterion Population. These figures clearly refute any attempt to present the CDP

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The data processing career ladder was very much in evidence – most of the applicants had risen through the ranks from operators to supervisors. Although only a tiny fraction of the applicants were still operating tabulating machines, 58 percent reported having done this at some time or another. (This implies that a fair number of the applicants who were not DPMA members had tabulating backgrounds). This was slightly more than the 57 percent who reported experience programming computers. 48 percent had worked as tabulating machine supervisors – reflecting the most common path of advancement for tabulating personnel. 38 percent had experience as systems and procedures experience in a general context, and 35 percent had worked as systems analysts in a computer context. Relatively few computer operators had risen up the ladder, though this may be explained by the newness of the technology – 21 percent of the applicants had experience of computer operation.

Forty-seven percent of these CDP candidates were members of the DPMA – far more than of any other association. A further 9 percent were members of the scientifically inclined Association for Computing Machinery (ACM). The figures also reveal that the DPMA had not been very successful in spreading interest to the other associations of managerial technicians – just 3 percent were members of the SPA, and less than half a percent were members of NOMA. On the other hand, the applicants were much better educated than the typical DPMA member. 40

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as primarily a means of certifying programmers. Nathan Ensmenger, "The 'Question of Professionalism' in the Computer Fields", IEEE Annals of the History of Computing 23, no. 4 (October-December 2001):56-74, the only published account of the CDP program, gives an impression of the CDP as a qualification for the "certified public programmer" and includes the claim that, "by the end of 1965 almost 7,000 programmers had sat for the exam." Less than 20 percent of those people were called programmers or coders, and more than 40 percent had no programming experience whatsoever – a higher proportion of the 1963 applicants had operated punched card machines than programmed computers. (Less than 1 percent of these applicants, incidentally, identified themselves as scientific or engineering programmers – dispelling any possibility that the CDP might be a qualification for programmers as a whole). Given all this, Ensmenger's conclusion that the CDP "failed to establish itself as a reliable mechanism for predicting programmer performance or ability" (page 70) seems to fundamentally mischaracterize the CDP's applicant base, as well as its objectives. The CDP program is also treated at length in Ensmenger, "From Black Art to Industrial Discipline", briefly in Shapiro, "Computer Software as Technology: an Examination of Technological Development", 178-98 and rather uncritically in Anderson, "The Data Processing Management Association", 116-51.

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percent of them had obtained a four year college degree or better, including 7 percent with masters degrees and 3 percent with CPA qualifications. Only ten individuals held Ph.D.s though – a far cry from their incidence in the operations research or scientific computing communities. The most commonly reported majors were business, accounting, mathematics and engineering.[731]

To the chagrin of the association's leadership, its own members fared less well in the test than those of other associations. ACM members, and those with engineering or advanced degrees performed much better than DPMA members. In an attempt to isolate a population of "tab people," whose abilities were of particular concern to the association, the analysis pulled out as a separate group those with no more than two years of college whose only reported experience was with punched card technology (whether as operator or supervisor). (The very fact that the association used a lack of a bachelors degree as a screening characteristic for tabulating staff confirms that it believed them to be uneducated). Both DPMA members and those identified as being "tab people" faired badly in all parts of the test, including the questions on punched card technology! They lacked the test-taking skills of those with more recent and extensive college training.[732]

The content of the test itself was subject to constant adjustment. By 1963 it had already been revised to eliminate unsatisfactory questions and substantially reduce the attention given to punched card topics. 1965 saw some major adjustments to the test, prompted in part by the increasing involvement of the Certificate Advisory Council set up to provide expert guidance over the test's design. In March, Adams reported to the executive that, "there is talk in the council about the restructuring of the examination anyway. Nobody has been particularly happy with the

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[731] Roemmich, A Descriptive Analysis of the 1963 DPMA Certification Applicants and the Selection of a Punch Card Criterion Population.

[732] Ibid.

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idea that we have a multiple choice test, or the way that the categories are structured."[733] Though the test remained entirely multiple-choice, the categories were indeed adjusted and plans were put in place to lengthen it to last for a full three hours. The new categories for 1966 were to be Automatic Data Processing Equipment, Computer Programming and Software, Data Processing Systems—Concepts, Design and Implementation and Quantitative Methods (an amalgam of the accounting, mathematics and statistics questions). While there was no longer a separate punched card category, the four remaining areas appeared roughly to parallel the data processing specialties of operator, programmer, analyst and manager.[734]

In 1965, three years after its public debut, the certificate appeared to be a qualified success. The number of candidates had increased with each administration, income exceeded expenses, and constant adjustments had made the test longer and more challenging. In 1965, a record crop of 6,951 candidates sat the examination, of whom 63 percent passed. Under the guidance of the certification council, the association was already considering ways of "expanding and extending" the program beyond the general qualification in data processing and into more specialized areas such as programming, analysis and operations. While the association's magazine boasted that, "the great surge of applications for this year's exam can be credited to the vigorous promotion and high quality refresher courses offered by most DPMA chapters," it was probably better explained as a rush to beat the new academic course requirements. [735] In all, seven thousand people held the CDP, not quite matching the pace Swearingen had hoped to set during

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[733] Data Processing Management Association, Executive Committee Meeting Minutes, 20 March, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 390-415. The test administered in 1965 was really the fall 1964 test, delayed by a few months to give more people a chance to prepare.

[734] Data Processing Management Association, Executive Committee Meeting Minutes, 26 & 27 June, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis. (There is some suggestion in the record that the mathematical section was believed to correspond to managerial skills, premised on the notion that management was becoming increasingly rigorous and quantitative).

[735] Anonymous, "The CDP Enters a New Phase", Journal of Data Management 3, no. 7 (July 1965):36-37.

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this initial window before the imposition of the educational requirements, but a creditable performance none the less.

The association's leadership had some knowledge that the education requirement was likely to prove hard for many interested members to fulfill. In order to explore the challenge ahead, analysis of the 1963 applicant pool had included questions on individual college courses taken. The news was not all bad. A relatively substantial 56 percent had the accounting fundamentals course demanded by the regulations. Things went down hill from there. The mathematics requirements proved a mixed bag. While 50 percent had algebra and 35 percent had basic statistics, only 26 percent had calculus and just 9 percent had the required course in intermediate statistics. Meanwhile the specialist courses remained rare – 17 percent claimed to have taken "Fundamentals of EDP," while 5 percent had experienced "Data Processing Systems." It seems hard to believe that more than a few percent of the 1963 examinee pool could have satisfied even the core course requirements. In addition to these core requirements, candidates were also expected to have satisfied a large number of elective courses chosen from a quite short list. Since 1963, the association had been distributing lists of college data processing courses to its members to help them prepare for the new requirements, but this was hardly going to deal with an educational shortfall of this magnitude.[736]

Despite this clear warning, neither the executive committee nor the certification council seemed to recognize the looming disaster. When the education requirements went into effect in 1966, applications for the CDP suffered a precipitous decline, dealing it a blow from which it never really recovered. Whereas 6,951 people had satisfied the other requirements and been allowed to sit the test in 1965, just 1,005 sat it in 1966 and 646 in 1967. Despite their superior

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[736] On the educational attainment of 1963 CDP applicants, see Roemmich, A Descriptive Analysis of the 1963 DPMA Certification Applicants and the Selection of a Punch Card Criterion Population. On the distribution of course lists see Data Processing Management Association, Exec Comm, 24 June, 1962, 74. Anderson, "The Data Processing Management Association", 119-20.

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academic credentials, this much smaller body of examinees were much less successful then their predecessors at passing the test, probably because it had itself been made more rigorous. While 4,365 people had been awarded the certificate in 1965, just 408 received it the following year. The result was to turn the program from a source of funds into a major drain on the association's resources, a problem only compounded by the amount of work that the tiny DPMA headquarters staff now had to do to check transcripts against the long lists of required courses and electives and the lack of standard course titles between universities.[737]

## Members of the DPMA

In retrospect it would probably never have been possible for the DPMA to hope to balance its wish to produce a truly professional qualification with the countervailing pressure to respect the limitations and needs of its existing membership. As it turned out, it managed to do neither. The fundamental impossibility of the task was compounded by the general lack of specialist courses in data processing, the association's lack of resources, and its failure to realize the magnitude of the project it had undertaken. The certification program suffered from another major problem: the association was never clear on exactly what data processing was, professionally speaking, or what the certificate was supposed to demonstrate. The same problem hampered many of its other programs.

By examining the deliberations of the association's leaders about who should and should not be allowed to join, we can uncover their assumptions about what data processing should be and which segments of it could be considered closest to professional stature. On its foundation in 1951, the NMAA had stated that it welcomed systems and procedures analysts along side its core

[737] Data Processing Management Association, CDP Ambassador guide, 1972, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 15.

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membership of tabulating supervisors, but that it was not open to machine operators. This corresponded to its desire for recognition as a managerial, rather than technical or craft, group. Following this initial statement, little attention was given to the subject of membership eligibility for the first decade of the national association's existence. The association was a federation of chapters, and control over membership remained firmly in the hands of local officials. In addition, the arrival of the computer had increased the technical complexity of much operations work, and introduced the entirely new activity of programming, which in the eyes of data processing managers fell somewhere between the traditional roles of tab operation and supervision. Since supervisors were welcome, while operators were generally shunned, the desirability of programmers as members of the association was an open question.

In 1964 the executive committee confronted the problem of membership eligibility. A special committee had been working on a proposal for "qualified membership." Its suggestion was that only those legally exempt from overtime payment should be permitted to join as full members. This reflected the traditional distinction between workers and managerial/professional employees. The scheme never got very far – in part because Canadian representatives were unable to think of an equivalent categorization. Its discussion, however, revealed that the association's leadership still did not have a clear picture of which strata of data processing it was supposed to represent. When Swearingen said approvingly that the proposed change, "Would not exclude programmers or analysts because those I know would be in the same category as managers," another committee member replied that, "I thought we wanted to exclude them."[738] The report also included an investigation of the membership qualifications currently demanded by local chapters. It found the most popular to be a job title of data processing manager or data

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[738] Data Processing Management Association, Executive Committee Meeting Minutes – 6 November – Verbatim, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 316.

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processing supervisor. Some chapters adopted the functional requirement that member must be, "directly responsible for the control of a number of people doing data processing functions," though these differed on whether supervisors of key punch operation (a post often filled by women) could be considered eligible. Some added an experience requirement of three years data processing work, similar to that demanded for the CDP.[739]

Billy Field, the head of the committee exploring membership requirements, favored annual checks to make sure that members still met eligibility requirements and to purge the association of those who no longer met them. Field and his committee also favored the creation of a new and higher grade of membership, for "a group of top executives that we might be able to lure into the Association... the people that might be hesitant to want to identify themselves even as a regular member of DPMA." This proposal clearly illustrates the extent to which "professional" standing in data processing followed the status hierarchy of the corporation itself. General managers without technical experience were not considered to be undesirable outsiders, or even allies to be granted affiliate membership, but a desirable elite to be courted through a status higher than that granted to practicing specialists. This also reveals their worry that such men might consider regular membership beneath them. No one present in the Executive Committee meeting challenged these assumptions, though Swearingen did suggest that the "snob appeal" associated with different classes of membership could backfire.[740]

A portion of each member's dues was passed on to national headquarters, in return for which each member received a copy of the association's journal. Its leaders knew exactly how many members it had – but volume of money received told them little about who these people were or what they wanted. Aware of its own ignorance, as it prepared to tackle the question of membership eligibility in 1964 the national association had sponsored a survey of its members.

[739] Ibid, 313-14.
[740] Ibid, 310.

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The results gave them, and indeed us, the first reliable statistical profile of the association's membership.

When the results were tallied, 73 percent of DPMA members had identified themselves with the broad category of "Manager, supervisor, or director of data processing." The association's membership profile was largely the same as it had been on its foundation, though supervisors of punched card installations were increasingly joined by supervisors of electronic data processing installations. To judge from the precise job titles given, the association's members ranked a little higher, on average, than the tabulating managers surveyed almost a decade earlier by Edwards. 36 percent were called managers of data processing, while 19 percent were accorded the lesser title of supervisor of data processing, and 3 percent were directors of data processing. These titles had largely replaced the mass of tabulating related terms reported by Edwards after he surveyed the tabulating installations of Oklahoma City during the mid-1950s. The two most popular of the traditional supervisory titles, "tabulating supervisor" and "IBM supervisor" were held by only 8 percent of the association's members.[741]

Indeed, the spread of "data processing" as a title had outstripped the actual adoption of computer equipment. A substantial 32 percent of DPMA members were responsible for tabulating machines but not for any kind of programmable electronic computer. Only 9 percent were responsible for large computers (defined there as those valued over $750,000 such as the 7000 series IBM machines). Most (54 percent) were in charge of smaller computers, the bulk of which were undoubtedly IBM 1400 series installations. Despite their shift into the electronic age, DPMA members were still responsible for operators more often than programmers or analysts – reflecting the roots of the organization among the direct supervisors of tabulating machine

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[741] Data Processing Management Association, Membership Profile, April 1964, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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operations. While 74 percent claimed to supervise at least one operator (and 23 percent supervised ten or more), only 52 percent supervised any programmers or analysts (and just 6 percent supervised ten or more).

The 27 percent of the association's members who classified themselves in some way other than manager or supervisor of data processing fell into several different camps. Some programmers and analysts had indeed crept into its ranks, but they formed a definite minority: between them they made up just 14 percent of the membership. Most of the analysts included appear to have been managers of systems groups, rather than rank-and-file preparers of flowcharts. This is borne out by a look at the actual job titles reported: only 6 percent of the sample had programmer as a job title. Yet while the association had largely retained its supervisory focus, defending its managerial dreams against erosion from below, it had so far failed to boost its stature by attracting the general managers Field was interested in. Just 5 percent of its members identified themselves as "general/corporate management." 2 percent were consultants, 1 percent were educators and 3 percent worked in sales. Neither had data processing grown much closer to the scientific and engineering work of computing proper – only 1 percent of the membership sample were primarily scientific or engineering computing specialists (though a further 13 percent were responsible for both administrative and technical applications). Almost none of the association's members held science or mathematics degrees. This mirrors that lack of computation specialists among CDP applicants.

The demographics of the DPMA membership were equally stable. 98 percent of its members were male. This certainly gave the association a lower proportion of women members than data processing as a whole, though this level was probably not unrepresentative of the heads of significant data processing installations. Data processing remained a field of young men in comparison to other corporate specializations, the mean member being just 36 years old. It was not, however, an area into which many seemed to have shifted recently – most had clearly served

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apprenticeships in the machine room rather than moving horizontally from some other managerial field. The median member had been working in data processing since 1953, and only 12 percent had entered the field since 1960 (i.e. within the past four years). Most of the rest, including almost all the 56 percent involved in data processing before 1954, had undoubtedly begun their careers with punched card machines rather than computers. This picture of the data processing supervisor as a craft master was completed by his lack of formal education. Only 27 percent held bachelor's degrees, and the vast majority of these were in business administration or accounting.

## DPMA Chapters versus DPMA Headquarters

The association's federal structure deprived its national leadership of a clear picture of what was going on in the chapters. As we have already seen, Elliot's headquarters staff and many of the elected national officers had little regard for its board of directors, composed as it was of delegates dispatched by local chapters. They complained that the role of director was too often seen as a reward for past service, rather than as a serious responsibility. A new system of regional divisions provided an intermediate layer of elected representatives intended to bridge the gulf between chapter and national levels. While divisional representatives were sometimes used as a sounding board by the association's national leaders, the system did not eliminate the friction – which if anything grew over the 1960s as Elliot entrenched his power and the scope of the national organization grew. Like most organizations of its kind, the DPMA witnessed a persistent tugging backward and forward between local and central operations.

Tensions between the DPMA's chapters, its executive committee and Elliot himself were powerfully illustrated in 1966. For some time, the DPMA had been holding two conferences every year – one somewhere in the eastern United States for the bulk of its members, the other one smaller, western, and primarily for the benefit of its Californian members. Each was hosted

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and organized by a different chapter every year. Elliot was proposing that these be replaced with a single annual conference. Half the time this conference would take place in Chicago and be run directly by headquarters staff. When not in Chicago, it would alternate between Los Angeles and New York.[742]

The episode pointed to something fundamental in Elliot's concept of the association, a tendency that became stronger as his twelve year reign as executive director went on. Not only did he view any expression of will on the part of the chapters as something akin to insubordination, but he also viewed the association more as a company than as a professional body. He saw other organizations, and even journals and magazines, as potentially deadly competitors. His concern was with efficiency and the maximization of revenues, and to this end he favored as much centralization of power as possible in his own hands and the hands of his staff.

Chicago was the location of the association's headquarters building, constructed at considerable expense and to the resentment of many of the chapters. Elliot had already hired a fulltime conference organizer, with experience organizing meeting for the National Association of Bank Auditors and Comptrollers. Elliot aimed to remove the members entirely from the running of the conferences. As he put it, every change to a new city, "just stacks up complications." He likened the conference to a circus, able to draw large crowds only in the biggest cities. He promised to bring over three thousand registrants to a Chicago conference, telling the executive committee that, "you are doing the wrong thing" in allowing smaller cities

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[742] Data Processing Management Association, Executive Committee Meeting Minutes, 5-6 August, 1966, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 85-88.

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such as Houston and Seattle to host conferences. Elliot thought the plan would, "reduce a lot of wasted effort and boil it down to a real operating organization."[743]

After canvassing the mood of the association, the Executive Committee members told Elliot that there was no chance of enacting this scheme. Not a single one of the division representatives had shown any support for the plan. Some of the executive, such as then-president Daniel Will, seemed sympathetic, but urged Elliot to recognize the political realities. As Will put it, "We are controlled by a couple of hundred people that are going to stick their hands up and fight us." Others were more bluntly opposed. Rich, himself to serve as president the next year, suggested that the rotation system had been working well and that it was foolish to try to force the issue against the will of the chapters. Another committee member asked whether the association should emphasize "the location where it is going to bring the most dollars, or ... our responsibility to our membership." Yet another took issue with Elliot's invocation of the many commercial expositions hosted in New York and Chicago as an example for the DPMA to follow. "Are we losing our objective here just a little bit?" he asked. "We are putting on a show as a service to our association, and our association is not a bunch of people who are buying shoes or furniture."[744]

Faced with this opposition, Elliot proceeded to chide and berate the executive committee for its lack of vision, urging it to allow him to personally present the idea to the unruly board of directors. He attributed the eclipse of NOMA to its failure to take strong national command of its own conference, and implied that a similar fate awaited the DPMA if it was unwilling to consolidate his own centralized control over the conference. This rhetoric did not persuade them. While the executive committee members might complain about interference from chapters, they usually maintained a much broader view of the purpose of the association than did Elliot. The

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[743] Ibid, 90-95.
[744] Ibid, 85-97.

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executive committee was made up of men who had started their careers as chapter members, before being elected as chapter officers, board members and finally national vice presidents or president. They were frequently annoyed when one of their proposals was dismissed by the board, or when a chapter seemed to flout their authority by running its own trade show or publishing its own newsletter. Jerome Geckle, for example, had remarked that, "I frankly have never been too proud of the International Director's meeting. I felt that there was a lot of wasted time at it."[745] Despite this, they still had an on-going connection with their own chapters to fall back on. Elliot, in contrast, never held any role within the association other than that of executive director, and perhaps because of this lacked any sense of the chapters as a potential source of vitality or ideas as well as revenue and bodies. Of course, for a more collegially minded director this hurdle might have been easier to surmount.

One of the most striking examples of Elliot's increasingly intolerant view of the association's grassroots came in a short document he presented to the executive committee in 1969. In this he suggested that a "power struggle" within the association pitted the executive committee and headquarters staff against "[c]ertain Division Chairmen and International Directors" who were "grasping at every straw or portion thereof, to criticize, criticize and criticize." By means of "a deluge of unnecessary unwarranted correspondence within their own group" they had "managed to close ranks and become a powerful weapon." Elliot's immediate purpose, however, was to stamp out any dissention within the executive committee itself by focusing on the threat posed by this third column. He warned that, "[t]he name of the game is 'take-over'," and that the very survival of the association was at stake. The "ultimate goal," he warned, "is to destroy the Executive Committee and Headquarters." In the short term, however, the "apparent and OBVIOUS aim" of these miscreants was, "to seduce the Executive

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[745] Ibid, 185.

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Committee." To do so, they employed a method "consistently used by the Communists. It is called 'divide and conquer'." Only a united stand by the executive committee and headquarters staff, something Elliot claimed had been lacking of late, could beat back the advance of these rebel forces.[746]

The mid-1960s did see the launch of a number of new programs aimed directly at rank and file members. Some of the executive committee members had been worrying that the association was failing to provide sufficient tangible benefits to them. Even Elliot admitted this. In 1964 he said that, "The members, outside the benefits that they receive from the Chapters, receive very little benefit from National, I mean something they can pick up and feel, see and smell.... they get the magazine once a month. Nothing else hits that house or their office or their desk from DPMA National..."[747]

As this comment suggested, the most tangible service provided to them by the head quarters was the association's monthly journal, known at different times as Data Management and as The Journal of Data Management. This was the successor to The Hopper, which itself had been renamed several times before being lost to the association as a result of legal problems with its publisher. The journal was at least intermittently profitable. Although $2.25 from each member's dues was earmarked for it, in 1966 Elliot had claimed to the executive committee that the actual cost was entirely covered by advertising revenue.[748] It was, however, a rather unexciting read. The association continued to have problems finding interesting articles to fill it, and relied in

[746] Calvin R. Elliot, DPMA (document submitted to Executive Committee meeting), 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[747] Data Processing Management Association, Executive Committee Meeting Minutes -- 21 June -- Verbatim, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 361-62.

[748] Data Processing Management Association, Exec Comm, 5-6 Aug, 1966, 232.

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large part on material supplied by the public relations departments of computer suppliers.[749] Field, whose hopes for the association often involved increasing its appeal to senior managers, hoped to fill it with "management character building articles". He wanted a publication that might be browsed with interest by executives, who would not only learn something about computers but would also be favorably impressed by the interest in managerial matters shown by their subordinates.[750] In practice, however, it continued much as before – though it was briefly supplemented with the DPMA Quarterly, intended to hold "longer treatises of substantial intellectual content."[751] While headquarters valued it as a way of promoting conferences, seminars, and the CDP program directly to the association's members, the journal had little of the intrinsic appeal of commercial publications such as Datamation and Business Automation.

In response to the perceived lack of tangible activity in support of its chapters, in the early- and mid-1960s the association launched a number of programs designed to educate its members and spread awareness of data processing beyond its own borders. While the CDP was the most expensive and important of these, it was far from being the only one. From 1964 onward, it provided materials to chapters so that they could organize "Executive Seminars in Data Processing" for the benefit of corporate managers. In 1965 it produced a 93 page textbook on the "Principles of Automatic Data Processing," printing more than 16,000 copies. The book was intended for use by high school students, college students, and (in an interesting conflation) managers. It accompanied the earlier-established "Future Data Processors" program, in which

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[749] Ibid, 224. Anonymous, "What's In It For Mr. President", Journal of Data Management 4, no. 10 (October 1966):22-26, page 24 on the 25,000 figure.

[750] Data Processing Management Association, Exec Comm, 5-6 Aug, 1966, 224.

[751] Anonymous, "What's In It For Mr. President", page 24.

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chapters provided twenty-hour lecture courses and field trips to local high school students in an attempt to interest them in data processing.[752]

The following year, it produced its first full scale data processing textbook, more than 40,000 of which had been sold in two years. The association launched "Project Image," the production of a series of films intended to bring the work of data processing to public attention. One result was a film intended for civic groups and secondary schools – "Man's Most Magnificent Machine." Perhaps the most successful of these outreach attempts was its sponsorship of a boy scout merit badge in data processing – by 1969 this program was being offered by more than 110 chapters. Its success may be linked to the opportunity it gave members to appear as authority figures in the broader community. In general they responded much better to initiatives of this kind than to those designed to remedy their own ignorance.[753]

Almost all of these projects proved much harder and more expensive to develop than had been expected. The short textbook, for example, dragged on for many years. We saw earlier that intermittent efforts had been underway on this front since the mid-1950s. The ultimately successful effort began in February 1963, under the auspices of Adams and the Education committee. By 1964, Swearingen could already comment that they had, "got caught like this on the textbook, on how much effort it would take for Headquarters."[754] The association had split the book into six separate parts, and assigned each of these parts to the representatives of one of the major computer companies. This plan illustrates the extent to which the national association,

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[752] Elliot, Questions and Answers for Datamation, 4-6. Though Nathan Ensmenger has referred to this scheme as the "The Future of Data Processors Program," this does not seem to be correct. Ensmenger, "From Black Art to Industrial Discipline", 236, emphasis mine.

[753] On the boy scout merit badge and other public outreach see Jerome W. Geckle, "What DPMA is Doing to Promote Professional Development of its Members", in Data Processing XIII: Proceedings of the 1968 International Data Processing Conference and Business Exposition, ed. Data Processing Management Association (Chicago: Data Processing Management Association, 1968), 340. For a good summary of the education programs offered to chapters, see Data Processing Management Association, Chapter Education Manual, Third Draft, 1968, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[754] Data Processing Management Association, Exec Comm, 21 June 1964, 236.

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which included almost no members from companies producing or designing computers, continued to rely primarily on the representatives of computer companies to provide explanation and training. The symbiotic relationship between IBM and tabulating supervisors, nurtured over decades, endured long into the computer era. But while Adams characterized the computer company men as "serious, dedicated and talented," two of the sections turned up six months late. One of these, from IBM, represented 25 percent of the total. When it arrived, the book was hurriedly assembled and edited. But when the draft was sent to advisory committee member Jim Campise for comment, it was found to be confusing, badly written and poorly organized. Geckle, the vice president responsible for education matters, experienced considerable embarrassment when he was obliged to tell the Board of Directors that a book which he had promised was finished needed to be completely rewritten. The salvage job ultimately proved more work for Adams than if he had written the book himself in the first place. As Geckle said, "[w]e have tried to do something that had never been done before. It was an experiment. Unfortunately it has gone sour on us."[755]

This was, in the end, one of the more successful projects. Efforts to produce the film went much less smoothly. The man commissioned to produce the film turned out to be something of marginal figure within his field. The association clashed with his efforts on the scripts (originally intended to include an image of a woman in bed – something they found far too racy) and discovered to their dismay that production would have to wait for him to raise sufficient funds to purchase film and equipment.[756] Other projects were started and abandoned. Attendance at many of the seminars proved very disappointing. As we shall see later, members of the association

[755] Data Processing Management Association, Executive Committee Meeting Minutes -- 15 August -- Verbatim, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[756] Material on the film project is stored in two "Project Image" folder in the Babbage DPMA collection, as well as forming a running topic of discussion during the Executive Committee meetings.

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proved most interested in taking part in projects, such as the boy scout badge, in which they reached out to children and members of the public. They also responded well to technical seminars. Seminars and educational programs designed to promote their interest in managerial matters were generally much less popular. The biggest program of them all, the CDP, ultimately found more qualified candidates outside the DPMA than inside it.

## The CDP and the Profession

The CDP was offered as a professional qualification for the entire data processing field, but was funded and controlled by a single organization. The relationship between the interests of the DPMA and the interests of the data processing profession as a whole was sometimes controversial. Elliot in particular tended to resist anything that appeared to weaken the association's independence or divert its resources away from programs under his own control. Indeed, he was rarely prepared to acknowledge that the interests of the two might conflict. Nevertheless, as the CDP program progressed it forced the DPMA to define its own role in the promotion of the data processing profession and, just as importantly, the possible status of the data processing profession itself as part of a broader profession of computing. A closer examination of the progression of the certification program will therefore illuminate the broader question of what data processing was, and different ideas about its relationships to computing and to management.

The certification procedures had been designed by the association's education committee, its headquarters staff and some outside consultants under the close supervision of the executive committee. But the association was aware that it did not, as yet, represent the whole of the putative profession of data processing. If it was to expand its appeal and uplift its existing membership then it had to increase recognition of the certificate among all those involved in data processing, though defining the exact scope of the profession remained problematic. Swearingen

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and his colleagues also recognized the need to involve well known figures from outside the association's own leadership in the direction of the program.

While informal external consultations had been taking place since 1960, a Certificate Advisory Council was created formally in 1963. The council was – as its name suggested – purely advisory. In practice, the executive committee retained firm control over the certification program until 1967. The advisory committee's voting members included three appointed members (generally from outside the association's leadership), and two members of the executive committee. Only by voting as a block could the three "external" members overcome the two delegates from the executive committee. Its recommendations were frequently ignored by the full executive, and could also be overridden by the association's Board of Directors. Initial appointments were Marvin W. Wofsey (assistant director of the Center for Technology and Administration at American University), well known computer consultant Robert L. Patrick and Laurence A. Johnson, director of data processing for the American Hospital Association. Appointees served three year terms. Subsequent choices included consultant, author and publisher Richard G. Canning and a number of senior data processing managers from corporations and government agencies.[757]

Establishment of the advisory council was followed by an advertising campaign to spread awareness of the certificate beyond DPMA members and data processing specialists. Its earliest efforts were insular and amateurish – consisting of little more than pushing the certificate in its own journal and placing small advertisements in publications such as Datamation and The Office. In 1964 the executive committee earmarked $4,000 for publicity, and retained the services of a public relations consultant for the first time in its history. The consultant promised to use his connections to place stories in Business Week, Newsweek and other national publications. He

[757] The 1972 ambassador document, page 12 lists all appointments up to 1971. The first meeting of the committee is discussed in Data Processing Management Association, Exec Comm, 24 June, 1962, 65.

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also drew Elliot's attention to the enormous number of trade publications in fields such as government, insurance and retail – prompting Elliot to remark "Frankly, this didn't even occur to us previously."[758]

Within the small world of data processing commentators, initial reaction to the certificate was muted but generally positive and encouraging.[759] In 1964, however, the association's leadership confronted the first high-profile external attack on its certification program, delivered in no less prominent a position than the editorial page of Business Automation. Its author, Richard D. Kornblum, had a number of things to say about the CDP. All of them were negative, though not all of them appeared well informed or coherent. He suggested that the CDP, "can only result in a harmful contribution to the practice of data processing." His primary objection appeared to be that no examination could test managerial accomplishment – suggesting he accepted the idea that a data processing career was fundamentally managerial. "[T]rue proficiency in any advanced managerial post," he insisted, could "arise only from a combination of the acquisition of technical know-how through schooling and on-the-job training; a profit-oriented understanding of a company's goals, operating procedures and problems; the possession by an individual of that elusive quality of leadership (called managerial ability)...."[760]

Kornblum was particularly critical of the use of CDP after one's name, in the manner of a professional qualification. Calling this "pompous nonsense," he observed that this was the action of "Alice-In-Wonderland types" and that, "no self-serving affixing of initials after a name will make the bearer a data processing manager." He went on to point out that even CPAs and medical doctors were required to perform internships before receiving professional certification. (Since

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[758] Data Processing Management Association, Exec Comm. 15 Aug. 1964, 319-20. For the advertising campaign, cite the archival document showing where placed and number of responses.

[759] Richard G. Canning, "The DPMA Certificate in Data Processing", EDP Analyzer 3, no. 7 (July 1965):1-12. Robert L. Patrick, "The Maturing Field", Datamation 9, no. 1 (January 1963):25-27. Anonymous, "DPMA Gives Nationwide Examination".

[760] Richard D Kornblum, "A Question of Degree", Business Automation 11, no. 6 (June 1964).

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the DPMA did enforce its requirement of three years experience in data processing for all CDP candidates, albeit not at managerial levels, this particular criticism seems ill placed). According to Kornblum, no "written exam, no matter how impressive the parchment awarded, can replace the above combination of requirements." Yet while this objection would appear to preclude any academic attempt to certify managers, he paradoxically went on to argue in favor of more academically rigorous approaches. He said that, "future higher level courses in data processing will put ever more stress on those academic requirements which the certificate exam cannot possibly evaluate." Indeed, the DPMA's plan to impose academic requirements in recognition of the "fallacies" in its program was the sole small crumb of recognition to be found in the article – something that could only have reinforced the association's sense that these requirements were crucial to the acceptance of the CDP as a credible professional qualification.

The executive committee members were deeply stung by this attack. Elliot suggested that, "if a department manager who has control of the corporation reads this, this is very bad for us." Yet he also acknowledged that it reflected a general confusion as to whether the holder of a certificate in data processing was a "Certified Data Processor." As he noted, "this committee or other executive committees before you folks, never have come out and made a statement what your certificate really is." Swearingen felt that, while "We have not, officially, encouraged anyone to use the CDP after their name. But, to make the comparison to CPA, gives us every right to use the initials afterwards." Further discussion, however, revealed that none present were sure whether the CPA tag was formally granted by a state board or by an examination, or exactly what legal requirements might accompany the addition of letters to one's name.[761] Two years later, the association tacitly endorsed the use of CDP as a prefix when it began adding it to the names of qualified people on its speakers roster, and of contributors to its journal. It stood for

[761] Data Processing Management Association, Exec Comm, 21 June 1964.

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Certified Data Processor. The letters also began to appear in its magazine and other publications.[762]

The reaction of the association's leaders to the attack exposed their underlying insecurities. Daniel Will asked whether anything was "behind" the editorial, tapping into a general willingness to contemplate a conspiracy arrayed against the association. Elliot, whose tendency was always to view other organizations as nefarious competitors, and to impugn the motives all who disagreed with him, was convinced that the attack was designed to protect Business Automation's own revenues by discrediting the DPMA. His mental state in the committee meeting transcripts sometimes recalls that of Nixon raging against his various enemies. "Now that we are out with our own publication," he ranted, "Chuck Gilbert [Editor of Business Automation] is no longer the top dog.... We have [advertisements] and we will get more. So this is a competitive thing." But Elliot also suggested that to write an official response would be to play into the hands of their enemies – the editors would only twist it to their own advantage. Swearingen and several others favored the sending of a collective letter showing that the association stood behind its certificate, but Elmer Judge, then president, refused to sign it. Elliot, invoking another perplexing conception of professionalism, supported this. "I don't think any member of the executive committee should sign his name to it. It's not professional. It just isn't right. It's degrading."

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[762] Data Processing Management Association, Executive Committee Meeting Minutes, 21-22 Jan, 1966, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 226-31. I have been unable to substantiate a claim made by Nathan Ensmenger that before 1966 the "examination and program literature" endorsed the use of the letters CDP as a suffix standing for "Certified Data Professional," and that this was only changed to "Certified Data Processor" after public controversy. Ensmenger, "The 'Question of Professionalism' in the Computer Fields", page 68. The association had clearly not anticipated the use of CDP as a suffix, as only in 1975 did its successor move to seek legal protection for the term to prevent private trade schools from offering their own CDP qualifications. Stanley R. Butterworth, "Reader Feedback: The Legal Status of CDP", Infosystems 22, no. 4 (April 1975):6.

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Instead, Elliot sought to persuade members of the CDP advisory committee, a group ostensively outside the DPMA itself, to send letters under their own names but to have them reviewed by the executive committee before dispatching them. One of its members, Robert Patrick, was associated with Datamation and refused to start a public fight between the two magazines. However another member, Larry Johnson, was more amenable and provided a letter. The letter invoked the history of the CPA as a model, pointed out that the value of the certificate would soon be bolstered with academic requirements, and conceded that this was not, "a certificate in data processing management." This, he suggested, could come only from experience. It could, however, "test proficiency" in the "body of knowledge" needed for data processing in the fields of technology, accounting, statistics and mathematics "which we think is vital to effective managerial decision-making in data processing activities."[763]

The effort to market the qualification beyond the DPMA's existing membership enjoyed some success, but this brought its own problems. The tension between the DPMA's obligations to its existing members, and the broader mandate of the certification council to promote the certification and education of data processing professionals, often stymied its work. For example, the DPMA's Journal of Data Management had been publishing a list of all those passing the examination and receiving the CDP. By 1965 the list included 4,365 names, and was becoming too long for inclusion in the journal.

Furthermore the DPMA and the certification council had no way of keeping in touch with the certificate holders who were not association members, and therefore did not receive the journal. Only half of the certificate holders were members of the DPMA. Adams and Swearingen worried that if the association failed to maintain its link to certificate holders then it would run the

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[763] Data Processing Management Association, Exec Comm, 21 June 1964, 42-43. The letter is Laurence A. Johnson, Letter to Richard D. Kornblum of Business Automation magazine, re: DPMA Certification Program, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota.

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risk of having them set up an independent association with its own agenda. As Adams reported to the executive committee in 1965, "we should be maintaining some link with this group. Otherwise we may find ourselves with a spin off of a separate organization.... there have been some rumblings by some highly placed people, that this CDP separate group is going to happen..."[764]

The advisory council had recommended steps including a questionnaire, a news letter and a roster of certificate holders. These would increase the visibility of the certificate, increase its prestige and build a feeling of community among its holders while simultaneously tying them closer to the DPMA itself.[765] Convincing the executive committee proved somewhat harder. Some worried that the publication of any list would make it easier for the certificate holders to form their own group. Others raised issues of cost and fairness. In the end the committee resolved to balance these problems by producing quarterly newsletters that would include the list of new and existing certificate holders as well as keeping them up to date with the newsletter. Consensus was reached after an agreement that the CDP holders would be charged $5 a year for this. This alleviated complaints such as Geckle's that, "[t]here is some feeling that in publishing a newsletter to CDP holders, we are providing a service to nonmembers free of charge, so that members are theoretically paying for service to nonmembers." The plan was to send out a questionnaire asking certificate holders for their latest addresses and trying to sell them a subscription to the newsletter. However, CDP holders paid $35 to take the test, and deserved to see their names in print somewhere. As Will observed "[w]e are almost obligated to publish a list of CDP holders somewhere. What this motion is doing is making these fellows pay $5 for it."[766]

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[764] Data Processing Management Association, Exec Comm, 20 Mar 1965, 391.
[765] Ibid.
[766] Ibid, 390-99.

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The passage of this resolution accomplished very little. As usual, Elliot's instincts made him reluctant to cooperate with anyone outside the association or to risk loss of control over any aspect of its operations. Having drafted the newsletter as instructed by the Executive Committee he had put distribution on hold, because it occurred to him that any roster of CDP holders would include the names of many DPMA members. Elliot claimed that the association's unruly Board of Directors was extremely protective of the list and that, "[t]here is always someone or some chapter accusing [us] of releasing that mailing list." While Swearingen countered that only the city, state and company would be supplied, Elliot insisted that a competent marketer could easily look up the street address and so produce a mailing list. He demanded that the committee vote again and explicitly order him to distribute the list. While it did so, some members of the committee clearly resented having to pass again a motion which had already been passed at their previous meeting and recommended by the advisory council.[767]

Elliot then moved to his second line of defense. He claimed that the committee's decision to cross list the roster by name and by geographical area meant that it would now fill about 150 pages, and so cost far too much to bundle with the newsletter and distribute for a $5 subscription. He proposed giving away the four page newsletter itself, at a cost of about $4,000 a year ("if we are going to try to keep this CDP holder close to us, let him know what is going on, what the DPMA is doing and his certificate program, then this is almost a must") but dropping the idea of a roster entirely. This would bind the certificate holders to the association while depriving them of the means to organize an independent group. Swearingen attacked this idea as driven by "fear that it will spur some organization of a separate group of CDP holders..." but Elliot's

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[767] Data Processing Management Association, <u>Exec Comm, 21-22 Jan, 1966</u>, 235-40.

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acquiescence to the newsletter was enough to persuade the committee to drop its insistence on the roster.[768]

Through this, the executive committee paid surprisingly little attention to the abrupt decline in the number of CDP candidates for 1966 caused by the implementation of the academic requirements. While Adams did note in his report to the executive committee that 560 of the 1800 or so people who had bothered to apply had been rejected owing to deficiencies in their academic pedigree, this came across more as an administrative headache than a crisis. "The education requirements were a problem," he said when presenting this report. "There were cases where people were borderline. They perhaps didn't have the letter of the academic requirement, but they had done so many other things that these things should be taken into account." At the same meeting, far more attention was paid to fresh attacks on the certificate – this time by some influential members of the ACM. (These are discussed later).[769]

By early 1967, however, the association found itself forced to grapple with some difficult questions. Elliot presented the executive committee with a six page memorandum outlining his own ideas for the CDP. His most pressing concerns appeared to be financial – with the decline in eligible applicants the existing program was straining the association's finances. The $48,000 net loss incurred by the CDP in 1965-66 represented 23 percent of the association's income from membership dues. As expenses rose and income fell, these losses were projected to rise to $68,000 for 1966-67, a startling 32 percent of dues income. If the DPMA was to follow the recommendations of the certificate advisory council and fund the expansion of the certificate then this might lead to disaster, for both the association and the certification program. This led Elliot toward an uncharacteristic recommendation: loosen control over the program and cooperate with other associations. He suggested that other associations such as the ACM and SPA would never

[768] Ibid, 241-55.
[769] Ibid, 225.

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accept the CDP or the other proposed qualifications while they remained under the sole control of the DPMA, and questioned whether any single association could hope to set standards for the entire field. He also worried that other associations were liable to produce their own examinations. His sudden willingness to abandon control in this area may have reflected a desire to get rid of a program he never really believed in more than a sudden conversion to the need for coordinated professional action.[770]

His specific recommendation was that, "a study group of knowledgeable people be formed to investigate methods of establishing a foundation." This foundation would be granted control of the certification program. He expected funding for this to come from data processing manufacturers and "private loaning foundations" as well as the DPMA and other professional organizations. According to Elliot, "[t]he foundation approach would then, without doubt, make the Certificate in Data Processing THE accepted certifying program and, of interesting and equal importance, keep the certifying program for data processing out of the control of government, whether it be federal or state."[771]

This is another case where a powerful but misguided idea of what professionalism consisted of influenced the association's actions. Elliot was instinctively hostile to the idea of any government involvement in the field. His refusal to believe that state regulation might have a role to play in bolstering the power of professional associations is startling to the historian, but reflected a widely held ideology within data processing circles. We saw before that Elliot viewed any attempt by the association to issue an official defense of its certification program as unprofessional. A few years later, he criticized a proposal that CDP members should have to pay

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[770] R. Calvin Elliot, The Elliot Recommendation to the Executive Committee Concerning the Future of the CDP Program, 1967, contained in .
[771] Ibid.

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annual dues to maintain their certification as unprofessional.[772] Professionalism could serve as a handy label for whatever one wanted to do anyway.

Elliot brought this proposal directly to the executive committee, bypassing the advisory council. Billy Field, then the association's president, endorsed Elliot's ideas and suggested that the executive should proceed with the plan regardless of the opinion of the advisory council. His opinion of its work so far seemed low. "In all due respect to you and the council," say Field to Jerome Geckle, chair of the committee, "it is not doing the job that we have got to have done."[773]

This was itself enough to expose considerable disagreement as to the council's role. Jim Parker spoke up in its defense: "I frankly feel that sometimes we make asses out of this Certificate Advisory Council. We go to great length to select the most qualified people in the country to serve on this Council, and we expect them to perform miracles in a lot of cases, and we don't give them any authority.... We ask them to make recommendations, and we turn around and vote it down. I wouldn't serve on the cotton-pickin' committee under those circumstances." This sentiment was seconded by Geckle, who argued that it was quite right for the committee's involvement to go beyond the design of the examination itself and into the broader questions of professional development. It was, he said, "an extremely, extremely difficult thing for the chairman of this committee to sit and watch this group completely devote themselves to an issue, come forth with a well qualified recommendation, and then to see [the executive] committee knife it for really, I feel, lack of complete understanding and knowledge."[774]

Some on the executive committee denied this, claiming that the solution was to set clear limits before sending an issue to the advisory committee, or that the advisory committee did not

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[772] Edith R. Jennings, Special CDP Report, 1968, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[773] Data Processing Management Association, Executive Committee Meeting Minutes, 16-18 March, 1967, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 52.

[774] Ibid, 49-50, 54.

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"resent this at all" and that nothing was "shot down without a great deal of justification." Field, however, acknowledged that the association had failed to back the advisory council sufficiently. Referring to the ill-fated roster, he recalled that, "Since the time the Council decided and recommended and were very serious about a roster, we have approved it three times and still haven't printed the thing." The committee as a whole appeared to recognize that the increasing separation of the certification program's scope from the DPMA membership, coupled with budgetary crunch, meant that the program was "at a crossroads". In something of an about-face, Field proposed passing increasing control over the certificate to the advisory council. The ideas met with general agreement. When Parker followed this with a formal motion to, "give authority to the Certificate Advisory Council in all matters pertaining to the CDP program limited only to the disposition of the program and submitting a budget to the executive committee on the needs to execute this program," the measure passed easily. This limited delegation of authority to the council took place immediately, and was followed the next year in its change of name from the Certificate Advisory Council to the Certification Council. Discussion of Elliot's more radical scheme was deferred until the council could make its own recommendation.[775]

Elliot proved to be correct in his belief that the future of the CDP lay with a special foundation supported by a number of different associations. But it would be another five years before the DPMA would take any serious steps in this direction. Its immediate reaction to the financial strain caused by the decline in eligible CDP candidates was more conservative: loosening the education requirements. The old course requirements had amounted in effect to an independent interdisciplinary major in data processing. The new requirement was to complete two years of college and to have taken two data processing courses. Even these modest requirements were waived for candidates with sufficiently long experience in data processing to

[775] Elliot, The Elliot Recommendation to the Executive Committee Concerning the Future of the CDP Program.

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have been eligible to take the test in 1965, prior to the initial imposition of educational requirements. The changes were announced in July of 1967, and by the following year the list of eligible candidates taking the examination had bounced back to 2,936. A substantial proportion of them qualified only though this so-called "grandfather" arrangement. In subsequent years this dipped rather than rising. Having first alienated the core of the existing membership by imposing the education requirements and then backtracked and sacrificed the certificate's broader credibility by removing them, the DPMA had left the CDP without a natural constituency. But for the moment, at least, the crisis had been avoided.

It was against this background that the association, and its newly empowered Certification Council, pursued an attempt to define new qualifications for data processing specialties, and eventually for the computer field as a whole. This brought it squarely into conflict with important elements within other computer related associations, particularly the ACM. It was also to force the association to confront the limitations of its push for professionalization, and to engage more closely than ever before with the world of scientific computing and the nascent academic discipline of computer science. To understand these developments, we must therefore explore the relationship of data processing to these parallel but largely separate communities. The next chapter tells the story of the interaction of the DPMA and its programs with other associations, and examines attempts by those within the scientific and technical computing communities to forge a broader and united computing profession.

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## 11. PAN-COMPUTER PROFESSIONALISM: DATA PROCESSING MEETS COMPUTING

This chapter addresses the interaction of the data processing community, and the DPMA in particular, with other computer-related associations and with other computer-related conceptions of professional identity. By reconstructing the way in which DPMA leaders saw the outside world, and the way in which the DPMA appeared to outsiders, it exposes the fundamental assumptions held on each side about what data processing was, and what the computer should be. It is focused particularly on attempts by a relatively small group of influential people to construct a new, overarching professional identity to encompass data processing, scientific computing, computer science and all other computer-related work. This effort, referred to here as "pan-computing professionalism," implied the assimilation of data processing along side other computer-related work within expanded or newly created associations. Pan-computing professionalism involved a fundamentally different conception of data processing work, as a specialty within professional computer work rather than a specialty within corporate administration.

Our attention thus far has been primarily on closely related groups of managerial technicians indigenous to corporate America. Office managers, systems men, machine accountants and data processors all grew up within the world of administrative management. As a result, they shared a quite unproblematic assumption that increased professionalism involved doing less hands-on technical work, rising within the organization chart, and moving as close as possible to the culture and concerns of executive managers. Only operations researchers, with their disdain for existing managers and unshakable faith in the superiority of the scientific method, really challenged this belief.

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Unlike earlier technologies such as bookkeeping machines, filing systems and early punched card machines, the electronic computer found its first widespread application outside the realm of corporate and governmental administration. Computer technology was originally developed and applied as a tool of scientific and engineering calculation. Many of those first involved in its programming and use came from scientific backgrounds, and an appreciable number of these men and women crossed over to consulting, sales and management roles within corporate data processing. Unsurprisingly, the culture and outlook of these individuals differed from that of the typical data processing manager. Computer science, which emerged as a new academic specialty during the 1960s, provided another way of conceptualizing the purpose of the computer and the true nature of the computer professional.

Data processing, computing (or as we would now say, scientific and technical computing) and computer science remained largely distinct, though the unprecedented complexity of computer technology and the overlapping activities of programming and operations work created elements of commonality between these distinct communities where none had existed between, say, pure mathematicians, electrical engineers and office managers of a previous generation. While none of these programs for professional recognition were entirely successful, careful examination of their relationships and incompatibilities sheds light on the paradoxical and hard to accommodate nature of corporate computing work.

## Computing vs. Data Processing

No one now speaks of data processing. Sometimes during the early 1990s it breathed its last. The DPMA, having largely withered away, was revived as the Association of Information Technology Professionals. Corporate computer departments were renamed as departments of Information Technology (IT), Information Systems (IS), or MIS. DP survives here and there. Automatic Data Processing, Inc. has been using computers to run payroll jobs for companies

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since the 1950s and stuck with its name throughout. The Black Data Processing Association does not appear to have changed its name yet. A quick Internet search reveals that a firm with the conspicuously archaic name of Data Processing Science Corporation is attempting to define itself as a leader in "architecture for e-Business," a term already taking on unpleasant associations of its own. Today, business people just tend to refer to computers and related phenomena as "technology".

For at least a quarter century, however, data processing and its many variants were the terms of choice to describe the use of computers for administrative and operational purposes by corporations, government and the military. The corollary of this, as yet rarely acknowledged, is that the term "computing" was seldom if ever used by members of the data processing community when discussing their own work. Although many were happy to use "computer" as a substitute for "electronic data processing equipment," the verb form was reserved for those performing technical or scientific work with their machines. That is hardly surprising, for this work had been known all along as computing or computation. It retained the same name when transferred to machine.

This historical wrinkle has major historiographic implications. We are accustomed to refer to study of the historical development, use and social place of the computer as the "history of computing." The term has some obvious merits. The "history of computers" sounds hopelessly inward looking – akin to the history of light bulbs. Computing is, at least, an activity. It implies a human and social element to the analysis. And, to the modern reader, it appears a much broader topic than the history of computation. Back in the 1950s, however, the accepted meaning of "computing" was much closer to the original sense of "calculating or counting," an activity that predated the development of electronic computers. Early histories of computing, from Berkeley's 1949 Giant Brains onward, took care to position the computer as the latest and best in a long line

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of computing tools. Anyone who read such an account would learn about the abacus, slide rules, Napier's bones, adding machines and other arithmetic devices.[776]

This was not an idea with any particular resonance among most machine accountants, office managers, or systems men. With some obvious exceptions, such as actuarial work, not very much computing took place in offices. As we have seen, administrative use of computers took place under the rubric of data processing, and was undertaken primarily by former punched card staff and systems men, along with a decent number of office managers and accountants. We saw in the previous chapter that very few data processing managers of the early 1960s had any involvement with computing (in the original, scientific and technical sense), almost none had scientific degrees, and most lacked degrees of any kind.

Likewise, few members of the scientifically oriented Association for Computing Machinery (ACM) took the CDP examination, though those that did were unusually successful at it. The ACM was founded in New York in 1947, with an initial membership of 175. By January of 1948, this had increased to 350. Since then it has been the most important society for those interested in computing (again, in the original sense) and one of the two primary venues for those interested in what became the academic discipline of computer science.

I make no attempt here to tell the story of scientific computing or of academic computer science. Neither topic has yet received a synthetic historical treatment, though both are better documented than the story of data processing.[777] The attention that I do give to these topics is

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[776] Berkeley, Giant Brains or Machines That Think. A similar sense is given in most histories of computing into the 1980s, for example Goldstein, The Computer from Pascal to von Neumann, Christopher Evans, The Micro Millennium (New York: Viking, 1979), chapters 1-3 and Michael R Williams, A History of Computing Technology (Englewood Cliffs, NJ: Prentice-Hall, 1985). More recent histories, prompted in part by broader awareness of the computer's role in non-numerical application, have presented it as the intersection of a much broader range of "information technologies". This is particularly apparent in Campbell-Kelly and Aspray, Computer and Steven Lubar, Infoculture: The Smithsonian Book of Information Age Inventions (Boston: Houghton Mifflin, 1994).

[777] On the history of academic computer science, see William Aspray and Bernard O. Williams, "Arming American Scientists: NSF and the Provision of Scientific Computing Facilities for Universities,

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intended rather to illuminate data processing, and its vision of the computer expert as managerial technician and aspiring manager, by considering some of the alternative identities constructed around the same technology.[778]

In its very early days, the identity of the ACM was quite diffuse. Few electronic computers existed, and in principle the association was open to all with an interest in them. For its first six years, the association's leading light was Edmund Berkeley, who served as its secretary. Although Berkeley had a mathematics degree, from Harvard no less, he was not an academic. He came to an interest in computing, and electronic computers, through his role as an actuarial methods expert for the Prudential Insurance company. He was fired by a belief in the potential of computers to transform both business and society. Giant Brains had made him the most effective popularizer of computing. But his belief in social activism seemed out of place to many of the association's more academically and technically inclined members. In addition, despite his hard work the ACM remained marginal as an academic association, and was under threat from the

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1950-73", IEEE Annals of the History of Computing 16, no. 4 (Winter 1994):60-74, Michael S Mahoney, "Software as Science--Science as Software", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002), and William Aspray, "Was Early Entry a Competitive Advantage? US Universities That Entered Computing in the 1940s." IEEE Annals of the History of Computing 22, no. 3 (July-September 2000):42-87. On the history of scientific computing much of Akera, "Calculating a Natural World", David Alan Grier, "The Rise and Fall of the Committee on Mathematical Tables and Other Aids to Computation", IEEE Annals of the History of Computing 32, no. 2 (April-June 2001):38-49, and David Alan Grier, "The Math Tables Project of the Work Projects Administration: The Reluctant Start of the Computing Era", IEEE Annals of the History of Computing 20, no. 3 (July-September 1998):33-50. On the history of the ACM, see Alt, "Fifteen Years ACM", Revens, "The First 25 Years: ACM 1947-1962 (sic.)", Anita Cochran, "ACM: the past 15 years, 1972-1987", Communications of the ACM 30, no. 10 (October 1987):866-72 and Eric A Weiss, "Commentaries on the Past 15 Years", Communications of the ACM 30, no. 10 (October 1987):880-85.

[778] For this reason, my interest in the ACM is focused entirely on its interactions with the DPMA, on the efforts of its Los Angeles chapter and business data processing special interest group to foster pan-computing identities, and on the efforts of some of its leaders to expand its appeal into the data processing area. By the same token, I pay little attention to the work of the IEEE Computer Society (and its precursors) except where it worked with other associations. While very important in many areas of computing, the computer society barely impinged on the awareness of the DPMA and did little during the 1960s to recruit data processing staff. Neither does it seem to have produced many leaders committed to the cause of pan-computer professionalism during these years.

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better established mathematical and engineering societies. In 1953 he was forced out, to be replaced by a physicist.[779]

The next year, in the first issue of the association's new Journal, its president laid out his plans for this "new phase of its existence." He suggested that the time for informality was over. The new journal would be academically inclined and professionally produced. He acknowledged that the engineering societies were better placed to research the building of computers, and so suggested that, "the Association can direct its efforts to the other phases of computing systems, such as numerical analysis, logical design, application and use, and last, but not least, to programming."[780] Membership then stood around 1,200 – much larger than any previous computing community, but still only a fraction of the number of the NMAA's membership. Although the Journal of the ACM published a few articles on data processing in its initial volume, including one on life insurance premium billing and some technical articles by IBM designers on the 650 and 702 computers, such topics were soon eliminated from its pages.[781]

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[779] This characterization of Berkeley's role is based on Akera, "Calculating a Natural World", 567-86. On the early history of the ACM, including lists of early council member, all changes in officer posts, and a chronology of meetings see Alt, "Fifteen Years ACM".

[780] Alton S Householder, "Presidential Address to the ACM, Philadelphia, September 14, 1955", Journal of the Association for Computing Machinery 3, no. 1 (January 1955):1-2.

781 Bashe, Bucholz, and Rochester, "The IBM Type 702: An Electronic Data Processing Machine For Business", F E Hamilton and E C Kubie, "The IBM Magnetic Drum Calculator Type 650", Journal of the Association for Computing Machinery 1, no. 1 (October 1954):13-20, George E Trexler, "Public Utility Customer Accounting on the Type 650 Magnetic Drum Data Processing Machine", Journal of the Association for Computing Machinery 1, no. 4 (October 1954):173-76 and R T Wiseman, "Life Insurance Premium Billing and Combined Operations by Electronic Equipment", Journal of the Association for Computing Machinery 1, no. 1 (January 1954):7-12. Almost no papers on data processing were published in subsequent volumes of the journal, though some did appear in the less academic Communications of the ACM once this alternate outlet was established in 1958. In his 1955 Presidential address, A S Householder admitted that he had "heard many complaints" that papers were too mathematical, and not enough dealt with business applications. His position was that this would be desirable "in principle", because "an increasing percentage of machines are being used in business applications, and hence an increasing percentage of our membership could or should be drawn from people in this field." The problem, however, was in his view quite simple: "not many high caliber papers are being written in this field." Alton S Householder, "Presidential Address to the ACM, Philadelphia, September 14, 1955", Journal of the Association for Computing Machinery 4, no. 1 (January 1956):1-4. Of course, a mathematician's definition of a high caliber paper might not have accorded with that of a data processing manager.

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While data processing people and corporate computing staff between them made up a majority of the ACM membership, the association's leadership, and in particular its governing Council, was dominated by mathematically inclined academics. Their biggest concern was to establish computer science as an academically respectable discipline in its own right – something beyond the engineering techniques of computer design or the computational craft techniques used to crunch numbers and run simulations in pursuit of research carried out by the real sciences. This meant rigor, mathematics, theory, logic and the production of research which could only be understood by real scientists. Theoretical examination of programming languages, algorithms, and computer architecture emerged as the distinctive elements of the new discipline, with flurries of interest in artificial intelligence. For most of the association's leaders, then, the challenge was to boost their academic credibility and separate themselves from university computer centers. Little in this project suggested that the association should go courting the former punched card machine operators of data processing.

It is therefore not surprising that, to most of those involved in either activity, data processing and computing appeared entirely separate undertakings. In 1962, for example, Herb Grosch was obliged to write of, "the day-to-day operation of a data processing or computing installation" when he wanted to make a point about the general operation of computers.[782] The two activities were performed in different places – computing took universities, laboratories, research departments and corporate engineering groups, while data processing was an administrative activity under the authority of the corporate controller. They used different and incompatible models of computer. In the case of IBM, the two groups of users even formed different groups – computing installations created SHARE, while data processing installations joined a group called GUIDE. IBM had to set up new departments to service its computing

[782] Grosch, "Software in Sickness and Health".

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business, and found it necessary to adopt new marketing methods and to hire representatives with scientific backgrounds to support the new customers.[783] Where computing departments quickly adopted FORTRAN for their programming needs, most data processing shops stuck with assembly language into the mid-1960s and then shifted to COBOL.

Programming, an alternative to computing used by Nathan Ensmenger to guide his recent dissertation, is even more misleading. As a frame for the contested identity of computer specialists it proves both too narrow and too broad. It is too broad because it forces Ensmenger to claim that data processing managers, computer scientists and software engineering advocates were competing for the loyalty of a single "programming community." It is too narrow, because none of these groups were actually trying to produce a profession of programming. For each of them, programming was merely a small part of a much bigger professional construction rather than a profession in itself.[784]

The question, then, is whether data processing and computing had enough in common during the 1950s and 1960s to make useful to consider them as being in any respect parts of a broader whole. The answer depends entirely on where one is looking from. From the point of view of computer hardware producers, the two groups of customers did indeed represent two segments of a single market. If one looks from their perspective, exploring the evolution and supply of computer hardware, then it makes perfect sense to view the whole thing as computing. From the perspective of use, however, it can be very misleading. The scientists and engineers

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[783] For the adjustments made by IBM to support its scientific users, see Akera, "Calculating a Natural World", 378-96.

[784] Ensmenger, "From Black Art to Industrial Discipline". It follows that if one is interested in the use of computers during the 1950s or 1960s then one cannot afford to implicitly endorse the objective existence of any coherent community such as "computer specialists," "programmers," "aspiring computer professionals" or "computer people" – all terms used interchangeably by Ensmenger. It is also notable that neither the Association for Computing Machinery, nor the disciplines of computer science and software engineering, nor the Data Processing Management Association, nor the Certificate in Data Processing, nor the IEEE Computer Society, nor any other significant association or credential of the period included the word "programming" or "programmer" in its title.

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who manned computing centers in corporations and universities formed a community largely separate from data processing.

Likewise, academics looking to win recognition for computer science as a new discipline did not, by and large, have very much respect for data processing staff. To many of the most vocal members of the emerging international computer science community, the acerbic Edsger W. Dijkstra being a prime example, business programming was a kind of programming (if a rather uninteresting one), and all programming was by definition the application of mathematics and of computer science theory. This made for a very different understanding of professionalism from that held by the leaders of the DPMA. If a programmer was not interested in computer science then that made him or her an unprofessional programmer. Systems programmers were, in this way of looking at the world, far more professional than applications programmers because they worried less about business concerns and more about novel algorithms and generalized tools. Even computer systems analysts, whose attention was focused on the pinning down and implementation of seemingly trivial details of business procedures, were at best very marginal within the computer science version of professionalism. Computer operators had little place in this identity, and neither did managers, accountants, systems and procedures experts, or tabulating machine workers. These groups were not just sub-professional, they were completely outside the computer science frame of reference.

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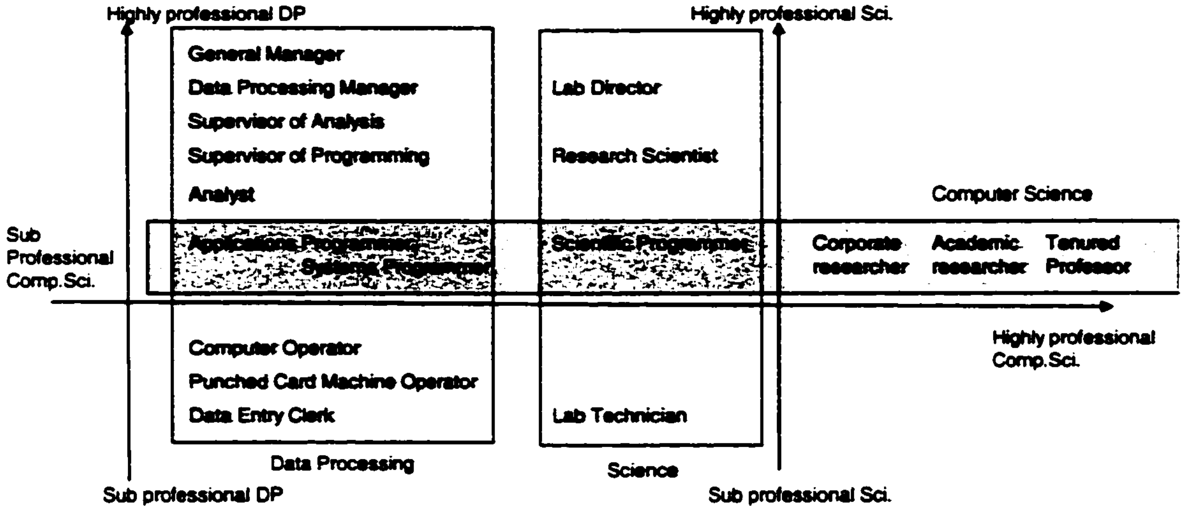


**Figure 39: Computer science and data processing as horizontal and vertical integrations of identity and professional status.**

One might, following Alfred Chandler's discussion of business mergers, refer to this as the horizontal integration of professional identity, a concept indicated graphically above. It singled out programmers from others in the data processing department, cutting through the data processing status ladder. The concept of professionalism espoused by the DPMA, and embodied in its CDP, was utterly different. The CDP was never spoken of as a certificate for programmers – it was a certificate for the professional data processor, and most particularly for the manager or would be manager of data processing. Because this emphasis on the knitting together of different roles within the data processing department, and the creation of an identity that could reach up the organizational chart from machines into management, I refer to the data processing vision of professionalism as the "vertical integration" of identity. The programmer was joined together with colleagues in lower status occupations (punched card, operator) and others in higher status roles (analyst, supervisor, manager). The DPMA's leadership hoped that this identity could form as a ladder, to be climbed through the department and ultimately out of it all together, onto the executive floor.

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Even as the horizontal concept of identity implicit in computer science professionalism isolated corporate programmers from their colleagues in the EDP department, it joined them with their estranged brothers in scientific computing, with the systems programmers and researchers working for firms like IBM, and with academic computer theorists of all kinds. An extreme version of this concept was given in 1967, when a University of Chicago computer scientist presented what must have seemed to him a rather generous definition of the "computer programming profession" including "programmology," "mathemology" and "systemology" which "taken together, should be viewed as the professional programming domain." Application programmers, however, were explicitly excluded as "sub-professionals".[785]

This view of the world required its adherents to see the shared activity of programming as the natural basis for an occupation, or profession. They were then faced with the problem that this occupation showed very little coherence or self-awareness. In 1962, for example, Christopher J. Shaw of SDC discussed what he saw as a spectacular "programming schism" emerging between the two camps, as computer specialists fragmented. This caused a "growing breach between the scientific and engineering computation boys who talk ALGOL and write programs in FORTRAN (which is something of a comedown) and the business data processing boys who talk English and write programs in COBOL (which is even more of a comedown.) It has already reached the point where the FORTRAN programmers and the COBOL programmers couldn't talk to each other if they wanted to -- which, of course, they seldom do." The last sentence is the kicker. While Shaw believed that the construction of a common programming language was the answer, he had already admitted that the two groups had little to talk about. What exactly would a tabulator operator or accountant retrained to program payroll operations talk about to an astrophysicist

[785] Alex Orden, "The Emergence of a Profession", Communications of the ACM 10, no. 3 (145-147 1967).

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retrained to construct computer simulations? Lack of a common computer language was the least of their worries.[786]

This was not one field of programming wracked by a growing schism between computing and data processing. These were two fields with almost entirely separate roots, cultures and concerns growing slowly closer together and striking sparks against each other in the process.

## Pan-computer Professionalism Defined

This is not to say that nobody during the 1950s and early 1960s tried to create a unified organization for computer people, or to define broad versions of professional identity for programmers and other computer staff that could somehow span computing and data processing – uniting a profession along horizontal and vertical axes simultaneously. A number of vocal individuals made such efforts. When they looked at computing, computer science and data processing they saw a fragmented, divided field – but they saw a field. They talked of schisms and divides – but nothing can be divided if it was not once whole. Where most might see a corporate manager specializing in data processing, they would see a computer professional specializing in corporate management. Where others might see a physicist specializing in mathematical simulation, they would see a computer professional specializing in mathematical physics.

Considerable effort was devoted from the 1950s onward to the formation of a single overarching professional identity to encompass everyone involved with computers: scientific users, computer designers and engineers, programmers and the data processing supervisors and analysts of administrative computing. I refer to this tendency as pan-computer professionalism, by analogy to pan-Arab and pan-African nationalism. All reflected a faith than one element of

[786] Christopher J Shaw, "Programming Schisms and Their Future", Datamation 8, no. 9 (September 1962):32.

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identity – be it a shared experience of colonialism or a shared bond with electronics – deserved to be elevated above all others to form the basic unit of community. All reflected a particular ideology and particular historical experiences. All foundered, which is to say that most members of these putative communities ultimately preferred to identify themselves in other ways – as members of more fractious and less inspirational nations. Relatively few within the DPMA were eager to join forces with the "longhairs" of scientific and academic computing. Within the ACM, likewise, most of those trying to establish the credentials of computing as a scientific profession saw little to be gained from an alliance with punched card supervisors and their successors.

Efforts in this direction were pursued most strenuously by a relatively small group of prominent computing figures. Such people were generally intelligent and highly successful men with scientific backgrounds, whose careers had begun in computing but whose professional interests (often as managers within computer firms, or as consultants) had brought them into close contact with data processing. While most were highly active in one or more of the societies representing different computer constituencies (the ACM, DPMA, IEEE and its precursors) they were associated with three particular efforts. One was AFIPS – an umbrella group expected by many of its founders to provide an overall identity for the computing field. Its story is explored below. The other two were the SHARE user group, and the ACM's own Special Interest Group for Business Data Processing (SIGBDP). Membership of these groups overlapped considerably, and leading figures of all three were part of a small community centered on Southern California, and in particular its aerospace firms and the RAND Corporation. A long-running series of annual meetings organized under RAND's auspices, and known informally as the RAND Corporation Symposia, provided an additional venue for the pursuit of pan-computing professionalism.

The push to build a profession that encompassed the whole of computing appears to have come primarily from people who had themselves worked in several different areas of computing.

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The common ground on their resumes tended to include an advanced degree in science, early work in scientific computation (often using the CPC card processor) around the end of the 1940s, followed by a shift to the electronic computer working on technical applications. The crucial moment for most of these men came in the early- to mod- 1950s with a shift to an organization with a broader purpose, to become either a specialist in computer applications for a computer vendor or within a computer services firm, a consultant, or (in many cases) part of a computer research group at the RAND Corporation. Further switches between these roles usually followed.

These shifts left many with considerable sympathy for the problems faced by data processing managers. They sometimes resented the perceived elitism and insularity of their more purely academic colleagues. In a 1963 article called "The Maturing Field," Robert Patrick gave the theme its classic statement. Patrick had recently vacated a senior job with technical computer services firm CEIR and entered business for himself as a consulting computer specialist. His background was in technical computation, including a spell with General Motors, and he had published a technical paper in the Communications of the ACM. This gave him an unusually rounded view of the different computer-related occupations.[787]

In his article, Patrick discussed the origins of the computing field back in the early 1950s, and the enormous excitement as a (scientific and technical) computing community first formed around 604 tabulators and Card Programmable Computers moved onto the new frontiers of the IBM 701. The SHARE user group was, according to Patrick, the central institution in the creation of this new computing elite, which he number around one hundred people. According to Patrick, "the outcome was a programming priesthood...." for whom "conferences were held with the IBM

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[787] Patrick, "The Maturing Field".

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inner circle." "Being head of an installation helped [with admission], although [systems] programmers of note were also eligible."[788]

Despite his own long involvement, Patrick was appalled with the subsequent development of this elite. He suggested many of its members had become administrators in charge of computing installations, but had "developed no unique skill of their own" and "in many cases" had "forgotten to work." As a result they had little hope for future advancement. Some were still "practicing technicians," but these men too were stuck in ruts, with little scope for advancement. While some had gone into research, he felt that this was usually nominal. "Many of these men lack the determination and self discipline required. They have merely retired at 35." He pointed out that standards activities, a major occupation of the engineering societies, had been "marvelously unproductive to date (probably due to their leadership)" and called universities "sinks for talent and manpower."[789]

Patrick called for the development of a new generation of well educated practitioners, able to replace this complacent and inbred elite. More interestingly, he implied that the DPMA should be part of this future. Admitting that he had "been an ACM member for many years and, as such.... prejudiced against the NMAA" he went on to associate the ACM with the complacent "priesthood" and the DPMA with the new generation of ambitious youngsters. He had just obtained a CDP, and praised the DPMA for harnessing the "diligence and drive" of its members to address their lack of formal education. He felt that the test would strengthen their overall competence and ensure that managers had a reasonable technical background. In the future, he

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[788] Ibid.

[789] Unsurprisingly, given his work with service and consulting firms, he believed that unproductive and badly run corporate computing centers were liable to find their programming work taken away by "small independent contractors." Patrick's hopes for the immediate future lay with the relative handful of the original group who had launched their own firms or assumed positions of true leadership within technical organizations, heading large staffs to tackle complex projects.

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looked forward to a series of examinations and specializations in the same mould.[790] Patrick himself was about to join this effort, as a member of the DPMA's Certificate Advisory Council.

In a much longer 1969 address to the ACM Special Interest Group on Computer Personnel Research, Patrick elaborated on some of these ideas in a way that made it clear how far his ideas on the proper nature of a unified "computer field" represented a formalization of his own personal experience. He offered an elaborate model of the development of the "computer field." In 1952 the field consisted of one kind of position: programmer/operator. By 1955 this had split into two separate roles. (The omission of the position of analyst or supervisor, present in data processing long before the introduction of the computer, reflected his own background in computation). By 1960, in his historical sketch, the field broadened to include three specialisms as programming itself split into utility (systems) programming and application programming.[791]

Returning to 1969, Patrick identified six components to the computer field: hardware (engineering), software, applications, sales, research and operations. He felt that the true computer professional needed basic knowledge of all these areas, and promising professionals should rotate through them to give broad familiarity. To rise to the very top, "and draw more than $20K, you've got to know two or more of the fundamental skills and be well-read in the other four." Yet it seems unclear how six such disparate elements could really form a single profession, or where (other than at IBM) one could hope to find all of them in a single company.

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[790] Patrick, "The Maturing Field".

[791] Robert L Patrick, "Selection Starts the Cycle", in Proceedings of the Seventh Annual SIGCPR Conference on Computer Personnel Research (New York: ACM, 1969), 13.

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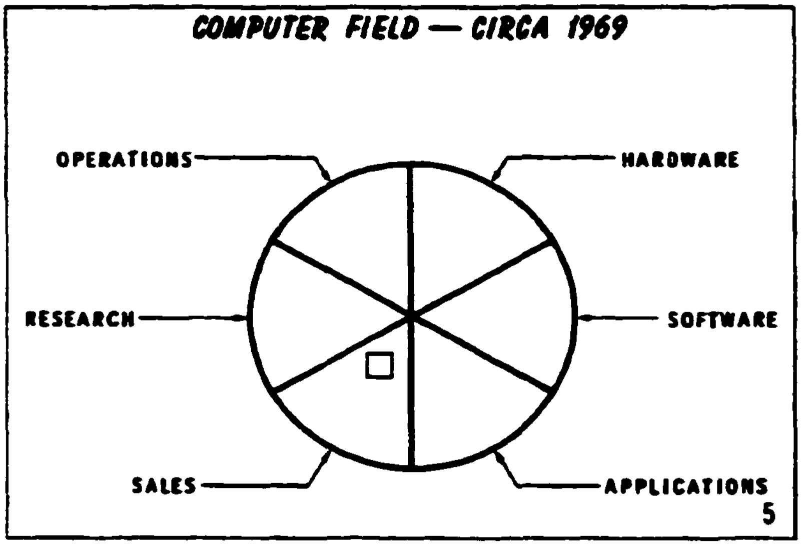


**Figure 40: Patrick's concept of the "Computer Field".[792]**

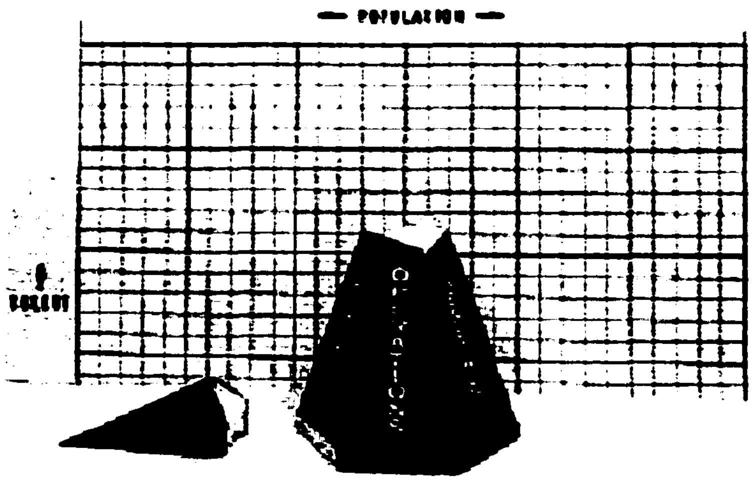

**Figure 41: Patrick's vision of a computer professional – the talented few who sit at the apex with a firm grounding in all areas.[793]**

Other exponents of pan-computer professionalism had similarly varied careers, often moving between jobs as consultants, managers of computing departments, academic researchers and software specialists at computer manufacturing companies. One need look no further for evidence than Herb Grosch, perhaps the single most vocal proponent of a unified computing

[792] Ibid, 17.
[793] Ibid.

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profession. During the 1950s and 1960s he worked for IBM twice, GE twice (running a computer installation, managing applications for its own computer development program and working on software research), the computer service company CEIR, the federal Bureau of Standards and for other firms as a consultant. Grosch had a knack for stirring up trouble and getting fired, and so his mobility was perhaps extreme. He was one of the most popular and controversial commentators on computing, writing frequent articles in Datamation and regularly presenting keynote addresses at conferences. In the 1970s, his celebrity made him the first successful write-in candidate for presidency of the ACM, and his tenure made for some of the bitterest personal feuds in the association's history.

Attempts to establish identities such "computer people," "the computer field," "the information processing field," or "the programming profession" or any variant invoke a situation not unlike that of the parable of the wise, blind men faced with an elephant. One gropes its trunk, another its leg, yet another its flank and so on. Each comes to a different conclusion as to the nature of the object confronting them. Depending on where each stood, it might seem a snake, a wall or a tree. As readers we are not ourselves blind – we stand outside the situation and are privileged to see the elephant for what it is. For this reason, the story works to illustrate any argument being made in favor of a heretofore unsuspected holism. Grosch, Patrick, and the others saw themselves as sighted men who had strayed into it. They would blame willful blindness to the elephant itself on lack of imagination, self interest, conservatism and complacency.

Yet the historical situation is really the opposite. The pan-computer professionalists wandered unusually broadly in their careers, and came across a wall, a snake, and a tree. They decided that what the world needed was an elephant. When they proclaimed its existence they were neither right nor wrong – the elephant could be conjured into existence only if enough people could be persuaded to behave as though it was already there.

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| | SIG BDP, LA ACM, RAND, SHARE | AFIPS | Managed Computer Center | Computer vendor | ACM National | DPMA Group | Consultant | Other |
|---|---|---|---|---|---|---|---|---|
| Paul Armer | LA ACM (Treasurer) RAND SHARE | Pres., 1968-9 | Douglas, RAND, Stanford | | Pres. Candidate, 1958 (lost) | | | Fellow, Center for Advanced Study in the Behavioral Sciences |
| Herb Grosch | SHARE | | IBM, General Electric, Bureau of Standards | IBM, GE (applications) | President, 1976-77. Vice president, 1974-75. Council 1968-1987 | Long Range Advisory Comm. | CEIR | |
| John Postley | SIG BDP (chair) LA ACM RAND SHARE | | Bureau of Standards, Northrop, RAND, Hughes Dynamics | IBM (operating systems) | | | | Informatics, Inc. (responsible for Mark IV project) |
| George Glaser | SIG BDP (chair) LA ACM (chair) | Pres., 1973-5. Treasurer, 1971-3 | | | Treasurer, 1968-1972. Council, 1973 | | Mc Kinsey, indep. Consult. | |
| Bruce Gilchrist | | Pres., (1966-67). Exec. Director (1968-73) | U. of Syracuse. IBM (Service Bureau Corp.). Columbia University | IBM (Data Processing Divn., 1965-1968) | Secretary, 1960-1962. Vice President, 1962-1964 | | | |
| Daniel D. McCracken | | | General Electric | General Electric | Vice President, 1976-978, President 1978-1980, Council 1974-1982 | | indep. consult. | |

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| | SIG BDP, LA ACM, RAND, SHARE | AFIPS | Managed Computer Center | Computer vendor | ACM National | DPMA Group | Consultant | Other |
|---|---|---|---|---|---|---|---|---|
| **Solomon L. Pollack** | SIG BDP (chair)<br><br>LA ACM (chair)<br><br>RAND | | Convair, Raytheon, National Bureau of Standards, North American Aviation, Computer Control Company | | | Long Range Advisory Comm., Certification Council | Information Management, Inc. | CODASYL Systems group |
| **Robert L. Patrick** | RAND consultant | | General Motors, CEIR services firm | | | Held CDP. Certificate Advisory Council, 1963-1965 | indep. Consult. 1962 onward | |
| **Fred Gruenberger** | RAND | | University of Washington | | | Early member of Southern Wisconsin Chapter – used tabulating machines for computing | | Computing News, 1953-1957. Convened Rand symposia. Worked briefly at Informatics. California State University |
| **Richard G Canning** | SIG BDP, (Chair 1971-73) | Secretary, circa 1970 | | | Distinguished Service Award | Certification Council | Canning Sisson & Associates | Published EDP Analyzer, wrote data processing textbooks |
| **Walter B. Carlson** | | Chair in 1980s | | IBM | Vice President, 1969-70. President, 1970-2. Distinguished Service Award | | | |

**Table 5: Key pan-computing professionalists, with affiliations.**

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## RAND, Los Angeles, and the Origins of Pan-computer Professionalism

Pan-computer professionalism sprang primarily from two southern Californian institutions: the RAND Corporation and the Los Angeles chapter of the ACM. Founded in 1954, this chapter was among the first active local groups in an association that had until that point had inspired little grassroots organization. During the late 1950s, this chapter was closely tied to the SHARE user group (for computing centers using large, scientifically-oriented IBM computers), to the aerospace companies such as Douglas and Northrop which made up the core membership of SHARE, and to the RAND Corporation itself. Its members included many of those who would go on to pursue the cause nationally, among them Walter Bauer (chapter chair during 1956-1958), Paul Armer, John Postley, Solomon Pollack, George Glaser and Fred Gruenberger.

Paul Armer, a computing specialist at the RAND Corporation and stalwart member of both SHARE and of the LA chapter of the ACM, was the first to give strong expression to pan-computer professionalism within the national association. Armer got his start in a Californian aerospace firm during the late 1940s. His work for Douglas began with a desk calculator but he soon moved on to the use of electrical punched card machines and the new CPC programmable punched card system. When Douglas span off the RAND Corporation he followed, to head its Numerical Analysis department from 1952 to 1962. RAND built its own computer (the JOHNNIAC) during the early 1950s, and later used it to pioneer work on timesharing operating systems – giving its staff unusually wide exposure to different aspects of computing. Armer himself was a prominent figure within SHARE, played an important role in AFIPS, and worked within the ACM to promote a broader vision of computing professionalism. In 1958 he was nominated as a candidate for president of the association, and used the contest to promote a pan-computer professionalism platform. He urged the association to "think BIG" and welcome

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diversity, to give greater power to local chapters, and to recognize the professional and geographical diversity of its membership.[794]

The following year, Armer and his friends returned to these themes at the so-called "RAND Corporation Symposium" – a series of small, informal discussions attended by an invited group of the most prominent experts on computing and computers. Its organizer was Fred Gruenberger, who had himself had worked at an early academic computing center. He gained prominence as publisher of Computing News, an important newsletter for discussion of computing matters, before spending almost a decade at RAND from 1957, where his main project was to promote computing in secondary schools. While his newsletter had initially focused on computing, and matters of interest to the scientific computing community, its appeal soon widened to include discussion of a range of data processing topics. By the time he joined RAND, Gruenberger could deal with the staffing and management of a 702 data processing installation one page, and the rival merits of Monroe and Marchant rotary electric desk calculators the next. The symposia gave him a different outlet to pursue his search for reconciliation between these diverse worlds.[795]

Attendees at the symposia were a mixed bunch, and rarely agreed on anything. Over the years, they included some famous names from computer science, such as Joseph Weizenbaum,

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[794] The story of Armer's run for ACM President is told in Akera, "Calculating a Natural World", 593-602. Later in his career he held directed the Computation Center at Stanford University and developed an interest in social issues of computing. Armer was involved in the establishment of the Charles Babbage Institute and active in the history of computing field. Two oral histories were produced by the Babbage institute, available as George D. Green, OH1: An Interview with Paul Armer (Minneapolis: Charles Babbage Institute, 1981) and Robina Mapstone, OH 59: An Interview with Paul Armer (Minneapolis: Charles Babbage Institute, 1973).

[795] Gruenberger documented his secondary school work in Fred Gruenberger, "A Diary For Tomorrow's Programmers", Datamation 9, no. 1 (January 1963):48-54. After leaving RAND, Gruenberger worked briefly for pioneering software firm Informatics, before taking a post at San Fernando Valley State College where he spent the rest of his career. Gruenberger continued the symposium after his departure from RAND, and the series ran from 1958 to 1976. The transcripts of all RAND symposia are found in the Rand Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis. The CBI website includes a finding aid giving background and listing all participants.

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Seymour Papert, Carl Hammer, Richard Hamming, and mainframe designer Gene Amdahl. J.C.R. Licklider, famous now as the military sponsor of early work on what became the Internet, attended once. Leaders of the ACM and the IEEE were usually invited, regardless of their outlook. Leaders of the DPMA were only infrequently included, though guests included others, such as Daniel D. McCracken and Richard Canning, with a good knowledge of data processing. But the core attendees appear to have been those, whether currently employed at computer companies, consulting groups or as industry commentators, who were interested in computing as a whole – the stalwarts of pan-computer professionalism.

In 1959, Gruenberger hosted the second of his RAND Corporation symposia as an invitation-only meeting before the Western Joint Computer Conference, to "discuss some of the problems plaguing the industry." Among the guests were Paul Armer, Herb Grosch, and Walter Bauer (then of Space Technology Labs). Many of these men were key figures in the NJCC organization (a joint organization responsible for hosting the leading computer trade show), the ACM, and the Institute of Radio Engineers (IRE) and American Institute of Electrical Engineers (AIEE) engineering societies.[796]

The main topic of conversation turned out be the ACM, and specifically whether it should be reformed to make it more broadly representative of the computing field, or simply abandoned. The meeting has emerged in retrospect as a key event behind the foundation of AFIPS a little later. While transcripts of all the symposia were prepared, most were simply

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[796] Other attendees included representatives of computer vendors and large users (among them Al Zipf of the Bank of America – leader of the project to standardize checks to include machine-readable account codes), industry commentators, Don Madden of SDC and a couple of academics. Large portions of the transcript of this meeting were published as Anonymous, "Is It Overhaul Or Trade-In Time (part I)", Datamation 5, no. 4 (July-August 1959):24-33 and Anonymous, "Is It Overhaul or Trade-In Time (Part II)". The full version is available as Fred Gruenberger, Second RAND Symposium, Unexpurgated, 1959, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis. The circumstances behind it were discussed in Rosamond W Dana and Henry S Tropp, "Reflections on a Quarter-Century: AFIPS Founders", Annals of the History of Computing 8, no. 3 (July 1986):225-51. For an example of Datamation's ambivalent relationship toward the ACM see Anonymous, "Editor's Readout: The Cost of Professionalism", Datamation 9, no. 10 (October 1963):23.

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distributed to the participants and then filed away. At least one was actively withheld from public distribution, owing to the sensitivity of its contents. But this meeting received a high profile, due in part to the participation of Datamation's editor in the discussion. He published long extracts from the transcript, under the provocative heading "Is it Overhaul or Trade-In Time?" Datamation's orientation was, in general, more amenable to data processing than that of the ACM and its publications, and through the 1960s its editors enjoyed tweaking the academic pretensions of the ACM.

One problem confronting the pan-computer professionalists was the indistinctness of the computing field. Computing was already an interest of many people belonging to existing associations for which computing was at best a secondary concern. Morriss Rubinoff, for example, estimated that computing was a primary or secondary interest for no more than 3,000 of the 50,000 AIEE members – making it hard to contemplate a federation of which the entire AIEE was a member. But as people like Grosch rushed to establish a broader definition of computing this problem could only multiply. Grosch, Armer and several others favored the use of "Information Processing" rather than computing in any new group, and as Grosch pointed out "libraries are just a sub-class of information retrieval devices." But this left open the question of what to do with groups like the American Management Association, the computer user groups, "all the librarians, all the microfilm operators," and so on. While Willis Ware, head of the Computer Sciences Department at RAND, complained that lack of representation in things like the National Academy of Science was in part because "we don't have a catch-all title for people in this line of work," it was by no means apparent that any line of work could be defined which included everything to do with computers but was not so broad as to be useless.

Herb Grosch was the strongest advocate of the "trade-in time" case. Rejecting suggestions of greater cooperation between existing societies, he pushed for an entirely new professional association with "a high priced executive director, lots of advertising, a whole series

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of technical journals…" This would "fill the void left by the ACM," and provide, "someone who is Mr. Computer; someone who can go down and testify before Congress if need be." His prescription was dramatic: "When you get right down to it, the key trouble is that we have two warring hardware groups and one poor moribund user's group, all trying to work together in this JCC farce. And what we have to do is sweep it all aside: we just have to start over." In the end, however, Grosch was the only one of the attendees to vote for the creation of a single new society designed to replace all the others. They estimated that perhaps 50,000 people were involved in the computing field, broadly considered.

The JCC, alluded to by Grosch, was a long running exposition addressed to the needs of the entire computing field. Since in 1951, a National Joint Computer Conference had been held each year on the East Coast. It was sponsored jointly by the ACM, and the computer groups of two engineering societies, the AIEE and the IRE. The latter two were the "warring hardware groups," while the ACM was Grosch's "poor moribund user's group." These shows rapidly developed into a financial bonanza for the groups involved, and from the 1950s to the 1970s they underwrote many of the other activities of these associations. In 1953 an additional annual meeting on the west coast was added, so that meetings were held in each spring and each fall.

The transcript reveals considerable dissatisfaction with the current organization of the ACM and the other societies to deal with the new diversity of computing activity. Only three attendees viewed a reformed ACM as the best basis for a new and broader association. One of these was Paul Armer. Although Armer had lost the recent ACM election to the mathematician Richard Hamming, a Bell Labs research star and a pillar of the nascent discipline of computer

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science, Armer's showing had been surprisingly strong. He believed that with continued work the ACM could be reformed from within.[797]

The "winning" choice was a third option: the creation of a new society in which members were not individuals but existing societies. All the existing societies would be preserved, but they would charter a new group to represent the collective interests of information processing as a whole. This would avoid the struggles and additional duplication involved in trying to start any new society to cover the entire field, or the Herculean task of trying to broaden the ACM out of its emerging niche in academic computer science and programming theory. The precedent for this was the existing JCC, though the charter of that group provided it with a carefully demarcated mandate around the organization of conferences. Not all present endorsed the concept without reservations. The broader any such group became in its membership and charter, the more unwieldy it would be. Rubinoff, formerly of Penn's Moore school and then of Westinghouse, suggested that the JCC only worked because of this narrow scope. "All it really does," he said, "is elect a local chairman and let him worry about the conference." In addition, he suggested that the power and financial benefits of the JCC gave its existing members, "a vast vested interest," meaning that it would fight any new group, while admitting additional members only "as second class citizens."

It was, however, Grosch who put his finger on the most fundamental weakness of this arrangement. "As long as your joint organization, whether the JCC or a successor to it, derives its

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[797] The other, Samuel Gorn, a computer scientist and member of the ACM council was probably more representative of mainstream option within the ACM leadership. Gorn's leadership work during the 1958-1968 decade was eventually honored with the association's Distinguished Service Award in 1974. While not exactly enthusiastic about the society's current state, he argued that, "the problem now is not the complete inflexibility of the ACM constitution, but its complete amorphousness." Whereas Grosch favored a new organization to replace the ACM, Gorn viewed it as a successor to the existing Joint Computer Conference. The third was Tompkins, a mathematically oriented researcher at UCLA and one of the association's founders. Yet while Tompkins was clearly part of its natural constituency, even he remarked that in its "attempt to straddle the entire field" it had "been contesting with itself to the point where I lost interest in it completely for a number of years."

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power from other organizations, it's going to be mighty hard to provide for such functions as having a front man, pushing for education, and the like. Those things are functions of the member societies too." If, as Miner of Remington Rand rather disrespectfully put it, the ACM, "suddenly came alive" then there would be little left for it to delegate to the new group.

The participants felt that the then-fashionable but vague idea of information as the stuff manipulated by computers might provide a good title for this umbrella group. Thomkins spoke of "the need to get the word computer out of their title and information into their title". Armer felt that, "Six months from now, information processing will be the O.K. word in this business." Oliver Selfridge of MIT's Lincoln Labs seconded him, pointing out that his organization already used information processing as the name of a new division. "Informatics" was already established as a European term for the study of computers. While the term was novel to Americans, the participants hoped to catch a new trend. It seemed to convey something broader and less tied to hardware and scientific calculation than did "computing".

In 1961, two years after the Rand Symposium meeting endorsed the concept of a new umbrella group to represent the "information processing" profession as a whole, the American Federation of Information Processing Societies was born. Several of those present at the RAND meeting were instrumental in its creation, including Armer and Ware – the latter serving as its first president. AFIPS superceded the existing National Joint Computer Committee. Its main function, and its source of revenue, remained the annual spring and fall Joint Computer Conferences. However, the change of name permitted the new group to represent the United States for the purpose of international collaboration in computer science, as a delegate to the newly formed International Federation of Information Processing (the rules of IFIP required a single representative society from each nation). This internationalist agenda was of great importance to several of the people most directly associated with the chartering of AFIPS, including Isaac Auerbach (founder of a prominent computer consulting firm) and Samuel

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Alexander of the National Bureau of Standards. Like many of their generation, they viewed the internationalism of science as a progressive force, a bulwark against the problems of the cold war. From the beginning AFIPS was therefore a conflation of contradictory projects – bolting scientific internationalism to pan-computer professionalism, and putting both in the hands of an organization set up to run a trade show.[798]

The heart of AFIPS was its Governing Board, on which sat representatives of the member societies. The number of votes, and the share of the conference proceeds, accorded to each society was determined by a formula based on the size of the society involved. While its new charter permitted AFIPS to explore professional issues forbidden to the JCC, its efforts here moved slowly. Its first leaders saw its key mission as "to be the preeminent national single spokesman for the computer field." By 1963 AFIPS had set up thirteen committees to investigate different issues, but remained a volunteer organization – the only paid post was that of a part-time information officer. Ware favored involvement in the exchange of technical information and in public relations, but not in the establishment of technical standards. As he saw the character of AFIPS versus that of its constituent societies: "AFIPS represents the intellectual activity of the entire field of information processing. There is no other organization with such a universal goal. The IEEE is largely the hardware population of the computing field, and the ACM largely the software population, which has grown into information processing through scientific computing."[799]

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[798] A collective oral history of the AFIPS founders was published as Dana and Tropp, "Reflections on a Quarter-Century: AFIPS Founders". The early history of the organization is also discussed in Robert W. Rector, "Personal Recollections on the First Quarter-Century of AFIPS", Annals of the History of Computing 8, no. 3 (July 1986):261-69. Harry H Goode, who died before AFIPS was chartered, has been remembered by his fellows as its key organizer. Isaac L Auerbach, "Harry H Goode", Annals of the History of Computing 8, no. 3 (July 1986):257-59. Auerbach recalled his work with IFIP in Auerbach, "The Start of IFIP-Personal Recollections".

[799] The first quote comes from a document in which Ware recounts the early efforts of AFIPS to establish itself as such as spokesman, Willis H Ware, "AFIPS in Retrospect", Annals of the History of

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AFIPS ultimately proved unable to take a strong role in the development of a clearly defined profession of computing or data processing. One of the biggest problems was the transient nature of its leadership body – while the same societies were represented from one year to another, it was often a different person who turned up at each meeting to do the representing. Partly as a result of this, the loyalty of AFIPS directors was often more to their own societies than to AFIPS as a whole.[800]

The ACM, in particular, was resented by the other member societies for its reluctance to forgo revenue from the trade exhibits that accompanied its own annual meetings. In 1965 a committee, headed by Walter Bauer (who had recently failed to win election as ACM president on a pan-computer professionalism platform), addressed this question.[801] Bauer viewed this as symptomatic of broader tensions:

> When ACM was formed over fifteen years ago, it has a total purview, including both hardware and software. Although ACM interests have changed to emphasize the non-hardware areas, there is nevertheless the feeling that the ACM has a broad charter which is challenged or to a degree encroached upon by AFIPS. This applied not only to the meetings, but to other areas such as public relations, sociological impact, etc. On the other hand, the never felt they had a charter which included software aspects and they therefore view AFIPS as increasing their purview rather than challenging it or competing with it in any way.[802]

Tensions did not always break down so neatly along associational lines, and certainly no single association can be blamed for the structural problems inherent in AFIPS. When the topic of

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Computing 8, no. 3 (July 1986):303-10, page 304. The other quotations are from Willis Ware, "Perspective on AFIPS", Datamation 9, no. 4 (April 1963):42-43.

[800] This point, all too obvious from surviving AFIPS records and from the recollections of anyone involved in it, is made again and again in Various, "Perspectives on a Quarter Century: AFIPS Presidents", Annals of the History of Computing 8, no. 3 (July 1986):275-302.

[801] It concluded that the revenue and attention the ACM gained from these exhibitions did distract from the JCC meetings sponsored by AFIPS, but that the ACM's increasing trend towards software meant that, "computer manufacturers and hardware people tend not to identify their interests with ACM's," meaning that the audience for the two shows did not overlap entirely.

[802] Frederick L Bauer, Report of the Ad Hoc Committee on AFIPS Conferences (Attachment 10 to Minutes of the Ninth Meeting of the AFIPS Governing Board, May 22), 1965, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

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"computers and society" questions came up at a 1967 board meeting Anthony Oettinger, then ACM President, declared himself "unutterably opposed to the narrow AFIPS proposed by Levine," the IEEE representative.[803]

The result, however, was that AFIPS did almost nothing during its early years of existence to peruse the role as a broad, united voice for the computing profession envisioned by many of its founders. As Grosch had anticipated, this society of societies was a prisoner of existing interests. While many prominent pan-computer professionalists of the 1960s and 1970s devoted great energies to AFIPS, in the end it always seemed to disappoint them.

## SIGBDP: The ACM Discovers Data Processing

The main vehicle for the promotion of pan-computer professionalism within the ACM itself was its ponderously named Special Interest Group for Business Data Processing, or SIGBDP. Like Gruenberger's symposia and the original plans for AFIPS, this had its roots in the RAND Corporation and in the Los Angeles chapter of the ACM. During 1960, several members of the latter set up a committee to investigate ways to attract data processing experts into the ACM. It included several familiar names, among them Paul Armer, James Gallagher (member of the AMA group which devised the concept of MIS and author of the first book on the subject), and John Postley.

Between hosting the RAND symposia and nurturing many of the most vocal proponents of pan-computer professionalism, RAND emerges somewhat unexpectedly as the most important early link between computing and data processing. We have already seen the importance of SDC, the RAND spin-off, in developing real-time computing techniques and spreading the "total

[803] AFIPS, Minutes of the Sixteenth Board Meeting, 1968, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

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systems concept" within managerial circles. Perhaps because of its early involvement with computers and the ways in which it challenged young men with scientific training to apply their talents to other topics, RAND nurtured a generation who combined leadership positions within the ACM with work as consultants, entrepreneurs, software experts, project managers and educators.

Postley served as president of the new group. His own background lay firmly in computing, as a specialist in the use of Card Programmable Calculators and other punched card equipment for scientific purposes. Shortly after obtaining a mathematics degree from UCLA, he returned to campus for a job working punched card equipment at the newly established Institute for Numerical Analysis, a Californian outpost of the National Bureau of Standards. The INA became a leading center of computation, employing the latest equipment providing consulting services and training to local firms. From 1951 to 1953 he worked as a computing expert at Northrop, again working with IBM punched card equipment. After a brief spell helping to design an electronic computer that Hughes ultimately decided not to manufacture, he joined RAND as head of the Data Processing Group in its Logistics department.[804]

As its title suggested, Postley's new assignment was a switch, and as it turned out a permanent one, from computing to data processing. RAND had contracted to help the air force produce a logistics control system, managing spare parts worldwide on behalf of the Strategic Air Command. This was just the kind of problem that early operations research enthusiasts had promised to solve via the application of mathematical techniques, systems thinking and the scientific method, so it was presumably on this basis that the job was entrusted to RAND. What RAND found itself faced with, however, was a state of the art challenge in data processing – storing huge amounts of information on computer, for retrieval as needed. This was a problem

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[804] On Postley's early career, see Forman, Fulfilling the Computer's Promise: The History of Informatics, 1962–1982, 2-11 to 2-23.

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about which neither it nor Postley knew very much. Under Postley's direction, however, it was eventually solved by the installation of an IBM 705 computer complete with banks of tape drives and RAMAC units connected through a specially built interface.[805]

During the course of this project, and some follow up work on other administrative systems for RAND and the air force, Postley crossed the country speaking with representatives of leading data processing installations. These included several of the organizations mentioned earlier as prominent users of data processing technology such as Metropolitan Life, Sylvania, the New York Port Authority, the Social Security Administration, and the consulting firm Haskins & Sells. As Postley was later to recall, these projects "convinced me that, even though it did not involve complex mathematics at that time, 'business data processing' was not the trivial exercise the academics who were then the leaders in the computing field deemed it to be."[806]

As a result of these experiences, and encouraged by other members of RAND, in 1960 he published a book called Computers and People. This was intended as a non-technical guide to the use of computers in business.[807] It was perhaps the broadest survey of the computer since Berkeley's Giant Brains, and around 25,000 copies were eventually sold. Postley himself claims that it was "was the first to deal with the entire field of computing, hardware, software, vendors, and users, as well as the social problems of computing." The book included a definition of the data processing specialist as a professional expert, a definition we may assume was addressed not just to managers but also to those within the ACM inclined to dismiss the data processing manager as a mere punched card operator.

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[805] Postley, "Mark IV: Evolution of the Software Product, a Memoir".

[806] Ibid. page 45.

[807] John A. Postley, Computers and People: Business Activity in the New World of Data Processing (New York: McGraw-Hill Book Company, Inc., 1960).The book was in many ways an early statement of the MIS vision, though the term was not used. As befitted a RAND analyst, he placed a great deal of stress on operations research and the use of computers for decision making and prediction. He viewed the computer as the key to a new and scientific approach to management.

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> Perhaps the most important requirement imposed on a firm by the introduction of EDP equipment into the data processing activity is a new kind of expertness, that of the "data processing specialist." This man is not primarily a computer programmer although he must know computer programming, he is not primarily an operations research specialist although he must have an understanding of operations research, and he is not primarily a computer designer or manufacturer although he must be familiar with the problems and capabilities of the computer designer and manufacturer.... While he must have a real consideration of all the technical areas just mentioned, the really new skill with which the data processing specialist is concerned is that of the operation impact of machines on management of all levels, employees not directly concerned with the machine, the computer operators themselves, and perhaps the general public for certain firms.[808]

The new group was launched with a special conference on data processing, held at UCLA. More than 500 people attended, drawn in part by the presence of Herb Grosch as keynote speaker. While the original group was local, its members hoped from the beginning to set up similar groups throughout the ACM's national organization. The ACM altered its bylaws to allow the formation of special interest groups in 1961, in large part because of the threat that this group would otherwise leave to create its own society. Walter M. Carlson, who as the national Vice-President presented the case for special interest groups to the association's governing council, experienced the disdain shown by its members for anything that might bring it closer to data processing. "[M]any of the ACM leaders I talked to spoke of 'super bookkeepers'," he recalled, "and some of them even reflected on joint Chapter meetings with punched-card people, where the managers usually brought along their best looking keypunch operator."[809]

After he left RAND in 1960, Postley co-founded a small computer services company, Advanced Information Systems. This led in turn to the development of generalized file management software, under contract for a variety of firms. In 1964 this company was acquired by fledgling software firm Informatics, where he led the continued development of what became the Mark IV file management system. These events give us a good feeling for the role of the Los

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[808] Ibid. 78.

[809] Walter Carlson, "ACM and Special Interest Groups", Data Base 25, no. 2 (1994):9-12.

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Angeles ACM chapter and the surrounding aerospace systems firms in supporting careers shifts from computing to data processing. Informatics' founder, Walter Bauer, had worked closely with Postley as a fellow officer in both the Los Angeles chapter of ACM and the IBM user group SHARE. Richard H. Hill and Francis Wagner, two of the other founders of Informatics, were also very active within these two organizations.

Bauer was himself another key advocate of pan-computer professionalism. Although he never worked for RAND, his background had a great deal else in common with that of Postley and his fellows. He had been selected as one of the two candidates for ACM President in 1964, though like Armer his pan-computer platform failed to attract a majority of the electors nationally. Bauer held a Ph.D. in mathematics and worked on one of the first electronic computer installations. He was part of the early aerospace computing community, heading a staff of 250 at the computation center of Space Technology Laboratories, part of the systems engineering effort of quintessential systems firm Ramo-Wooldridge. By the end of the 1950s, Bauer was pioneering a number of civilian as well as military systems projects, for a different division of Thompson Ramo-Wooldridge (at it had become).[810] For Bauer, too, this involvement in the military systems elite of southern California formed a vital bridge between a scientific background and a career as a civilian manager focusing on data processing applications. During his campaign he suggested that ACM had to reform itself to appeal to the enormous number of qualified non-members and that it was weakened by an excessive attention to numerical analysis and algorithms.[811]

Postley's successor as head of SIGBDP had a similar background. Solomon J. Pollack's diverse career included stints as an OR analyst at RAND (where he published work on decision

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[810] These included a traffic control system for Los Angeles, and a real-time data base system designed to provide information to the DOD on damage suffered during nuclear war.

[811] Walter F. Bauer, "On ACM's Role and Its Welfare", Communications of the ACM 7, no. 12 (December 1964):700. For Bauer's background, and the founding of Informatics, see Forman, Fulfilling the Computer's Promise: The History of Informatics, 1962--1982, 1-3 to 1-22.

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tables), a data processing expert at Rockwell's Space Division, and jobs with Convair, Raytheon and the National Bureau of Standards. He also worked at IBM, where he was responsible for the development of operating systems for the System/360 series computers. While he remained active in the ACM, he had many contacts with the DPMA. In 1964 he took part in its technical seminars on COBOL. He served during the late 1960s as a member of the DPMA's Long Range Advisory Committee, providing that association with an external perspective on its strategic goals. During the early 1970s he served on its Certification Council, overseeing the future of the CDP program. Like many of these men, he spent the 1970s as a consultant.

We can thus see that pan-computing professionalism was a powerful force during the 1960s. It was vocally propounded by a number of the most visible and influential figures within the scientific and technical computing community. Though neither Armer nor Bauer had succeeded in winning post of ACM president they, and their allies such as Carlson, held considerable influence and prestige within the national organization. They dominated the Los Angeles chapter of the ACM, and the national Special Interest Group for Business Data Processing. Indeed, it was to accommodate their interests that the ACM first allowed the creation of its federal structure of nationally organized Special Interest Groups – a structure that was to prove crucial to its continued growth and vitality as academic computing research grew increasingly more specialized during the 1970s and 1980s. Yet to achieve their dream of a unified profession of computer people, they would have to reach beyond the existing boundaries of the ACM and engineer a rapprochement with the managerially-oriented members of the DPMA.

## "Would You Want Your Sister To Marry One?" Computing Flirts with Data Processing

Notable in its absence from the 1959 RAND Symposium discussion, broad it was in its demarcation of a possible new profession of "information processing," was any actual knowledge of the National Machine Accounting Association (NMAA) and its activities. While Grosch spoke

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broadly of librarians and "microfilmers," neither he nor anyone else present had any detailed knowledge of the NMAA's policies, membership or aims. When one suggested that the NMAA should be involved in a new grouping, they realized ("I doubt if any of us know the leading lights in the NMAA...") that they did not even know how to approach it. The existence of the ACM was likewise almost unknown to the NMAA leadership. Even as it began to turn its attention from punched card machines toward computers, the NMAA's members remained far more interested in what managers thought of them than in what scientists and engineers of computing thought of them.

The NMAA's then president, D.W. Paquin appears to have been the first member of the NMAA leadership to have any contact with the leadership of the scientific computing community or with the ACM. Paquin, an employee of accounting firm Lybrand, Ross Bros., and Montgomery, held an unusually expansive idea of the potential of data processing professionalism. He was the closest thing to an exponent of pan-computer professionalism produced by the NMAA during this era. But even Paquin seemed less than well informed on assuming office. In August 1959, he wrote to the executive committee that he "was accorded quite a shock when I was informed that the ACM, which has been in existence since 1948, has developed quite a substantial membership list." He was "considerably disturbed that the Executive Committee has not been completely informed as to this group." On the basis that he knew "several of the top personnel" he volunteered to investigate. He feared that the ACM would soon establish a professionally staffed headquarters and move decisively "into our areas, those of business and commercial applications." While admitting that odds were "heavily against a

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merger" he felt that, "with our headquarters already established we might be able to entice certain of them."[812]

As this reaction showed, the interest of the DPMA leadership focused immediately on the prospect of merger, rather than of more modest collaboration. A month later, the NMAA executive committee authorized Paquin to "investigate a possible merger" with the ACM.[813] In November, he reported a meeting in New York with "many of their top people. They are all very impressed with out financial situation and the new building. Many top people are agreeable to merger, whereas in the case of their president, he is not."[814] The information he passed back to the NMAA executive committee, based in part on contact with the pan-computer elements of the Los Angeles area ACM, gave it a very positive picture of the prospects for cooperation. At least some members of the committee considered merger to remain a real possibility.[815]

His connections with this community helped Paquin get invited to a 1959 Joint Computer Conference, to meet representatives ACM and IEEE leadership. But his friends had been unable to protect him from the disrespect of their colleagues. As Gruenberger summarized the meeting, there was "hostility you could cut with a knife, when you showed up with the NMAA membership to come into the ACM. I don't think rude is the proper word; it was just downright insulting what they did to him.... To characterize it in a few words 'Do you want a sorter operator sitting next to us at an ACM meeting?'" McCracken added jokingly that the real question was

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[812] D. B. Paquin, NMAA Executive Communication, August 10, 1959, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[813] National Machine Accountants Association, Exec Comm, 18-19 Sept, 1959.

[814] D. B. Paquin, NMAA Executive Communication, November 10, 1959, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[815] National Machine Accountants Association, Executive Committee Minutes, 4-5 Dec., 1959, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis and National Machine Accountants Association, Executive Committee Meeting Minutes, 17 February.

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"[w]ould you want your sister to marry one?"[816] Interviewed years later, Paul Armer was to recall this (or a related meeting) in equally regretful terms:

> Herb Grosch and I went to a meeting at [NMAA] and said, "Look, at least we should be talking to each other." We got the [NMAA] people invited to a National Joint Computer Committee meeting at which they were really treated shamefully, mostly by the IEEE people, but also by some other ACM people, who essentially said, "You're nothing but EAM installation managers, you're really beneath us and we're involved in science. Go away." [817]

After discovering their own ignorance of the NMAA and the rank and file of data processing, and inspired by their broad sense of the brotherhood of "computer people" of all kinds, Gruenberger and his friends decided to remedy this ignorance by inviting Paquin to the next RAND Symposium. They deplored the snobbery of their colleagues in the ACM, and in return Paquin spoke frankly about the backward nature of his own membership, saying "within the ranks of the NMAA we have this problem: They say, 'Well, you're not going to shove computers down our throats; we're punched card people.' But if they would just understand that punched cards have a very limited life, and this is what we're trying to do (out of deference to IBM), they will gradually acclimate themselves to this field."[818]

Many of those gathered at the 1960 RAND Symposium were highly sympathetic toward business data processing. Attendees included many of the best known figures in computing, among them programming expert Dan McCracken, business man Erwin Tomash (formerly a pillar of the Los Angeles computing community as its Univac representative), Morris Rubinoff of the University of Pennsylvania's Moore School, Paul Armer, Frank Wagner (then of North American Aviation), and the editor of Datamation.

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[816] Fred Gruenberger, RAND Symposium Transcript, 1960, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis, 14.
[817] Mapstone, OH 59: An Interview with Paul Armer .
[818] Gruenberger, RAND Symposium 1960, 15.

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Paquin himself appeared to doubt that, "the computer field" and "the computer profession" were useful objects of debate. The others discussed these matters for a few minutes, at the end of which Rubinoff had claimed that the computer field was at the intersection of many disciplines, and that mathematics, philosophy and linguistics were the proper foundation of the "computer sciences." Paquin suggested that altogether too much stress was being placed on the scientific side of the computer. In his own concept of professionalism, "we're not really talking here about computer specialists but the data processing specialists who use the computer as a tool. At least in the data processing end of the business we believe that this is a two pronged affair. We need data processing experts who use the computer as a tool just as you in the scientific end need scientists who use it as a tool."[819]

Not all were so kindly disposed toward Paquin, or to data processing. Jackson Granholm, who had taken over from Gruenberger as the publisher of Computing News, attacked Paquin over the low quality of business data processing staff – blaming computer problems on "the tendency of business users of computers to buy fifteen million dollar machines and staff them with fifteen dollar people." He also made the accusation, common among scientific specialists, that business data processing staff lacked their own expertise and were mere puppets of IBM salesmen, deriding "business installations with large machines and fairly large staffs where the greatest expert around the place on the use of this machine is the account representative."

The discussion revealed some fundamental disagreements on the nature of professionalism. According to Paquin, "the problem is one of evolution in our branch of business from punched cards to EDP, and that we will evolve into a profession." Despite his insistence that the computer represented the future for his association, Paquin also argued that, "we are not going to achieve professionalization in the field of data processing just through evolution. I think we've

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[819] Ibid, 8.

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done an outstandingly lousy job (speaking for the punched card personnel who could be in this position had they properly oriented themselves in the past) of laying out a path or program to follow..." When asked whether the NMAA saw itself as a professional organization, he replied "No, but they're trying to achieve it.... I think we've given too much accent to the computer per se as a contributor to professionalization." He suggested that business qualifications remained more important than technical ones, even those related to computers. Paul Armer agreed, saying that "the card sorter operator [is] not ever going to be a professional man, nor is the tape jockey. But, in the business area, the guy who's working on the problem, say, of inventory control, can be a professional man."

Rubinoff held that to become a computer professional one need only take an assortment of courses in programming, design, business applications and other topics such as those already offered at his own Moore School. But McCraken disputed this, saying that "they're professional engineers of professional accountants of professional mathematicians. They're not professional computer people." "What," he asked, "could you possibly teach in computers for more than about a year, that is specifically computer rather than fragments of other fields?" Rubinoff stuck to his guns, insisting that, "the ideal of professionalism is an individual one," and so was best tackled by educating people one at a time. This was based on a scientific vision of professionalism as a state of personal virtue mandated by cultural norms rather than formal rules. Paquin too challenged this, saying that "we believe in the NMAA that you must plan for it, and that's why we have gone to this certification." This would involve a "period of apprenticeship" followed by the earning of a formal qualification. That was, of course, the model followed by accountants and doctors – something lost on Rubinoff, and some of the others, who insisted that this sounded like unionism to them and they wanted none of it.[820]

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[820] Ibid, 19-28.

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Gruenberger also was unconvinced by the academic science model of professionalism as a model for computer people as a whole. "You keep talking," he said to Rubinoff, "about these schools that are doing all this wonderful teaching. I think it's great, but it accounts for approximately, say, one per cent of all the people who are entering our field..." While Rubinoff held that this elite (in the form of the ACM leadership and the faculty of university departments) would set the agenda for the rest of the field, Gruenberger retorted "that one per cent is going down, not up. The demands for people are now and will become greater than all the schools in the country can keep up with. We're limping backwards there. If that's your avenue to professionalization, it's dead."[821]

Gruenberger, Armer, and McCracken clearly considered Paquin to be one of their own. But he was about to vanish precipitously from view. Paquin left the NMAA in disgrace and pursued by a lawsuit, after he signed a long term contract for the publication of the association's journal on very unfavorable terms and then accepted lucrative consulting fees from the publisher. As Paquin had been the most vocal proponent within the NMAA of improving ties with the ACM, his exile seems to have disgraced his cause as well as himself. Stories of the rebuff suffered by Paquin at the hands of the ACM entered the folklore of the NMAA. Had he been able to persist, he might have tied the association more strongly to the emerging elites of academic and scientific computing. Following Paquin's departure, Alfonso Pia (NMAA president during 1961-1962) made a return trip to visit the ACM. "I went to ACM, I didn't have an invite, but I am a member and I went. I talked to several people including the President. I confirmed more strongly to myself that there was never any serious consideration of merger and no people of importance were ever contacted."[822]

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[821] Ibid, 26.
[822] National Machine Accountants Association, Executive Committee Meeting Minutes, 8-9 Sept - - Verbatim, 142.

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For the next few years the leaders of the DPMA (as the NMAA had now become) treated the ACM in particular, and other associations in general, with a certain amount of suspicion. They were worried that it might begin to switch its focus to administrative computing, and use is strengths in areas such as university student groups against them. Pia warned in 1962 (presumably in response to the growth of SIGBDP), that "ACM is starting to roll. We better wake up. They have learned some things over the past few years where they have made some goofs, and they have seen us do things that are beneficial, and they are taking an interest in business operations." When another committee member said that, "I don't think they have any interest in our membership, really, or in the type of person that we have," Pia responded "we sure have it in theirs."[823] Pia at least knew what the ACM was, even if he didn't like it.

Following Paquin's unsuccessful attempts to build closer ties to the ACM, the next big push came from the other side. In 1963, Robert S. Gilmore, then International President of the DPMA, wrote to Calvin Elliot, its executive director, in a state of some surprise. He opened with the news that, "I received a copy of a letter from A. V. Perlis, President of ACM, to Bob Patrick in which Patrick was asked to serve on an ad-hoc committee on the proposal for a merger of ACM with DPMA." Gilmore asked Elliot whether he had "any knowledge of this action of any data even remotely connected to it."[824] In his reply, Elliot admitted that he knew nothing about the committee or its purpose, but had been able to confirm from Bob Forest, newly appointed Datamation editor, that it existed. Elliot urged Gilmore to obtain further information via a meeting with Patrick.[825]

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[823] Data Processing Management Association, Exec Comm, 30 Nov-1 Dec, 1962.

[824] Robert S. Gilmore, Letter to R. Calvin Elliot, 17 Sept., 1963, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[825] R. Calvin Elliot, Letter to Robert S. Gilmore, 7 October, 1963, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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The official mandate of this committee is unclear, but clearly Patrick and his allies had won at least some level of official backing in their quest to further pan-computer professionalism though a merger.[826] As formally constituted, the committee was chaired by its only other member, Frank Wagner (Informatics executive and longtime pillar of SHARE and the Los Angeles ACM). By November, Wagner had written to Gilmore, proposing that the DPMA formally establish its own committee for the purpose of liaison and negotiation. Elliot took umbrage at this, claiming that protocol required a clear president-to-president statement of the committee's exact purpose. He pointed out that, "I am constantly reminded that ACM claimed we (NMAA) tried to become part of their group and they turned us down," so at the very least he wanted ACM to ask clearly and formally so that, "we won't have to dodge that embarrassing question every time we turn around about whom approached who." Elliot insisted that, "if ACM is serious in flirtation they should offer some basic recommendations or outline before DPMA appoints a committee."[827]

In July 1964, the ACM delegation of Wagner and Patrick met with a DPMA team composed of Elliot and immediate past-president Elmer Judge. The location was the Thunderbird Hotel in El Segundo, California. Judge, though the official DPMA representative, was not empowered to negotiate but merely to decide whether a formal liaison group should be appointed. The two groups briefed each other on their respective associations, and prepared fact sheets

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[826] From Perlis's involvement it is clear that the approach had at least some formal recognition, and an "ACM-DPMA Relations" composed of Patrick and Wagner showed up the next year in an official published list of ACM committees. No published record of its purpose can be located, and it is not clear whether the ACM council was truly considering merger when it authorized it. In a letter written some years later, Robert W. Bemer, a longtime supporter of the ACM best known today as the father of ASCII, claims that, "as a member of the ACM Council I was the first to propose a formal merger with the DPMA, somewhere about 1963. R. W. Bemer, Letter to Robert C. Haavind of 15 July, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[827] R Calvin Elliot, Letter to Robert S. Gilmore, 10 Jan, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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setting out basic information on membership, governance, objectives and activities. The official minutes, prepared by Patrick, record that Judge and Wagner agreed to recommend the establishment of a permanent six member committee, to meet four times a year to, "foster cooperation, jointly indoctrinate both societies in mutual aims." A more specific list of agenda items included subscription interchange, lecturers, certification program participation, cross publication of journal articles, and joint meetings."[828]

The word "merger" was not included in Patrick's discussion. However, this topic dominated the report of the same meeting prepared by Judge and Elliot for the next meeting of the DPMA Executive committee. They had been told that around 15 percent of current ACM members were interested in data processing, but that many more were expected to become interested in the future. They felt that the DPMA's own direction must lie "on servicing management and systems groups, as well as adopting programs to assist it's (sic.) Data Processing Manager members to make the transition into systems and general management." Oddly, they appear to have believed that this represented a convergence with the ACM, presumably because of the then-prevalent idea that the future of senior management was mathematical. The report concluded that, "[i]n the light of the seeming similar future functions of the two organizations.... We feel that we would be remiss in our duty to the Data Processing profession if we do not further investigate the possibility of close co-operation and possible merger." (The language they recommended for the committee's official mission came no closer to this than instructions to "investigate concerning mutual aims and purposes and objectives").[829]

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[828] Robert L. Patrick, Minutes of the APMA-ACM Committee's Meeting of 7/9/64, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[829] Elmer F. Judge and R. Calvin Elliot, Report to the Executive Committee Covering ACM/DPMA Ad Hoc Committee Meeting, 1964, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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John Swearingen, who as we have seen was the driving force behind the Certificate in Data Processing, also emerged during the 1960s as the most enthusiastic of the DPMA's leaders when it came to collaboration with other groups. As early as 1961, he had suggested that association's headquarters staff should be receiving SPA and ACM journals and attend the meetings of the other societies. His own career came closer to fitting the pan-computer professionalism pattern than that of his contemporaries in the association, including both an early introduction to computers and a broad range of computer-related jobs. For much of the 1960s he worked in GE's Nuclear Energy Division in San Jose. While still some distance from the Los Angeles heartland of pan-computing professionalism, this placed him firmly on the west coast, and in 1967 he moved to LA to manage computer operations under contract to NASA. He followed this with a spell at consulting and services firm Computer Sciences Corporation, before taking a government job running computer services for the US Senate. His concept of professionalism was likewise broader than that of his DPMA colleagues, and he remained a stalwart supporter of a broad certification program that would eventually offer programming and other qualifications for the computer professions as a whole.

Swearingen had by now taken over from Gilmore as DPMA President. As Patrick and others had noted at the initial meeting, by "happy coincidence" the incoming presidents of both associations lived close together. The two were urged to set up regular meetings and to develop a rapport. George Forsythe, the new ACM president, had a background in mathematics and was then director of the newly formed Department of Computer Sciences at Stanford University. Over a series of lunches they forged a working relationship and explored opportunities for cooperation between the two societies. Swearingen reported that Forsythe had no interest in actively

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producing a merger discussion" and that as "a new president, [he is] not ready to do business with another association. He is trying to find out what his own association is doing."[830]

Instead, the two agreed to recommend a permanent liaison committee, which would function for some time before "trying to determine whether a merger was feasible". Yet Swearingen was clearly warming to the task. He thought merger to be a real possibility in the longer term. He reported symbolic gestures such as an of journals, in which "I thought I was going to give him something that upset him; but his is one of the worst." To illustrate the need for mutual awareness, he pointed out that the two associations had held their conferences in Detroit a week apart, without anyone involved in scheduling on either side being aware of this. Others were less keen. Will, who was to follow Swearingen as President, asked about the expense and questioned why Forsythe and the others could not come to DPMA headquarters in Chicago for discussion. "Are we putting out too many olive branches, or shouldn't they be coming a little closer to us?" Elliot suggested that the threat could not just be ignored, saying that, "according to what Bob Patrick has to say, the ACM will soon be competition" if they could only find a strong leader. He reported that Patrick had told him that, "they [the ACM] had the brains and we had the money." Another committee member admitted the need for close contact, but thought "we should do it on a spy basis rather than mutual understanding basis where we go to them all the time and they don't come to us."[831]

Swearingen and Gilmore, both living in California, were appointed as official liaisons with the ACM. As the meetings proceeded, they developed an increasingly broad understanding of a broader vision of data processing, and grew more enthusiastic about the possible expansion of the DPMA. As Gilmore told the executive committee, the "data processing field must encompass hardware, education, basic systems, documentation, programming, applications and

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[830] Data Processing Management Association, Exec Comm, 15 Aug, 1964, 344, 46.
[831] Ibid, 341-49.

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administration to be inclusive of all facets of the field.... It was felt by the committee that we should take steps to consider a merger, not only with ACM, but with the SPA." Gilmore asked the executive committee for authorization to begin more formal negotiations, to address matters such as the name, membership, structure, and chapter organization of a merged society – though he admitted that he was as yet unsure whether interest in a merger was shared by more than a few people on the ACM side.[832]

They still had some reservations. As he learned more, Gilmore realized that, "we should have more in relationship to the SPA than the ACM," but felt that as talks were already in progress a three way merger would provide the best complement. He also felt that Patrick and Wagner remained closely identified with the LA chapter, and seemed to him quite marginal within the national association. Speaking of SIGBDP, he suggested that, "they were not ostracized, but they were certainly frowned upon by many of the other ACM members. However, it is a successful organization, and they are quite proud of it." He was worried that the "engineer and academic type people" to be found in the rest of the ACM might not share their interest.[833]

Jerome Geckle, one of the most outward looking and managerially successful members of the DPMA leadership, also supported the idea of merger. He suggested that the traditional separation between business data processing and scientific computing that had divided the two societies was beginning to break down, because "business data processing is going to get more scientific and probably the reverse." Cooperation was essential, especially in the area of education. He also supported merger with the SPA. "If we overlook it, we are running the risk of the constant battle between the two associations which eventually would see the downfall of one,

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[832] Data Processing Management Association, Exec Comm, 20 Mar 1965, 420
[833] Ibid, 423.

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I think I would rather see us pulled together under one tent, even though we may remain divided in some ways."[834]

This all made collaboration with the ACM sound both natural and desirable. Yet as the Executive Committee as a whole considered these recommendations, it became clear that Swearingen, Gilmore and Geckle had altogether lost touch with the mood of the other DPMA leaders. The other committee members were united in their hostility to any moves toward broader collaboration. One committee member suggested that while the process of convergence mentioned by Geckle was real, at least in the aircraft industry where formerly separate computing and data processing installations were being combined, this didn't mean that the DPMA had anything to learn from the ACM. He thought that if, "these scientific type people are going up in the organizations, as they are combined, they are going to have to learn something about business data processing. They are behind the eight-ball, not us." Gilmore's request for a vote on merger negotiations was ignored. The true depth of the committee's hostility, however, was revealed in its reaction to Swearingen's own very modest proposals for limited cooperation. Swearingen and Forsythe had agreed that the two societies should sometimes send mailings to their own members on behalf of each other – for example seminar or conference announcements. Elliot opposed this, citing his long standing refusal to allow mailings on behalf of equipment manufacturers and suggesting that use of the mailing list by a rival society would set a bad precedent. "I think this is one of the most jealously guarded properties...You have my word that our list has never been distributed because that is our biggest asset." The committee then passed a resolution denying ACM the use of its mailing list for any purposes. Following this, Swearingen withdrew without a vote his proposal on joint sponsorship of speaking tours.[835]

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[834] Ibid, 425.
[835] Ibid, 430-32.

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The DPMA leadership remained sharply divided. At its next meeting Swearingen proposed showing the CDP examination to Forsythe to gain his feedback on it. Given Forsythe's academic pedigree and service on a national college examination board, Swearingen considered his opinion valuable. Even this suggestion set off harsh criticism from more insular members of the committee, who asked why Forythe couldn't pay his $35 and take the test like everyone else if he wanted to see it. Swearingen persevered, winning permission to "administer" the test to Forsythe and attending the 1965 AFIPS conference. Yet the amount of work required to gain the consent of his colleagues for this trivial activity could hardly have encouraged him in his broader hopes for collaboration.[836]

In mid-1965, Daniel Will took over from Swearingen as DPMA president. He continued to follow Swearingen's policy of engagement with other associations, but kept exchanges on a personal level. He attended the ACM Council meeting, and invited Bruce Gilchrist of AFIPS to the DPMA meeting.[837] But Cal Elliot and some other members of the committee successfully opposed plans to invite outsiders to the DPMA's Board of Directors meeting.[838] Will was followed in turn by Billy R. Field, who was in general colder to the prospect of cooperation. Swearingen pushed without success for the adoption of an official policy to shape these ad-hoc discussions."[839] Elliot expressed a similar sentiment, saying that "it is necessary for this group here to establish some kind of policy. I mean, what do you want to do with ACM? Do you want to romance them, make love, marry them, become engaged?" He urged caution in sending DPMA representatives to other meetings, saying that, "we are dealing with a competitor and therefore I

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[836] Data Processing Management Association, Exec Com, 26-27 June, 1965, 385-89.

[837] Data Processing Management Association, Exec Comm, 21-22 Jan, 1966, 95-105.

[838] Data Processing Management Association, Executive Committee Meeting Minutes, 18-19 June, 1966, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 26-28.

[839] Ibid, 30.

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would believe that before we send and individual into that camp that he should at least have some information under his belt as to just what you want him to do."[840]

By August 1966, discussions had still produced little of substance. Will was frustrated, complaining that,

> we have spent considerable hundreds of our dollars to go to the West coast to meet with these people and have meetings with them and we have never seen any documentation of any kind as to what their purpose was or even the results… At that time it was understood they were thinking of merging with us and, of course, they were the ones who first put their hand out. Now, on the other hand, nothing developed in relation to this because the people with whom we met really had no authority. They were an ad hoc committee of some subcommittee and so nothing happened. ACM did not want to merge, did not even want to entertain that. It was a bad replay in connection with this group.[841]

Will recommended that the association should drop further liaison. "I do not think we should merge with ACM. Our objectives are not the same and we do not have the same type of people. You will be mixing nuts and bolts…"[842] (Oddly, it did not seem to have occurred to Will that nuts and bolts were created only to be mated with each other.) The discussion that followed revealed continuing ignorance as to the ACM. Some felt that the ACM was full of "long haired" academic types. But according to one member, the ACM meeting he attended was more relevant than he had expected. It catered, "to the business EDP people [and] government institution people rather than to the long-haired type guy." Will did concede that Ph.D.s were only about 11 percent of the membership, adding that he had "asked in relation to this because I had previously heard that they were part of the sweatshirt and sneaker group." He added that, "Of course, they may have the best brains in the data processing industry scientifically speaking, but if they are ever going to be management people, they will likewise have to learn management techniques."[843]

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[840] Data Processing Management Association, Exec Comm, 5-6 Aug. 1966, 194.
[841] Ibid, 198.
[842] Ibid.
[843] Ibid.

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Elliot continued to view the ACM as a source of competition. Ever business minded, he suggested that its true appeal lay in the low fees charged for its conferences. "They are competitors of ours in two ways. The first way they are competitors is that they have conference and so they compete for the same dollar that we compete for... Second.... here were two to three thousand business data processors in Los Angeles who were active ACM members and not DPMA members."[844]

It was, however, Geckle who best summed up the situation. He said that the DPMA had "not developed sufficient depth of knowledge to make a policy. I frankly don't believe we are going to do anything. I don't think we are romancing these people. [We are the] executive committee of the largest body of data processing people in the entire industry and yet, on the other hand, we lack all knowledge about this other group that exists." As Geckle recognized, Elliot and other members of the committee were using ignorance as a reason to avoid seeking close alliances with other organizations, but had little real interest in overcoming this ignorance.[845]

Discussion of merger with the SPA stretched on into 1968 but ultimately foundered on similar troubles. As with the ACM, these discussions began with personal contact between leaders of the two associations. This time contact was initiated by Allen Burns, the SPA's president and a Peat, Marwick and Mitchell procedures expert, who met with DPMA President Charles L. Davis through the intervention of a mutual friend. Burns was in favor of changing the SPA's name, and at least according to Davis this was a major attraction of the DPMA – "He liked the Data Processing Management Association because it did have 'management' in the title of it."[846] Even though his hopes for "possible merger with the DPMA" were not disclosed to his

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[844] Ibid, 206-7.
[845] Ibid, 201.
[846] Data Processing Management Association, Exec Comm. 21-22 Jan. 1966, 100-03.

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colleagues, Burns initially failed to convince the SPA leadership to set up a committee to explore cooperation between the two associations. He hoped to continue lobbying and win support later. Davis continued to report good progress in his informal discussions with Burns, though he cautioned "it is the association we are in conflict with and parallel to...."[847]

Elliot himself was much more kindly disposed toward the SPA than toward the ACM. As he put it, in typically competitive fashion, "In connection with SPA, we might want to romance them more to get them in with us because their goals are more similar to ours than that of any other association that I have ever been up against."[848] Field, who had opposed ties to the ACM, also saw more overlap. He claimed that "people swap membership between SPA and DPMA a lot. I believe this happens a lot. I have bumped into it, and I have asked a few questions after I saw it happen locally."[849] Despite some continuing reluctance to invite SPA officials to a DMPA meeting, it seems to have been reluctance on the SPA side that ultimately sank the idea. In 1967, Geckle reported that they "have had very little luck communicating" and that the SPA was preoccupied with a major upheaval of its own organization.[850]

Because traditional systems and procedures groups had largely been absorbed by data processing and MIS departments by the late 1960s, the failure of the DPMA to merge or collaborate with the SPA proved particularly damaging to its hopes of representing the upper echelons of a united data processing profession. As Swearingen and his colleagues realized once they found out more about both associations, their interests overlapped much more substantially with the SPA than with the ACM. From 1969 onward, the SPA changed its name to the more

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[847] Data Processing Management Association, Exec Comm, 18-19 June, 1966, 29.
[848] Data Processing Management Association, Exec Comm, 5-6 Aug, 1966, 212.
[849] Ibid, 118.
[850] Data Processing Management Association, Exec Comm, 16-18 Mar, 1967, 117. See also Data Processing Management Association, Executive Committee Meeting Minutes -- 14-16 September -- Verbatim, 1967, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 624.

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modern sounding Association for Systems Management (ASM), but otherwise retained its focus on the relationship between systems analysis and management. In the 1970s, it operated a certification and professionalization program of its own, further undermining the DPMA's authority in these areas.

## Certification and Pan-Computer Professionalism

By the second half of the 1960s, the DPMA's professionalization efforts, and in particular its CDP program, were driving its contact with other associations. Swearingen's efforts to build stronger ties to the ACM, pursued through personal meetings with Forsythe, had met with considerable suspicion from members of the DPMA Executive committee. While members of the DPMA leadership had been holding discussions with ACM representatives for some time, their contact had been largely confined to advocates of pan-computer professionalism such as Patrick and Wagner. Certification sparked name-calling on both sides, after word of the CDP program drew the attention of broader and more academically inclined members of the ACM leadership towards attempts to boost the professional standing of data processing. The public eruption of controversy with and around the ACM on the certification topic only reinforced the prejudices of conservative DPMA members against the "long-hairs" of computation and academe.

In October 1965, Donn B. Parker presented the ACM Council with a motion setting out the "ACM Position on Requirements and Qualifications for Employment in the Field of Information Processing." As chairman of its Professional Standards and Practices Committee, Parker was himself pushing the ACM to take a more active position on issues of professionalism – and in particular on the question of ethics. However his reaction to the CDP program was not positive. The resolution pointed out that any attempt to introduce concrete measures of computer programming aptitude was premature, owing to the rapidly changing nature of technology. More

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fundamentally, it suggested that the DPMA's certificate could be used only "for the sub-professional worker or technician in computer programming to do the work not requiring the technical competence, experience and responsibility of professionals." Requirements at the professional level "should be set by professionals in the field" based on personal evaluation of "previous work experience, education, recommendations, publications and other activities". The resolution would bind the council to "the position that considerations for professional employment in computer programming should not include qualification by examination such as that offered by the DPMA Certificate program."[851]

Parker's resolution bore little relevance to the CDP as it then existed, but it reveals the depth of anxiety that some members of the ACM felt toward the prospect of allowing the DPMA any role in computer-related certification. It also reveals an entirely different conception of professionalism. Despite Parker's worries, the CDP was not an attempt to create a mandatory qualification for the computer programmer. As its actual name suggested, it was a Certificate in Data Processing. It was intended as a qualification for the data processing supervisor, and in particular as a way of helping its membership of punched card supervisors, and perhaps some would-be supervisors, demonstrate managerial interests and a basic knowledge of newer technologies. Many of the DPMA's leaders did not even want programmers in the association. As we saw earlier, only 17 percent of those who took the test listed computer programmer or coder as their job description. One did not even need to know how to actually program a computer to pass it.

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[851] Donn B Parker, Proposed Resolution (Revised, November, 1965): ACM Position on Requirements and Qualifications for Employment in the Field of Information Processing, Submitted to the ACM Council for Consideration by Donn B Parker, October 1965, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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Just as importantly, the DPMA enforced a two year experience requirement for CDP candidates. The requirement could be satisfied by punched card work, or work as a computer operator, but one could hardly create an examination requiring two years experience and then expect to see it used as an entry-level certificate for trainee programmers. Furthermore, at the time Parker proposed his motion stringent education requirements were coming into force, requiring the CDP applicant to have assembled an eclectic array of relevant college courses. Membership of the ACM, in contrast, then required nothing more than eighteen dollars, two letters of recommendation, and either a college degree in any subject or four years of work experience.

By framing it as a qualification in "the computer programming field" rather than data processing, Parker implied that the CDP was intended to cover a number of fields upon which it had no actual bearing. On the other hand, the criteria endorsed by Parker's resolution as indicative of a true professional were problematic. They were essentially those used to award tenure in an academic job – education, recommendations, publication, professional activities. Yet fine as they were for computer science, they made very little sense for data processing, or even for his somewhat fuzzy concept of a "professional level" computer programmer. Should one really promote a corporate application programmer into a junior supervisory position based on her education, strong publications, and the acclaim of her friends in the local ACM chapter?

The problem was not lost on Parker's council colleagues. A. S. Householder, a mathematician who had himself served as an early president of the ACM, suggested that it would be impolitic to single out the DPMA for condemnation.[852] Herbert R. Kohler of the Patent Office pointed out that the council currently lacked information on the DPMA program, and that

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[852] A S Householder, Letter to Donn B. Parker, October 11, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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examinations were used in "law, medicine, dentistry and some phases of education and engineering," in which they often formed a pre-requisite for obtaining a license. "We cannot conclude," he sensibly observed, "that professional qualification examinations are, in themselves, undesirable."[853] Likewise, these fields changed with considerable rapidity, yet examinations were kept up to date. In recognition of these points, Parker removed explicit condemnation of the DPMA but left the resolution otherwise unchanged. In fact, it included the startling claim that, "it is impossible to devise any single examination or set of examinations on which to certify or withhold certification of would-be professionals."[854]

Forsythe acted with some vigor to address the threat posed to cordial relations by the resolution. Prior to its debate, he had lunch with DPMA then-president Daniel A. Will and invited the DPMA to send a representative to the ACM Council meeting. Despite Forsythe's reassurances that the motion was unlikely to pass, Will refused to do so, or to meet with council members separately. The DPMA was represented unofficially by Carl Diesen, an ACM member whose only connection with the DPMA was as a member of the Certificate Advisory Council. Forsythe and Diesen were able to persuade the Council that, "passage of the resolution would seriously rupture the dialog that is beginning between DPMA and ACM." Instead, the ACM Council agreed to set up a committee to explore how the CDP was actually being used. Though Parker himself had insisted on joining the new committee, Forsythe packed it with data processing experts and pan-computer professionalism supporters including Diesen himself, Bob Patrick, John Postley, and Stan Naftaly (who had been chairing the DPMA's COBOL seminars).[855]

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[853] Herbert R. Koller, Letter to Donn B. Parker, October 18, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[854] Parker, Proposed Resolution.

[855] On the DPMA boycott of the meeting, see Daniel A Will, Memorandum to Billy R. Field, December 1, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis. On the failure of the resolution and the creation of the ACM committee to investigate the CDP, see George E. Forsythe, Letter to Carl Diesen et al.

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Swearingen was impressed by these steps. He wrote to Will that Forsythe had shown "a very good attitude" and that the decision to set up a group to study certification was "a good move." The resolution had revealed that, "many ACM counselors knew little about the CDP and not much more about certification practices in general." Swearingen suggested that the DPMA should therefore welcome formal contact from the ACM on this matter. He went on to give the central question of pan-computer professionalism one of its classic statements.

> The certificate issue is but a symptom of something larger. The larger issue is that after years of officially ignoring each other, we have both suddenly discovered there is another society.... Do both our associations function in the same profession? or is it just that some of out members happen to function in a common profession? Are the association on parallel paths? or have their orbits crossed momentarily? Are there some things that one or both are doing separately that could be done better cooperatively, such as certification and conferences? Are there some things that neither can do well independently (but need to be done) such as legislative lobbying and standards.[856]

At the next meeting of the DPMA executive, in January 1966, Swearingen continued to push on this theme. He admitted that the resolution reflected a substantial swath of prejudice within the ACM leadership, saying that "they revealed many of their council members have a deep fear of DPMA, and the certificate, and that they also have correspondingly little knowledge of the certificate itself." Making the best of a bad job, however, he went on to argue that this showed the need for learning on both sides – "finally our associations are bumping up against each other, and this is a natural evolution, I think. As we both grow in stature and in coverage of the industry, we can expect more of these contacts." [857]

The hopes of the DPMA certification team to follow the CDP with similar qualifications for specialist areas of data processing, possibly including qualifications for programmers of

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December 9, 1965, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[856] John K Swearingen, Letter to Daniel A. Will, January 3, 1966, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[857] Data Processing Management Association, Exec Comm, 21-22 Jan, 1966, 54-61.

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different kinds, ensured that objections of the kind raised by Parker were unlikely to do away. The same meeting of the Executive Committee saw included its first detailed consideration to the extension of the certificate program beyond the CDP itself. It accepted the recommendations of the certificate advisory council, which had been meeting until 3 a.m. that morning to thrash out a proposal. Fresh from his appearance at the ACM Council meeting, Diesen was appointed chair of a new sub-committee of the Certificate Advisory Council, to oversee this "orderly expansion and extension of our certificate program." It planned to produce more intensive tests in different areas of data processing. To avoid trivializing the existing CDP, these would be presented as specializations rather than "higher level" qualifications, but as in medicine "specialization is the elevation process."[858] The progress of this initiative is discussed in the next chapter.

## How To Not Join AFIPS

The DPMA (or NMAA as it then was) was part of the original conception of AFIPS as a force for pan-computer professionalism shared by many of those present at the 1959 RAND Symposium. The association did not, however, form a part of its eventual membership. Pia and his colleagues had some contact with AFIPS on its establishment in 1961, and the association received copies of its constitution during discussions regarding membership requirements. Pia, Swearingen and Adams (the Education Director) responded with cautious interest. Swearingen resolved to, "[d]o nothing that sounds like an application to join, be legalistic about it. Keep up the contact and find out more about them."[859]

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[858] Ibid, 95-97, 256-61.

[859] National Machine Accountants Association, Executive Committee Meeting Minutes, 8-9 Sept - - Verbatim, 142, 69-71.

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This interest was soon replaced with distrust. As Pia said in 1962, "AFIPS is a glorification of the ACM." In his view, and that of Elliot, it was therefore an enemy. He and others actually discussed setting up their own international federation of societies to counter both AFIPS and IFIP. "ACM are more blue sky boys," mused Pia, "highly academic, so I do not think AFIPS covers the need, and I think there is a real need for this grouping, and if we don't do it, somebody else will." This idea never went anywhere, in part because even the executive committee members who favored it doubted their ability to gain the approval of the membership for such a use of resources. As Pia himself asked, "Had we joined AFIPS, what would we tell our membership?"[860]

During the next few years AFIPS impinged little on the awareness of the DPMA. Their attention was turned instead to the apparent possibility of merger with the ACM, and if AFIPS was discussed at all then it was in this context. Although Bruce Gilchrist had written to invite the DPMA to apply for AFIPS membership in 1964, the possibility of membership was given no immediate consideration. The issue resurfaced in January 1966, when Swearingen expressed the opinion that they, "should also be looking very closely at AFIPS and IFIP to see whether there is any point in our associating ourselves with them in any way.... I believe in the near future we should make a decision, yes or no, for a reason."[861] Will, then President, was more cautious. He reported a recent meeting with the newly elected Gilchrist:

> We had lunch, and during the course of the lunch I told him they were going to have to take off their sweat shirts and sneakers if they were going to expect us to join them. And he said, "Yes, I just admit that the Ph.D.'s in AFIPS have always looked down their noses at anybody who doesn't have that classification," but he says "We have certainly drawn closer together in just our discussions."

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[860] Ibid, 169-71 and National Machine Accountants Association, Executive Committee Meeting Minutes , 31 Aug & 1 Sept -- Verbatim, 236, 53, 61. The transcript actually shows "AFIDIPS" rather than "AFIPS" in these quotations, but this is probably just a transcription error.

[861] Data Processing Management Association, Exec Comm, 21-22 Jan, 1966, 98.

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Will was not sure about joining AFIPS, but was inspired to spread awareness of the DPMA. He reported that when he attended one of the Joint Computer Conferences organized by AFIPS he found many cocktail party guests so ignorant of data processing that they read his nametag and then asked him what company the DPMA was.[862]

Bruce Gilchrist attended the next DPMA meeting as Swearingen's guest. Gilchrist was central to AFIPS during this crucial period in its existence. He served as President of AFIPS from 1966 to 1968, and proposed a plan to reform it by broadening its programs and expanding its membership. Following the acceptance of this plan, he spend the five years from 1968 to 1973 trying to implement it, working full time in the specially created post of Executive Director of the AFIPS. His successor as president, Paul Armer, favored Gilchrist's appointment as a chance to move AFIPS towards rebirth as something closer to the strong base for pan-computer professionalism he had originally pushed for back at the 1959 RAND meeting. Gilchrist made sustained attempts to broaden the focus of the federation, to include a broader consideration of professional issues and business data processing.[863]

Gilchrist courted the DPMA over many years, in a process that must have come to seem quite tortuous. For Gilchrist, as for many of the other leading exponents of pan-computer professionalism, a managerial job in a computer manufacturing company (often in an applications and software department) had been especially important in fostering a sense of unity between computing and data processing. His full-time job with AFIPS followed almost a decade of work at IBM, in which time he had moved from its Service Bureau Corporation to be a manager of its

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[862] Ibid, 264.

[863] As Walter Carlson summarized this period, "AFIPS was reconstituted to attract membership of all interested societies without impacting the financial stake in conference surpluses for ACM, IEEE, and SCI. The JCC Board was created to handle the conference planning and operation, and 40 per-cent of the surplus was earmarked for the three societies, with the remainder used to support AFIPS project operations. AFIPS was finally incorporated as an educational and scientific (tax-exempt) organization." Walter M. Carlson, "A Letter from ACM's Past President: The Wonderful World of AFIPS", Communications of the ACM 16, no. 5 (1973):273-74.

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Data Processing division. He had served the ACM as secretary and as vice president for several years earlier in the 1960s. Gilchrist's scientific computing credentials were impeccable: he had a Ph.D. in meteorology, and began his computing career at the Institute for Advanced Study, and as the head of the Syracuse University computer center. (Neither was he ever estranged from this world, eventually returning to it as director of computing for Columbia University).

Despite more contacts with Gilchrist, meetings with Paul Armer, and more trips between AFIPS and DPMA meetings, little concrete occurred during 1967. Jerome Geckle, nominated as the official DPMA liaison with other societies, had been addressing his personal ignorance of the ACM, SPA and AFIPS – which he admitted had been almost complete. He briefed his colleagues the aims and objectives of AFIPS, stressing the jealous guarding of power by member societies and the "rather fabulous amount of income" generated for them by its conference. He reported its conference proceedings to be very nicely printed, but to hold material, "of very little interest to you." "All long hair?" asked one of the committee. "Ninety percent of what may be considered long hair," replied Geckle.[864] But he assured his colleagues that Gilchrist would like to change this, saying that "they are crying to get us in."[865]

Geckle believed Gilchrist to be capable of turning AFIPS into a far more effective organization than that bequeathed to him by its previous leaders. He also hoped that AFIPS would give the DPMA a way of working with the more savory elements of the ACM without facing interference from its Council. Others were less impressed. David B. Johnson, the Secretary-Treasurer, was actively hostile to Geckle's assertion that the JCC and IFIP conferences had "tremendous stature." According to Johnson, this was true only among, "the long hair." "In the Bell Laboratory computer people," he continued, "they think that is wonderful, joint computer

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[864] Data Processing Management Association, Exec Comm, 16-18 Mar, 1967, 86-92.
[865] Ibid, 106.

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conference, and engineering people, once they are elected, you know, the long haired guys. They think that is where they belong."[866]

Geckle identified a number of strengths of AFIPS. One was its ties to government people, including Defense Department officials. He was impressed by its potential as "the voice to government of the computer industry." Another strength was the presence of senior representatives of computer vendors. Unlike the DPMA itself, the AFIPS board included a number of computer industry leaders. But its biggest appeal was financial. He saw its conference as something akin to a syndicate: "you have to buy a piece of the action in order to participate, and the bigger this nut gets, the bigger their holdings are, the more difficult it is to expand the federation."[867]

As Geckle saw it, the field needed an umbrella group. The question was whether to join AFIPS or to attempt to create a rival, managerially-oriented group including the SPA, the successor to NOMA, and other administratively oriented societies. In other words, the question was whether the field of which data processing formed part was computing, or business administration.

Elliot was not convinced. His hostility to AFIPS, apparently rooted in a reluctance to give up any of his own power, was strong and unwavering. After listening to Geckle's discussion, he remarked that the "only thing that I can't understand about the organization is that they don't [do] anything." According to Elliot, "AFIPS, in my opinion, is a spinning on dead center organization.

[866] Ibid, 108.

[867] Ibid, 98-102. Geckle estimated that $60,000 initial payment might be required by AFIPS the price of membership. While this does not appear to be in accord with official AFIPS regulations, he was at least right to sense the overriding importance of conference income and its distribution in shaping the relationships of AFIPS and its member societies.

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It has never left the ground, and it is an umbrella operation, but the umbrella is upside down. It is catching all the dough.'"[868]

Later that year, Virgil De Vine of the System Development Corporation replaced Geckle in the liaison role. His job at SDC, which had retained at least some of RAND's culture, may well have predisposed him toward the pan-computer position. Letters and calls continued to flow backward and forward, and at the August executive meeting he reported himself impressed with Armer and Gilchrist, saying that they were, "pushing in the same direction we are pushing in." While not yet ready to recommend membership of AFIPS, he was clearly warming to the idea. His more immediate suggestion, however, was that the DPMA immediately should take what was essentially a token role in a new international committee. AFIPS and the DPMA would jointly represent the US data processing community to an international group. This would involve little more than the production of a newsletter and a quarterly journal of reprinted material. The two groups would collaborate via mail in reviewing materials for these.[869]

This rather modest suggestion triggered a range of reactions from Elliot, all hostile. Speaking generally of AFIPS, he suggested that Geckle's support had been grossly premature because no "thorough investigation" had been made. AFIPS, according to Elliot, was "like Howard Hughes' plywood boat that got about five feet off the water." The specific proposal would be an involvement with IFIP, "which is a European organization." (Since visiting Europe to explore the potential for collaboration, Elliot had been rather skeptical of European efforts). He then returned to his favorite themes of competitors and conspiracy. "Such as the plan to expend this into a multiple article type of publication that could be classified as a magazine and ultimately compete with our Journal, that would, thereafter, over a period of a year or two or three, move into advertising and build ourselves another competitor; help another guy get into

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[868] Ibid, 107.

[869] Data Processing Management Association, Exec Comm, 14-16 Sept, 1967, 609-15.

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business." Although De Vine offered to do the work himself, Elliot sowed enough doubt to have the measure deferred for further investigation.[870]

De Vine returned to the question of AFIPS at the January 1968 meeting of the executive. Relating more than 18 months of continual contact between the executive committee and the officers of AFIPS, he suggested that it was now time to make a decision. His personal recommendation was now highly positive. In his view, an umbrella was badly needed and AFIPS was the most credible candidate, having "in general achieved their original goal of being the recognized voice of information processing." He believed that membership of AFIPS would leave the DPMA as the dominant international data processing society, but also allow it to "contribute greatly to the unification of all specialized disciplines" within the "total information processing community." It would raise the profile of the DPMA among desirable groups of potential members, and strengthen its program for "the upgrading of information processing to a professional level" while spreading the cost. Without the DPMA, he said, this "single voice" was "only the voice of the world of scientific computing. Until such a time as a business data processing influence is reflected in that voice, they cannot truly represent the total information processing community."[871] He also argued that the ACM was poised to strengthen its own SIGBDP group to fill the void if the DPMA continued to prevaricate.

De Vine quoted a letter from Gilchrist, claiming that the true purpose of AFIPS was now as a meeting ground for all professional societies. "Historically," Gilchrist wrote, "the JCC (Joint Computer Conferences) have worked out very well; but AFIPS does not regard this as its reason for existing. We are much more impressed with the work we have started, such as the survey of people in the industry, the preparation of the history of computing, consulting with the

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[870] Ibid, 600-19.

[871] Data Processing Management Association, Executive Committee Meeting Minutes -- January 18-19 & 21 -- Verbatim, 1968, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 60-70.

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Smithsonian Institution, and the question of privacy, and so on. These are all topics which I believe DPMA is or ought to be vitally concerned."[872]

The committee also had before it the report of the DPMA's recently established Long Range Advisory Committee. This panel was intended to bring some of the leading minds in data processing to bear on the issues facing the association. Its members included Robert V. Head, Herb Grosch, Solomon Pollock, and systems man Leslie Matthies. Among its recommendations were a six to zero vote that the DPMA should join AFIPS immediately, and a list of ten reasons to do so. These included the financial benefits, improved international standing and greater recognition by the US government.[873]

Many members of the Executive Committee seemed convinced by this. Others suggested that more evidence or legal opinions were needed. De Vine clearly found this foot dragging frustrating. "Your question," he said, "on whether we understand the AFIPS organization well enough to be objective in our consideration of the question recalls to my mind that this question was asked at the last Executive Committee meeting, last year, when Jerry [Geckle] presented his proposal and the consensus was we do not have enough information available. So help me, try as I did, there is very little I could contribute in this area that Jerry had not adequately covered in the past. There is very little more that I could say on this to provide you with information."[874]

Faced with the prospect of a decisive vote, Elliot deployed a new weapon. He delivered to the committee copies of a counter-proposal. It offered an attempted point-for-point rebuttal of the ten arguments in favor of AFIPS delivered by the long range advisory committee. He dismissed various of its points as "absolutely ridiculous and unfounded," "hearsay" and "totally untrue." He also pointed out darkly that most of its members belonged the ACM. His alternative

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[872] Ibid, 67A.

[873] Herbert B. Stafford, "DPMA -- Minutes of Long Range Advisory Committee Meeting", January 5 and 6 1968.

[874] Data Processing Management Association, Exec Comm, 18-21 Jan, 1968, 77A.

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plan was for a new association "similar in some respects" to AFIPS. Its focus, however, would be on "the business data processing community," and it would not be allowed to include commercial exhibits in its conference. He warned again that mixing the DPMA with the scientists and engineers of the ACM and IEEE, "would not create a homogenous blend." In contrast, his proposed new grouping would consist exclusively of business groups. As well as the obvious SPA, he suggested the American Management Association, the NAA, the American Institute of Chartered Accountants, the Society for the Advancement of Management and specialized industry associations such as the American Gas Association and the Life Office Management Association. "Organizations such as this," he argued, "are all reputable groups that are working, in one way or another, in the same business data processing areas as DPMA. These association, like DPMA, are practitioners rather than electric or electronic engineers, scientific programmers, etc."[875]

Elliot thereby confronted the association with what was really the most fundamental question of all: were they managerial professionals with an interest in the computer, or were they computing professionals with an interest in management? If the association was to remain true to data processing then its destiny clearly lay with management. As Elliot told the committee, "If DPMA wants to continue to represent the business data processing profession over the years, this proposal is an excellent entry into that area. So many associations are now deeply involved in data processing, and they need guidance; they need help; they want help. They come to us for help. We cannot give it to them."[876]

Whereas Elliot's rhetoric defined the DPMA as part of the data processing field, De Vine's support for AFIPS was expressed in the language of computing. As he told the committee, the DPMA was an important "facet of computing." The question was therefore whether to have,

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[875] R. Calvin Elliot, January 17 1968.
[876] Data Processing Management Association, Exec Comm, 18-21 Jan, 1968, 85A.

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"one voice for computing, or do you have a business data processing voice and a scientific computing voice?" He said that, "if we feel that it should be a combined voice, then I feel that AFIPS is the direction we should go."[877]

It is not clear whether Elliot truly believed such a group could be created. There is no evidence, before or after, that he attempted to establish one. His general fear of competitors seemed to mitigate against any substantial alliances. His aim was most probably to throw more uncertainty in the air and delay any vote for at least another six months. His proposal won the support of several committee members. They remained wary of the "scientific types" of the ACM and saw no reason to "rush into" AFIPS. Elliot himself seemed to be getting quite shrill, bemoaning the extent to which the executive group were "divorced from the daily activities of the DPMA" and the many threats to its exhibit income from conferences. Yet the most nakedly emotional pitch came from Charles L. Davis of Ling-Temco-Vought, who emerged as Elliot's closest ally against AFIPS. He seemed to view joining AFIPS as something akin to a corporate takeover by a much larger firm. While he professed himself open in principle, he was very concerned with the saving of face.

> I do not agree that we need to make a decision on this in such a big hurry. A lot of us have spent a lot of years in DPMA, and I do not refer just to this group. I also refer to the people who preceded us in this outfit. I think now that we are just getting into a position to negotiate with them–and I really think that this is what it should be, not that we buy in or beg them to let us join; I think we ought to sit tight and let [them] make us an offer.... They should be courting us, not us courting them.... They ought to offer us a full membership, with as big a cut of the pie, as anybody or anyone else, with maybe a few years of free dues, or something like this.... We have put a lot of work into this organization. If somebody else is to use it, let's make them pay for it. Let's not give up. We are good. We are just as good as they are.[878]

Elliot won a delay in the vote until the summer. In August, Davis took over as international president. Unsurprisingly, no moves toward AFIPS membership took place during

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[877] Ibid, 87A, 90A.
[878] Ibid, 99-103.

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his term. Here, as on other occasions, Elliot's stalling tactics worked so well because he alone endured for year after year on the Executive Committee. The turnover rate among committee members was quite high, and seemed to accelerate during the late 1960s. Geckle lasted only two years. DeVine had left by 1969. Most new members of the committee had little knowledge of other organizations. It took a while for people like Geckle to form strong ties with their counterparts in the ACM or AFIPS. Elliot needed do no more than to browbeat committee members and delay action, confident in the knowledge that a new committee would be along shortly.

While Elliot remained the power behind the throne within the DPMA, no meaningful steps toward membership of AFIPS or other collaboration with the ACM would be allowed to come to fruition. The DPMA was to remain its own little island for a few years more. By the early 1970s, however, the DPMA was in new hands and Walter Carlson had become the first pan-computer professionalist to lead the ACM. AFIPS membership, joint certification programs and the expansion of the ACM to encompass all computer-related work were suddenly back on the agenda – though as we shall see in the next chapter, considerable problems remained.

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## 12. DATA PROCESSING PROFESSIONALISM IN CRISIS

The last three years of the 1960s were a watershed period for the Data Processing Management Association (DPMA). Throughout the early- and mid-1960s, Elliot and his staff at DPMA headquarters had been tackling one new project after another, as the association continued its steady growth (propelled in large part by the continuing boom in the computer industry itself). In the areas of education alone, it had provided material to chapters to help them organize research grants, executive seminars, home study, Certificate in Data Processing (CDP) review courses, the Future Data Processors program, and the Boy Scout Merit Badge.[879]

By 1967, a number of ambitious projects were underway to raise the association and its members to new heights. One was its management seminar series, designed to improve the corporate position of its members by educating them in the concerns of general management. Another was a membership drive – the association budgeted for a 15 percent membership increase in 1969 and promoted this goal with the slogan "Up and Away with 30K." The final, and most ambitious, was the expansion of the association's certification program beyond its existing CDP for data processing supervisors and into a series of new certificates eventually expected to cover all computer-related corporate jobs. Its first stage, ready for launch, was the new Registered Business Programmer examination, and examinations for systems analysts and scientific programmers were in the pipeline.

Coming as they did at the end of two decades of steady growth and constant, if painful, expansion of the services offered by the association these three initiatives held the promise of a proud future – in which a larger and more managerially powerful membership body used credentials developed by the association to enforce standards within their data processing

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[879] Data Processing Management Association, Chapter Education Manual, Third Draft.

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departments and thus cement the DPMA as the governing body of a strong and well defined profession. Yet all three of these projects were to fail quickly and publicly, throwing into doubt the conception of professionalism they embodied and pushing the association itself into a financial crisis.

## The DPMA in the Late 1960s

Ever since its foundation as the NMAA in 1951, the DPMA had been striving to raise the status of its members from technical supervisors to generalist managers. Since the late 1950s it had become increasingly aggressive in its attempts to shift its focus (and its existing members) from punched card technology to computers. To judge from the visitors to its 1967 conference, it was enjoying some success with the latter project but making slow progress with the former. Although the DPMA's members were far more involved with computers than they and their predecessors had been a few years earlier, the association's profile had otherwise altered little.[880] 70 percent of its members worked in managerial or supervisory positions, and 92 percent claimed influence on the purchasing decisions made by their firms. Yet, to quote from the report, "the educational level of the audience was quite low in comparison with many industrial exhibitions." Only 55 percent had college degrees of any kind – more than half of which were in business administration.[881]

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[880] In 1967, the association engaged a specialist firm to survey visitors to its conference. The survey was returned by 534 of the 1,764 registrants. 71 percent were members of the DPMA – non-members could also register, most of whom were presumably locals or interested non-specialists. We can assume that this population was skewed towards more able and senior members, and those from large companies, who were able to pay for their travel. A very broad range of industries were represented, with a slight preponderance of non-manufacturing firms. Insurance companies made up the largest single group. Exhibit Surveys, Audience Survey of the 1967 DPMA Business Exposition, Boston June 20-23, 1967, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minnesota.

[881] Ibid, 1, 14. Despite the generally held impression among scientific computing experts of the DPMA meeting as a mere trade show, 40 percent of attendees said they attended for the technical sessions, while only 23 percent cited new products and developments as the primary motivation.

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These data processing managers and supervisors had little in common with those academics and technical computing experts who would have referred to themselves as members of the "computing" field or identified with the nascent discipline of computer science. After the DPMA itself, the most popular association among visitors to its conference was the relatively small Systems and Procedures Association (SPA) – home of the administrative "systems men" whose work was increasingly closely tied to the computer – of which 8 percent of attendees were members. Looking at the two main computing societies, we see that just 4 percent of conference attendees were members of the Association for Computing Machinery (ACM), and 1 percent members of the Institute for Electrical and Electronic Engineers (IEEE). Their educational backgrounds were very different from those of technical computing specialists, most of whom held scientific or engineering degrees. 30 percent of the total held business administration degrees, 4 percent held degrees in economics and 3 percent industrial engineering degrees. The only scientific degree to make the list was mathematics, with 4 percent. Likewise, just 1 percent of attendees held Ph.D.s.[882]

Yet the divide between general management and data processing was almost as striking. This is clear from the job titles of the show's attendees. 48 percent of them were called data processing managers, and a further 15 percent were called systems and procedures managers. 14 percent were categorized as "program managers or analysts." These three groups, accounting for more than three quarters of all attendees, were managerial technicians of one kind or another. Holders of professional and general management titles made up a much smaller group. Just 4 percent were operations managers, and 2 percent were accountants. The same pattern showed up in their reading matter. 48 percent read Datamation, and 38 percent read Business Automation

[882] Ibid. Neither did this audience appear attracted to the exhibitions organized by the computing societies. 8 percent had visited SPA meetings, and 7 percent AMA meetings. Just 4 percent had been to a Joint Computer Conference (the leading computing show, organized by the umbrella group AFIPS) and the same number had visited the ACM's own show.

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(validating my use of these sources as indicative of the information available to data processing managers). Yet Business Week, a magazine with enormous circulation among businessmen, was read by only 6 percent. Neither the Harvard Business Review, Fortune or Dun's Review – all staples of senior management – reached the 5 percent cutoff. [883]

One can see why the association's leaders, who continued to see professionalism and advancement largely in terms of improved managerial credibility, were eager to provide seminars in which its members could hone their managerial skills and awareness and to run "executive seminars" designed to boost the credibility of the DPMA with senior managers. One can also see why few within the DPMA leadership viewed the ACM as particularly relevant to these goals.

## Crisis 1: The Failure of Managerial Professionalism

The first wave of disappointment for the DPMA came in 1967, with the failure of an ambitious national series of management seminars. One of the two seminar outlines was designed to explore management science techniques, while the other presented managerial skills claimed to, "Double Your Effectiveness." Calvin R. Elliot, its Executive Director, had committed the association to offer these at twenty-three sites across the United States. The DPMA had previously enjoyed great success with its series of technical seminars on the COBOL programming language. Yet as the scheduled dates loomed, almost nobody had registered for the new managerial sessions. At the Dallas seminar, one of the first to be held, the results could not have been worse. The Fort Worth chapter alone had more than five hundred members. Promotion had been extensive, including a personalized telephone call to each member, appeals at chapter meetings and use of local contacts. Letters had been sent to all members of the seven adjacent chapters. The chapters themselves had been printing and distributing material vigorously. But on

[883] Ibid. Interestingly, two of the most vocal groups in data processing were statistically irrelevant – consultants and academics each made up 1 percent of the visitors to the show.

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the day of the seminar, just forty-six people showed up, of whom only twenty-one were members of the association. Only five people from the entire Dallas chapter had responded to the call. For the forthcoming Portland, Oregon session, eight thousand pieces of mail to members of twenty-four chapters had produced three advance registrations.[884]

The Executive Committee left no metaphor unused when discussing this grave situation. Theodore Rich, then the president, called on his fellows not to "start jumping out of the boat and throwing the oars aside.... by pouring coal and breathing fumes, we can keep from losing our shirts on this thing." Elliot was less hopeful – he had already "pulled every stop that there is in the books to promote these seminars. There was no stone that we did not turn over half a dozen times." As Secretary-Treasurer David B. Johnston said to him, "you really poured your blood into it." But it was Davis who came up with the most salient cliché – "You can lead a horse to water, but you cannot make him drink. You can tell him about it. If he doesn't want to go, he won't go."[885]

Having run a well coordinated and lavish promotional campaign, it was clear to them that something was fundamentally wrong with their approach. The committee was sufficiently shocked to begin to reexamine its assumptions about the interests of the members in management issues. As president-elect Charles L. Davis noted, plenty of people in his own firm (Ling-Temco-Vought) could have attended the Fort Worth session and had their fees paid, but none had even asked to go. He thought that, "it was the title of the seminar. If it had been time sharing or some technical thing they would have felt easier about spending the money and their time to go." Elliot reported himself heartbroken, and said that it was, "the first time I have really been shaken on anything." Johnston blamed the low "caliber" of the members, arguing that the executive committee had forgotten that its own interests did not mesh with those of the rank and file. He

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[884] Data Processing Management Association, Exec Comm, 14-16 Sept, 1967.
[885] Ibid, 272-78.

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said of the membership that, "[a] big segment are guys who are, in my opinion, chained to their machines. They are low-level guys who cannot get away from their office. They have the built-in fear, because they are low-level individuals, to not even ask...."[886]

Edward Lineback, Vice President for Bylaws, pointed out that, "the smaller installation people feel they are not ready for it. They are not advanced enough to get into it. They are still dealing with the punch card." Another member blamed the continuing technical upheavals imposed by the shift to third generation systems:

> If we had given a program on how to de-bug your COBOL System... I think we would have had people out. People are so wrapped up in the new third generation systems that they do not have the time for the management level, how to manage. They are tied up with production problems, and problems of getting their systems going, and getting their new systems converted and getting them in operation, and they have got real technical problems right now.[887]

Even Immediate Past President Billy Field, who was forever pushing his colleagues to address their efforts toward executives, conceded that, "we have over-estimated our clientele." Though he had been, "hitting them on the head with the fact that they need to get their heads out of the machine and into corporate management circles and find out what is going on," this had accomplished little. Field suggested that if a data processing supervisor asked his boss for permission to attend a management seminar, "that is going to mean that they are after his job." And of course, there was the problem of someone who might already be classified as a mid-level manager taking what was essentially a remedial course in the subject. This led some of the committee members to reappraise their priorities. As Johnston suggested that the association should find out what its members actually wanted and provide it, rather than rushing to, "give them something that we think they ought to want."[888]

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[886] Ibid, 279, 85, 88.
[887] Ibid, 289.
[888] Ibid, 290, 94.

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Similar disastrous results ensued across the country, as further seminars in the same series were held over the following months. When the costs were counted at the next meeting of the committee, Field was still more shaken:

> This was one of the greatest disappointments to me to find that in our Association we do not have the people who are thinking management. Sure they are crying 'management'. If you will attend a meeting of the Board of Directors, you will find everyone saying, "Management." The idea is "Let's shoot all of the keypunch operators because we are managers." They are not managers.... When we talk about managers, we are talking about what five years ago were known as "supervisors," and they are still doing the same job with a different title, perhaps not as effectively, because they are working with equipment with which they are less acquainted.[889]

Despite this, Field was not yet willing to give up. Instead, he used this sad discovery as proof that managerial training was needed more badly than ever: "we learned a little bit more about where the average member lives, and I think if we look around we can realize this field has catapulted men much higher in company management than they would otherwise have reached on their management ability.... [U]nless he develops that ability before conditions change, he is inevitably going down the ladder."[890]

The association's assumption that managerial professionalism was an attainable goal for its members was further shaken by the discussions of the Long Range Advisory Committee, set up in 1968 to give it an external brain-trust to draw upon. As shown earlier, it included a number of key pan-computer professionalists, among them Solomon L. Pollack, Herb Grosch and Robert V. Head. It met three times during that year. On the first of these meetings, after welcoming the group to DPMA Headquarters, Davis told them that its aim was, "to create more professionalism in the field of Data Processing in industry." Rich added that, "the main weakness in DPMA was

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889 Data Processing Management Association, Exec Comm. 18-21 Jan. 1968, 170-1.
890 Ibid.

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that the members do not feel professional and equal to other professional groups.... there is a definite interest and urgency to have Data Processing people recognized as professionals."[891]

The committee's response indicated a fundamental divergence between the growing movement toward pan-computer professionalism and the more corporate and managerial data processing concept of professionalism held within the DPMA. The same year, for example, Jerome Geckle had quoted the association's code of ethics in an article entitled, "What DPMA is Doing to Promote Professional Development of its Members." After setting forth the "educational and professional development of its members," he went on to quote the first article of its code of ethics, "That I have an obligation to management, therefore, I shall promote the understanding of automatic data processing methods and procedures to management using every resource at my command." This ethical code placed service to corporate employers above all other goals, and equated managerial status with professionalism.[892]

The Long Range Advisory Committee had little truck with this sort of thinking. It observed that the position of data processing management was ambiguous, because the "DPMA identifies itself separately from top management and that top management is not necessarily included as part of Data Processing management." This was true enough, and few within the association could have disputed it. Grosch also reiterated his conviction that data processing was but part of the broader profession of computing – something the DPMA had not been particularly responsive to in the past. But the more fundamental, and to the DPMA more surprising, challenge was to the very idea of management itself as a profession. The committee reported a consensus that, "Data Processing is not a profession because a person aspires to move up and out of Data

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[891] Stafford, "DPMA -- Minutes of Long Range Advisory Committee Meeting". On the committee, see also Solomon L Pollack, "On DPMA's Long Range Advisory Committee", Journal of Data Management 7, no. 3 (March 1969):74-75 and Anonymous, "DPMA Long Range Advisory Committee", Journal of Data Management 4, no. 3 (March 1968):78.

[892] Geckle, "What DPMA is Doing to Promote Professional Development of its Members".

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Processing and that higher management is not considered to be a profession." Higher management not a profession! Instead, the advisory committee felt that the DPMA should recognize the technical nature of its strengths and its members' interest, and establish "continuity in DPMA membership from the lowest Data Processing people to the highest Data Processing manager." Going further, it argued that, "many potential members are lost because of the word 'management'," and made, "a recommendation that the name should be changed to Data Processing Association." Setting the DPMA's assumptions on their head, the committee's report implied that data processing could perhaps become a profession (or part thereof), whereas data processing management by definition could not. The gulf between pan-computer professionalism and data processing professionalism could not be made clearer. [893]

Yet the committee's attempt to identify the essence of true professionalism was also quite inconclusive when considered as a guide to action. Following a brainstorming session, it identified "skill and training, solo role, licensing, ethics, and snobbism" as the five crucial elements of a profession, largely by reference to medical medical, which it believed to possess all five in abundance. It was not sure how to get these things, but it did suggest that the DPMA institute higher grades of membership, seek closer ties with other professional groups, merge with the SPA, join AFIPS, and establish specialized but lower-level examinations in programming, systems and other fields to supplement the CDP. By following these steps, it suggested that, "the DPMA might be able to reach professionalism," as long as a degree or CDP was required for full membership.[894]

Later in 1968, the pan-computer professionalists returned the favor when Davis (by then himself DPMA president) was invited to the RAND Symposium. While the leaders of the ACM and IEEE were routinely invited, the privilege was rarely extended to DPMA presidents. The

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[893] Stafford, "DPMA -- Minutes of Long Range Advisory Committee Meeting".
[894] Ibid.

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meeting was devoted to the topic of professionalism. Its participants, including Paul Armer, Bruce Gilchrist, and George Glaser, as well as key members of the ACM and IEEE, went back over the issues which had originally motivated the formation of AFIPS. The contents of the resulting discussion were so controversial that the final transcript was not circulated for possible publication, as was the normal practice. The group remained rather critical of the conservative nature of existing societies, and had been somewhat disappointed by the reality of AFIPS. On the other hand, they showed some optimism for the future of the ACM, and the chance for substantial advancement toward true professionalism.[895]

Davis remained quiet through most of the discussion, probably due to a lack of familiarity with, and interest in, the issues under discussion. But when quizzed by the others, he expressed skepticism over possible DPMA membership in AFIPS, and a preference for affiliation within data processing (via alliances with groups like the SPA or Financial Executives International), rather than with computing groups. This alternative idea of professionalism seemed to surprise other members of the group. Armer called the DPMA "chicken" for being scared of ACM domination if it joined AFIPS. Yet Anthony Oettinger, whose term as ACM President had recently finished, was quick to recognize its implications, noting that, "it says that the DPMA views itself more on the management and administrative side and less on the technical." Oettinger admitted that many within the ACM were eager to banish discussion of matters perceived as insufficiently technical. "The notion that ACM is a sort of holier than thou academic intellectual sort of enterprise--not inclined to be messing around with the garbage that

[895] Fred Gruenberger, RAND Symposium 11 (Expurgated), 1968, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

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comptrollers worry about--has been and still is, to a sufficiently large percentage of the members, an attitude that one can feel considerably paranoid about."[896]

## Crisis 2: The Expansion of Certification

The second of the three crises for the DPMA's program of managerial professionalism came from the association's long-planned attempts to extend its certification scheme. As noted earlier, the executive committee had approved a plan to extend the CDP certificate through additional specialized qualifications in particular areas of data processing. These specializations were initially expected to be more demanding than the basic qualification but not to replace it – akin to specialized qualifications sought by many medical doctors after receiving their basic certification. Somewhere along the line, this shifted to a plan to produce a set of lower-level qualifications for programmers, analysts and operators. These were designed as more technical, less demanding qualifications for those who, unlike the supposedly managerial CDP holders, did not have to deal with data processing as a whole.

By 1968, the Certification Committee had presented a detailed plan for a "Certificate in Computer Programming—Business" to the Executive Committee for its approval. It sailed through, only to run aground on the rockier ground of the association's Board of Directors. The board ordered it deferred for two years – an order essentially ignored by the Certification Committee, which continued to develop it at its own time and expense. The decision by the council to continue development of the new business programming test despite the board's vote to defer it caused some grumbling from the association's chapters. Despite this, a sample version

[896] Ibid, 117-23. While Oettinger was himself a computation specialist in the purest sense, as a long-time member of the Harvard Computation Laboratory and student of its legendary founder Howard Aiken, he was by no academic bigot in his ACM role. Indeed, it was Oettinger who asked Richard G. Canning to chair and ad-hoc committee to "investigate ways in which the ACM could better serve the business data processing community" – efforts which resulted in a series of seminars as well as publicity for the Special Interest Group in Business Data Processing. A G Oettinger, "President's Letter to the ACM Membership", Communications of the ACM 10, no. 8 (August 1967):464-67.

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of the examination was tested in 1969 on several groups. In response to the hostility of the chapter representatives the certification team did, however, move to clarify the relationship of the new test to the existing CDP. In its report to the Executive Committee, it insisted that the former was,

> a completely separate program directed to a different audience and testing for a completely different level of knowledge....There are thousands of business and scientific programmers and systems analysts who are experts in their fields, but do not have the general breadth of knowledge and experience to qualify for the CDP examination. Many of these specialists will move up and become more knowledgeable in all areas of data processing, but many more will remain in the special or technical areas and will never gain the experience and broad knowledge required to pass the CDP examinations. The test is intended to examine, recognize and register that vast group of people who are qualified and who perform such a vital service to our profession, but who may never be capable of qualifying for or passing the Certificate in Data Processing Examination.[897]

The new qualification, the first in a projected series to be aimed at these specialist groups, would therefore be called the "Registered Business Programmer examination" or RBP. The concept of registration was deliberately chosen to appear less professional than that of certification, a change made to deal with the hostility expressed by the chapter representatives who composed the Board of Directors. Even as it prepared to implement examinations for programming skill, the DPMA went out of its way to show that it did not regard programming as a professional activity and that its only professional certification remained the managerially-oriented CDP.[898]

Additional tests to address scientific programming, systems analysis and possibly even management were slated for future development, with the scientific test expected to arrive first. These planned tests, in particular the one intended to "register" scientific programmers,

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[897] DPMA Certification Council, 1968-69 Certification Council Report, 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 8.

[898] Ibid.

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represented an attempt by the DPMA and its semi-autonomous Certification Council to set standards for senior programmers of all kinds, as well as for the full range of data processing occupations. While the hostility of some ACM figures to the CDP had been largely based on misrepresentation of its scope and constituency, the new tests could only confirm their fears with their intent to lay down standards for programmers. These tests, and particularly the one for scientific programmers, represented a direct challenge to the authority of the ACM over computing. This was an act of remarkable hubris on the part of the DPMA, which still included almost no scientific computing experts among its membership. Elliot, however, was spoiling for the fight. "They have been very jealous of our regional CDP program," he said of the ACM. "Now, it is common knowledge we are going into a business programmer situation, and there has been some leakage, if you will please, on scientific, but nothing has been confirmed. And if I may, I would like to heartily recommend, strongly recommend that it be kept at this table because [the ACM] would like to jump at that scientific area." He felt that without the board's earlier challenge to the RBP, development of the scientific test might already be well underway.[899]

The RBP was "designed to test for in-depth knowledge in the business programming area" and "directed at the senior programmer level." It was to include 150 questions, last for three or four hours, and would be offered for the first time in the Fall of 1970 – by which point the moratorium imposed by the board would have ended. Because it was perceived as a technical, rather than a truly professional, qualification there were no requirements for knowledge or experience.[900] The RBP was, in theory at least, a test which might plausibly be required for all business programmers in an organization – either as an initial screening device for experienced

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[899] Data Processing Management Association, Executive Committee Minutes -- 3-4 & 6th December, 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 257.

[900] DPMA Certification Council, 1968-69 Certification Council Report.

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recruits, or as a requirement for promotion as a senior programmer. [901] According to the vice president responsible, there had "been some question that this… is not directed to the DPMA member. As far as the examination itself, that is probably true, because it is directed at the senior programmer level. However, as managers, I think this will be extremely valuable to DPMA members…. If we are looking at prospective employees and a person had passed this examination, it would tell us a lot about him."[902] The test would thus, "be one of the greatest tools that we as managers have ever had."[903]

The test was targeted at what seemed like a well-defined occupation – the business programmer. But as it struggled to produce a satisfactory examination, the council came up against the problem that programming, even administrative application programming, did not seem to involve any easily testable shared body of occupational knowledge. One could not really test applied programming skill without using a specific programming language. But, as one Executive Committee member pointed out, "a number of companies use COBOL and a number of other companies use PL-1 and a number of other companies use [assembler] and RPG and some companies develop their own and so on." The test therefore included questions on several specific languages – twenty-five on COBOL, with a small number on each of assembly language, FORTRAN and PL/1. It also included more generally applicable questions on the principles of sorting, operating systems and other software tools. Like the CDP, it was designed to be non-manufacturer specific. Yet very few practicing programmers were likely to have experience in all the languages involved – something presented by the Certification Council as a positive point because "experience alone will not qualify him to pass this thing. He has to get out and do some

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[901] Data Processing Management Association, Executive Committee Minutes -- 13-15 June, 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 254-56.
[902] Data Processing Management Association, Exec Comm, 3-6 Dec, 1969, 159.
[903] Ibid, 246.

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research." The presence of FORTRAN, a language ubiquitous in computing but largely unknown in data processing circles, provoked particular dissention within the executive committee.[904]

In a puff-piece presented in the association's own Journal of Data Management, its assistant education director presented lofty claims for the new test. It would, he wrote, allow the data processing community to "put its house in order." Using rhetoric then becoming common among those looking to somehow regulate, systematize, or place on a scientific basis the practice of programming, he suggested that, "The 'art' of programming has been a persistent mystique in the short and frantic history of computers... the connotations have stifled attempts to develop useful measures of programming skills." He claimed that it was the, "first statistically sound method of identifying programmers who possess the proficiency to perform at the senior level." While implicitly acknowledging that the current shortage of programmers removed the need to carefully screen them, he insisted that a rapid expansion in the supply of trained programmers would soon bring supply and demand into balance – at which point the test would be widely used to, "select programmers along more conventional lines."[905] The association distributed 50,000 study guides to promote the new exam, and issued its chapters with a new pamphlet called The Programmer in Your Company's Future.

The RBP proved to be another debacle. It was administered publicly for the first time in October 1970. 1,100 people sat the examination, of whom 434 passed. The final version included 130 factual questions and a further twenty "work questions." These were, unfortunately, so plagued with editing and content problems that the credibility of the examination was fatally

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[904] Ibid, 249-51. The Certification Council's suggestion that all programmers should know at least a modicum of FORTRAN was apparently motivated by a concern to position the business programmer as a member of a larger programming occupation. FORTRAN was occasionally used, particularly in the early 1960s, for data processing tasks. See

[905] John A Jr. Guerrieri, "Who Needs Registration", Data Management 8, no. 4 (April 1970):40-41.

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undermined. Answers to seven questions were excluded from the grading, while a further eighteen were counted despite typographical errors. Even the official report admitted that, "the 'face validity' of the examination was judged to be low" by those who took it.[906] The association's attempts to promote the test also stumbled. While the Chicago chapter reported no trouble in "getting space, instructors or a solid outline" for a review course, "only five people signed up.... very little enthusiasm was shown by the membership."[907] This was not really surprising. The test was aimed at programmers, and was intended to help DPMA members by giving them a tool to screen job applicants, rather than by providing them with a qualification they might personally seek to attain. But the association lacked the ability to effectively push the test beyond its own borders and into the population of business programmers. Instead it relied on its chapter meetings and newsletter as promotional tools, and thus failed to promote the test to those who might actually take it.

Enrollments were slow to rise. The test was offered again October 1971. By the following June, it was becoming apparent that it imposed an unsustainable financial burden on the association. Its secretary-treasurer was forced to report that the revenue from the RBP was "very poor," while the Vice President for Association Liaison and International Affairs called the results "a little shocker" that called into question its whole policy of "of working with the [Certification] Council."[908] We saw earlier that the CDP program had never fully recovered from the drop in applicants caused by the 1966 and 1967 enforcement of the stringent requirements

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[906] Herbert B. Safford, "Preliminary Evaluation of the First DPMA Registered Business Programmer Examination", Data Management 9, no. 4 (April 1971):28-30.

[907] J. A. Driscoll, Report to Board of Directors re. CDP and RBPE reviews, September 13, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[908] Data Processing Management Association, Executive Board of Directors Minutes -- 26 June, 1972, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 6-8. Attempts to salvage the RBP after its disastrous debut are also discussed in Data Processing Management Association, Executive Board of Directors Minutes -- 9-10 December, 1971, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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forcing applicants to have taken a long list of specific college courses. The failure of the RBP program imposed a new and significant financial drain on the association, shattering its assumption that it had sufficient influence and resources to develop a comprehensive testing program of the kind envisioned by its Certification Council.

## Crisis 3: Dwindling Membership

Had the association continued to grow, the deficit caused by the abrupt drop in CDP enrollment, the failure of the management seminar series, the botched introduction of the RBP examination, and the abrupt drop in CDP enrollment might have been absorbed by increased revenue from its members. But its membership growth, rapid through most of its first two decades, faltered at the end of the 1960s. Its goal for 1969 was a 15 percent increase, promoted with the slogan "Up and Away with 30K."[909] But as the decade finished, its membership had failed to reach even twenty-seven thousand.[910] Worse was to come. The recession of the early 1970s provoked considerable worry among those who worked with computers, as the high-technology bubble of preceding years burst. While it ultimately proved little more than a blip in the astonishing long term growth in employment for programmers, analysts and other data processing specialists the slowdown did lead businesses and individuals to curtail their unnecessary expenses. DPMA membership proved to be something that many individuals could live without when their companies changed policy to end automatic reimbursement of professional dues. The association's revenue from conference exhibits was also squeezed.

By 1972, its membership had fallen to a mere twenty-four thousand people. When data processing employment resumed its rapid growth over the next few years, the association stagnated. It was never able to resume significant growth in membership. It also found itself

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[909] Data Processing Management Association, Exec Comm, 13-15 June, 1969.
[910] Data Processing Management Association, Exec Comm, 3-6 Dec, 1969, 134-40.

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fighting a losing battle in its attempts to attract a more managerial audience. Throughout its existence, its membership was dominated by low-level supervisors. Repeated attempts were made to broaden its appeal, but none succeeded. As its newly elected president admitted in 1974, "DPMA has been an interim organization, that is, members join when they have a lower level supervisory position. They retain membership until they reach middle or upper level management positions."[911]

Membership matters remained under the effective control of individual chapters, rather than the national association. In 1970, its Executive Board of Directors (a short lived alternative to the problematic combination of an enormous board of directors and a small executive committee) discussed membership issues. Concerns over membership eligibility remained tied to conceptions of professionalism, but the DPMA remained unable to articulate a coherent and workable sense of what professional status actually meant in the data processing field. The specific item under discussion was a plan to offer multiple levels of membership – including a higher grade only available to those with the CDP or a masters degree in an approved subject. The association's growing body of student chapters was a particular problem, because upon graduation the students were unable to join many regular chapters because of their lack of experience. This rather undermined the point of having student chapters in the first place.[912]

Rich, a long time member of the association's leadership, suggested that professionals of all kinds should be welcome as regular members without specific experience or job requirements, saying that, "whether he be a doctor or engineer or someone else, if he is interested enough in data processing, to learn more about the profession, he should be allowed to join the organization

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[911] Helen M Milecki, "An Interview with DPMA's President", Data Management 12, no. 8 (August 1974):29-31.

[912] Data Processing Management Association, Executive Board of Directors Minutes – 22 June, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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at the present time.... [Y]ou are not going to have the local bum at the tavern plunk down $30 to become a member of the association."[913] The idea of data processing professionalism was still so inchoate that Rich found it most natural to illustrate the existence of a broad yet desirable profession through the questionable proposition that doctors and engineers might be looking for a new hobby. Picking up on this idea, one of Rich's colleagues supported the idea, and suggested that a name change to Data Processing Association should accompany the admittance of non-managerial professionals. Another objected, saying that "I don't think we should degrade it to the point of just throwing it wide open... we should keep it on the professional level and not just open it up to anybody who has $30." As a third said, "if we make it wide open, we will fill the membership of chapters with junior key-punch operators and junior programmers." These, of course, were exactly the people who might want to join. Some chapters were already admitting them, as evidenced by the reply of a fourth member who countered that, "Some of these people we are talking about are the key people to develop and there is no better way to develop them than some of the education programs we have." He said that his own company included, "one operator, a young man, who is aspiring to be a programmer, an assistant manager or manager. I think this is a fine, fine route for him."[914]

Indeed, junior but capable and ambitious youngsters with a lack of formal education were probably those who might benefit most from membership in the association, and in the long run could have strengthened it substantially. Yet its quixotic pursuit of a fuzzily defined professional status blinded many of its leaders to this fact. The DPMA's continuing ambivalence toward programmers, and its frequent hostility toward operators, was a direct product of the punched card machine era – in which supervisors strove mightily to set themselves aside from the blue-

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[913] Ibid, 66.
[914] Anonymous, "Parker Heads DPMA Officers for 1970-71", Journal of Data Management 8, no. 8 (August 1970):32-35, 62-82.

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collar work of machine operators and to project a managerial image. But although exposure to managers and accountants shaped their goals, most remained convinced that the technical, craft knowledge of programming and operations work could never be the basis for professional status. Professionalism involved somehow cutting oneself off from that, guided by a vague notion of medicine or law.[915]

The association was, among other things, too narrow to make its managerially-oriented vision of data processing professionalism into a real success. During the early 1970s, both the newly founded Society for Management Information Systems and a resurgent ACM SIGBDP proved better able to claim the loyalty of the most senior data processing staff. The Association for Systems Management (formerly the SPA) retained its appeal for systems analysts with managerial aspirations, while the newly formed Association of Computer Programmers and Analysts (ACPA) did its best to represent the more junior data processing staff denied a warm welcome in many DPMA chapters.[916] As demonstrated by the failure of the RBP program, the DPMA contained neither large numbers of career programmers eager to take the test personally, nor enormous numbers of senior data processing or general managers able to impose it on their employees. The association was oriented toward managerial advancement, but as the collapse of its management seminar programs showed, its rank and file members were interested in technical

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[915] The DPMA continued to push the professionalism theme in its magazine. See James P O'Grady, "Who Profits From Professional Development?" Data Management 13, no. 1 (January 1975):30-33.

[916] The ACPA was founded in August 1970. Its initial aims are discussed in Anonymous, "Latest Association: Programmers and Analysts", Datamation, October 1 1970. Malcolm H Gotterer, "The Impact of Professionalization Efforts on the Computer Manager (Panel)", in Proceedings of the 1971 Annual Conference, ed. Association for Computing Machinery (ACM: New York, 1971). By 1971 its president, Paul C. Notari claimed that it offered a code of ethics, technical and managerial education, and was "developing certification examinations for both computer programmers and systems analysts." Inverting the normal definitions of professionalism, he faulted most data processing staff as non-professional because they did not place loyalty to their employer above all other virtues. This was apparently the centerpiece of the ACPA ethical code. Anonymous, "Certify Professionals: Who and How?" Datamation, October 1 1970. The ACPA is discussed briefly in Shapiro, "Computer Software as Technology: an Examination of Technological Development", 204 and in Ensmenger, "From Black Art to Industrial Discipline".

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education but had little motivation to improve their management skills. To add insult to injury, those who did attain appreciable managerial advancement would most likely leave it for greener pastures.

The actual membership profile of the DPMA changed very little from the early-1960s to the early-1970s.[917] While its members appeared to have become somewhat better educated over the previous decade, their academic achievements remained very modest compared to those of most professional groups, or to the more technically inclined computer societies. In 1971, just 44 percent of its members had bachelors or higher degrees.[918] They did not, as a group, turn naturally to colleges for new skills, having received far more occupationally relevant training from computer manufacturers than any other source. On the job training was also more important than university education. The survey included demographic information missing from earlier investigations. This confirmed that white men made up virtually the entire association. Just 4 percent of its members were women. "Orientals," Hispanics and Blacks between them accounted for over 2 percent of its ranks.[919]

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[917] In 1971, the DPMA surveyed its membership again (this time as part of a joint AFIPS project). Most of the association's members remained quite junior supervisors of one kind of another. 79 percent claimed to supervise or manage other people. The median was about seven supervisees, though 4 percent of its members claimed to supervise more than 100 people. Its appeal remained strongest within data processing departments. The survey also asked in what "major component of the organization", presumably equating to a corporate division, the respondent worked. 51 percent reported that they were part of a "computing, data processing, or information services" group. 14 percent were in finance, the traditional home of data processing, and 12 percent in "administration or personnel" – presumably including hybrid management services organizations. 6 percent were consultants or provided other professional services. Between them, research and development, manufacturing and engineering accounted for just 4 percent of the membership. The only surprise was that 8 percent worked in marketing groups – presumably as technical or business-oriented marketers within computer firms. American Federation of Information Processing Societies, Summary of DPMA Respondents to 1971 Personnel Survey, 1972, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[918] Academic specialization was still dominated by management subjects: 22 percent of the total had degrees in business administration, 6 percent in engineering and 6 percent in mathematics. It seems likely that many of these business degrees were acquired from evening classes, rather than as full-time undergraduates.

[919] American Federation of Information Processing Societies, Summary of DPMA Respondents to 1971 Personnel Survey.

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**Rethinking Certification**

By the start of the 1970s, pressure was growing on the DPMA to work with other computer-related societies, particularly the ACM and AFIPS, as it attempted to broaden the coverage and appeal of its certification programs. Since the origins of the CDP program, most of its recipients had not been members of the DPMA, and few had rushed to join the association afterwards. Indeed, many of those who had been DPMA members when the attained the CDP let their membership lapse soon afterwards.[920] DMPA members were thus underwriting a qualification held mostly by outsiders. This fitted well with the idea that professionalism meant serving the field as a whole, rather than the narrow interests of the association's members, but it posed two problems that were not going to go away. One was the resentfulness of many DPMA members; the other was the desire of CDP holders themselves to receive continuing benefits from and involvement with the future of the certificate. Clearly the association needed to work with the field as a whole to gain broader support and involve other associations with the costs and promotion of the certificate. Almost from the beginning, outsiders received formal representation though the Certificate Advisory Council (later the Certification Council).

The problem was defining what the field was, given that the CDP was supposed to be a managerial qualification first and foremost. Should the DPMA collaborate with the ACM, or with business organizations such as the SPA or the American Management Association? These pressures only increased as the association's membership declined, its strategy of managerial professionalism faltered, and the failure of the RBP placed an increasing burden on its coffers. Meanwhile, continuing efforts within AFIPS and the ACM to address professional issues such as certification led many within the DPMA to worry that their self-perceived early lead in the area was liable to be snatched away.

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[920] The problem of CDP holders leaving the DPMA is discussed in Data Processing Management Association, Exec BOD, 9-10 December, 1971.

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Elliot had, to give him his due, proposed back in 1967 that the association's certification programs be transferred to a foundation involving the SPA, the ACM, and other data-processing groups. But his subsequent actions reverted to his more typical pattern of instinctive hostility to all collaborative efforts. In 1970, for example, representatives of the DPMA, AFIPS, the business machines group BEMA, and a chain of vocational EDP training centers met at the Washington offices of the mighty testing firm ETS. ETS was proposing to create a new "policy board" to guide in toward the preparation of a new "Entry Level Programmer Test." ETS would share development costs with the associations, provide the benefit of its expertise and administer the tests. The board representing the sponsoring associations would receive most of the surplus proceeds, to dispose of as it wished. Tests for groups such as the Society of Actuaries and the American Board of Obstetrics were already administered under similar arrangements. ETS expected to attract around 30,000 people a year, and to follow the initial test with a series of specialized language examinations.

The main contribution of Elliot's representative to the discussions appears to have been to challenge the legitimacy of the other participants. First, he insisted that vocational schools must not play a part in developing the tests, even though their graduates would be a large part of the market. They "would be obligated to do everything possible to influence the development of the examination so that every graduate of all its schools could reasonably pass." Next, he complained that the expenses of the BEMA and ACM representatives were paid for by their employers (Honeywell and Univac), and not their associations – meaning that they could not truly speak on behalf of these groups. Finally, he insisted that the ACM could only take part if it bore a full

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share of the development costs – something he was told at the outset it would be unable to do because of its own financial crisis.[921]

Unsurprisingly, the testing plan failed to proceed. Here, as elsewhere, the DPMA displayed a striking reluctance to give any ground to what it perceived as commercial interests. Although its concept of professionalism was fundamentally managerial, it was nonetheless hostile to any alliance with computer manufacturers, private publishers, vocational educators or profit-seeking groups. This perhaps resulted from a deeply held resentment among punched card and computer staff that they were sometimes seen by outsiders as mere stooges of equipment suppliers, a fifth column within the corporation more loyal to IBM than to their own firms. The DPMA refused to sell its membership lists, to endorse any commercially produced training courses for its examinations or to put itself in any position where it might hand control to commercial interests. Almost none of its senior leaders worked for suppliers of computer hardware or software. Such commitment to professional aloofness stands in remarkable contrast to that of the engineering societies of the early twentieth century, whose prosperity and ability to set vital technical standards and see them adopted stemmed in large part from their close ties to equipment suppliers and their willingness to compromise the ideals of professional autonomy.[922]

The same year, the DPMA played an equally disruptive role in a session organized by AFIPS to discuss "professionalism in the computer field." The two-day event was chaired by former Labor Secretary Willard Wirtz. Participants included Gilchrist, Canning, ACM President Bernie Galler and a variety of senior data processing figures. In an apparent snub, Don Young, a

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[921] D. J. McPherson, Memo to R. C. Elliot re: Entry Level Programmer Examination, June 15, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

[922] See Bruce Sinclair and James P. Hull, A centennial history of the American Society of Mechanical Engineers, 1880-1980 (Toronto ; Buffalo: Published for the American Society of Mechanical Engineers by University of Toronto Press, 1980) for an insightful reading of the technical standards process in the ASME.

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DPMA staff member, was the association's rather less renowned delegate. The delegates agreed on the need to develop a "universal" code of ethics covering the computer field, and to move toward a shared certification scheme through careful analysis of job descriptions and requirements for different positions. On the conclusion of the event, AFIPS issued a press release which was reported in Business Automation and other trade publications. It praised the event in rather general terms – claiming that it was a, "major step in an ongoing study by AFIPS of the overall needs for professionalism in the computer field."[923]

In his private report to Elliot, Young denounced the event. "It is fairly obvious that this is an early attempt on the part of AFIPS to gain identity, the role of 'industry spokesman,' and a status as an association on its own.... I don't believe its member groups are aware of this intention.... DPMA is the obvious target of the certification situation." "If," he continued, "this program is short-circuited, delayed, diverted, or (as a last resort) discredited, AFIPS' ambitions will be seriously impaired."[924]

The same terror of "competitors" that drove Elliot to undermine all collaboration with other societies motivated him toward consideration of another problem: the possibility that CDP holders might themselves decide that the DPMA did not represent their interests and decide to form an association. As we saw earlier, this fear was one reason behind his reluctance to issue a roster of existing certificate holders. The issue surfaced again in 1968, when the Long Range

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[923] The text of the press release is attached to Don Young, Memorandum: AFIPS Roundtable on Professionalism, to R. C. Elliot, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis. It was reported in Anonymous, "Certify Professionals: Who and How?".

[924] Young, Memorandum: AFIPS Roundtable on Professionalism, to R. C. Elliot. The DPMA's public objections, however, concerned the issuing of a press release – which given the publicity-hungry set of participants seems a bizarre objection. Young wrote to Gilchrist to explain that the news release was "quite a surprise" and that "although... carefully worded, it still gives enough detail to create some erroneous impressions." Given his stated desire to short-circuit, delay, divert or discredit the program, his warning that, "this premature exploitation--against stated attentions--might seriously impair future sessions of this sort" might be seen as disingenuous. Don Young, Letter to Bruce Gilchrist, February 2nd, 1970, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

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Advisory Council argued that the DPMA "must do something for the CDP holder to keep his interest up, other than just giving him a CDP and letting him sit back." It suggested that the association encourage CDP holders to devise their own committees through which to coordinate voluntary projects to support the certificate program and boost the profession in general. Elliot, however, refused to sanction the idea of inviting CDP holders to attend the association's conference and set up their own committee. He feared a loss of control, warning that "the plan will be developed right there in Montreal in different rooms at night, and they will have the CDP organization so fast it will make your head swim.... Every year we have more CDP holders. We have to face the fact that once they are together, there are two or three sharp boys who can organize that group right away."[925]

The idea resurfaced at the next executive council meeting, by which time Herb Safford, the executive committee's liaison with the long range advisory committee, presented a list of possible projects for the CDP holders, each one of which would be organized by a project leader reporting to the vice-president responsible for education. One of them was the production of a technical guide to the principles of data processing. He seemed frustrated by their reaction, which was to seize on this single project and shrink it beyond visibility. Safford spoke up forcefully to remind their colleagues that the idea was precisely to "get the jump on someone else's forming a CDP holders group" by keeping CDP holders busy and involved. He feared that without such action, they might form a group completely outside the control of the DPMA within the next year. J. D. Parker, the committee member responsible for certification matters, seconded the point. "I am extremely concerned with the CDP holders, their activity or lack of activity so far. We have certified these people and have sort of left them out there." These arguments were of little avail. Concerned to maintain editorial control, the other committee members suggested that the CDP

[925] Herbert B. Stafford, "DPMA -- Long Range Advisory Committee -- Summary of Correspondence from Committee", April 17 1968.

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holders might prepare a single article as a test, and publish it in the association's existing journal. Elliot further suggested that the operation should be overseen by his own headquarters staff. But the idea then seemed to lose momentum, amid discussion of how busy they already were.[926]

Elliot's contribution to the 1969 discussion reveals both his increasingly embattled reaction to criticism of the headquarters. Prompted by consideration of a CDP group within the DPMA, another member suggested that the association follow the model of the engineering societies and allow the formation of subgroups of technical issues. At this, Elliot urged the committee to "take a good hard look" at other societies which had permitted the establishment of such "groups and projects." "ACM," he continued, "is having trouble today because they went this route." He blamed it on the academics. "They went this route, and a bunch of selfish academicians who don't want money, who don't need money, because they have all kinds of little tricks going for them, and all they want is their name in print -- that is what sold ACM down the river..."[927]

Elliot viewed the perceived anarchy of the ACM as a powerful argument for his own brand of patriarchal rule. "Yes," he said, "we seem to want to pack a lot of people in Headquarters, within reason, to perpetuate the continuity of the organization." While the executive committee "seem to flimflam back and forth," he and his headquarters of staff brought stability and purpose to the organization. "You can kick my ass out of this outfit," he announced, "and I really mean it; but goddam it, let's all get in and row the boat together, and quit farting around.... We are running around in circles."[928]

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[926] Data Processing Management Association, Executive Committee Minutes -- 27-29 March, 1969, contained in Data Processing Management Association Records, Minneapolis, 489-507.
[927] Ibid, 508-09.
[928] Ibid, 509.

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Elliot would not tolerate the existence of alternative centers of power within the DPMA. As part of a cost-reduction task force, he had already eliminated funding for an impending meeting of the Long Range Advisory Committee. Safford was furious, pointing out that the committee members were deeply involved in the activity. "The exuberance of and the enthusiasm in this committee is tremendous. They are friends of DPMA." He pointed out that the costs involved were small, and that its participants would feel slighted and so were unlikely to retain any enthusiasm for the project. Elliot apologized, but said that as the association's only external committee it was the obvious thing to cut.

By 1969, however, the association was beginning to make tentative plans to place the certification program in the hands of a joint venture. In 1969 the board of directors approved the concept of an "Education Foundation." This was originally conceived "to more or less administer the CDP," but as discussion progressed more tasks for it were considered. While the DPMA had originally planned to retain majority control over it, input from the Long Range Advisory Committee had convinced it that it would be necessary to give up control to have it accepted. As J. D. Parker reported to the Executive Committee, "if we are going to make this thing go, we are going to make it be a total data processing industry foundation." He planned to set the foundation up under DPMA control and then draw in other associations later.[929] Despite winning rapid approval, the foundation idea appeared to stall for five years. The reason for this is not clear, though it appears that that the existing Certification Council soon decided that it would be better not to give up its control of the CDP.[930] While discussion of an education foundation continued, it

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[929] Data Processing Management Association, Executive Board of Directors Minutes -- 5th December, 1969, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 169-71.

[930] Data Processing Management Association, Exec Comm, 3-6 Dec, 1969, 271.

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was no longer expected to take control of certification activity.[931] When divestiture of the CDP program did occur, it was by a different route.

## The 1970s: A Partial Rapprochement

During the early and mid-1970s, pan-computer professionalism enjoyed something of a vogue. From Paul Armer in 1958 onward, its supporters had been trying and failing to win election as ACM President. In 1964, Frank Wagner was the losing candidate. This itself reflected a certain measure of success – nominations for the job were made by a small committee of ACM worthies, charged with putting two names forward to the membership. But in 1970, Walter B. Carlson became the first man with a data processing orientation to lead the association. He was at this time working as an advisor to IBM, and his career in computing stretched back to the formation of Du Pont's first computer group in 1954. It had been Carlson who presented the case for special interest groups to the ACM council a decade earlier, on behalf of Postley and his colleagues in the Los Angeles chapter.

Carlson's statements were bold. In 1970 he became the first senior ACM figure to publicly present the case for merger with the DPMA when he announced that the, "odds on the Data Processing Management Assn. merging with the Assn. for Computing Machinery are zero for the next five years and 100 percent within the next ten." He claimed that the ACM was under new management, and from now on would reach strongly toward business in search of new

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[931] Indeed, when the DPMA Education Foundation was eventually established in 1975, its remit was to improve professional education in data processing, develop model syllabi and courses, push for standards and solicit grants. Its Board of Regents was drawn from the association itself, from data processing managers and from teachers of data processing in business schools. In practice it never had much to do with other associations, though George Glaser did serve as a founding member of its board. Anonymous, "Education Foundation Committee Holds First Meeting", Data Management 13, no. 1 (January 1975):38. On the history of the Education Foundation, which appears to have been set up in part to provide a legally eligible recipient of AFIPS dividends see Anderson, "The Data Processing Management Association", 74-115. Its major accomplishment was the promotion of a model curriculum for data processing in the 1980s, to provide a business-oriented complement to the ACM's more academic model curriculum for computer science.

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members: "what we're saying to business data processing people is, 'we're going to work with you and your technology.' There have been a lot of people responsible (for) ACM activity that decry business. Business is where I happen to come from.... People who sang those songs are no longer... in charge."[932]

Carlson moved to strengthen the ACM, and develop into a true reflection of his vision of a united computer profession. He served from 1968 to 1970 as its Vice President, during which time he developed an ambitious program for its expansion. Prior to his election, he wrote to the ACM members under the title "There is a Tide in the Affairs of Men..." (thus, perhaps inadvertently, casting himself in the role of Brutus). He wrote that its number one goal must be "a broad base of membership built upon all who are professionally involved in computing technologies and computer-related activities." His specific goal was 100,000 members by 1975 – roughly quadruple its 1969 level. While an annual growth rate of one third might seem hard to maintain, nothing less could make sense given the assumptions of pan-computer professionalism. Carlson approached the matter by starting with the size of the potential membership pool. He estimated that about 200,000 people were currently involved in the "profession" – in which he included designers, training experts, systems men, application programmers, and even operators, as well as the academically inclined software and computation specialists on whom the ACM's leaders had previously devoted the lion's share of their attention. Observing that established technical societies attracted at least half those working professionally in their field, he claimed that 100,000 members would represent a relatively modest 40 percent of the likely size of the profession in 1975.[933]

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[932] Iris Poliski, "ACM Wedding Date Set", Business Automation 17, no. 13 (November 15th 1970):6, 27.

[933] Walter M. Carlson, "Letter from the ACM Vice-President: 'There is a Tide in the Affairs of Men...'", Communications of the ACM 12, no. 10 (October 1969):537.

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Carlson usually justified these plans by citing the need for a single group to create a framework for the profession to establish broad agreement on its positions, and represent it to government and to top corporate managers. He called for the expansion and strengthening of its existing special interest groups and committees, to "create a body of fundamental knowledge which reflects agreements reached amongst both theoreticians and practitioners." Carlson had little doubt that this would require the ACM to build strong groups in many areas it had so far ignored. He demanded no less than "a profession-wide effort that pulls together, evaluates, and reports on the techniques used in teaching about computers and systems, in designing and building them, in programming operating systems and applications for them, in operating them, in evaluating the benefits from their use, and in managing the people who perform these technical tasks." To achieve this, be recommended collaboration with other as many other societies "as we possible can."[934]

As part of his plan to greatly expand the association and broaden its appeal, Carlson demanded a fundamental upheaval in its local chapters, intended presumably to replicate the vitality and innovation of the Los Angeles chapter that had played such an important role in the early careers of many of the pan-computer professionalists. The ACM's chapters had always been of secondary importance within the association and, for the most part, had been shrinking since the mid-1960s. He blamed this on the dominance of small cliques, and suggested that chapters try to undertake useful projects and, "attract the younger computer crowd." He went as far as to suggest prizes for chapter chairmen able to deliver substantial membership growth. Among his other ideas was collaboration with local chapters of the DPMA for the purpose of "creating a local computer ombudsman to help people who are frustrated by what they perceive to be computer-caused problems." (These included computer privacy, a key issue for many pan-

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[934] Walter M. Carlson, "ACM President's Letter: Finding the Real Expert", Communications of the ACM 13, no. 9 (September 1970):525.

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computer professionalists during the 1970s). His primary criticism, however, was aimed at "ACM Council and ACM Headquarters" for failing to support chapters properly and foster programs of interest to a diverse and youthful membership. "Over the years," he wrote, the council had, "adopted policies that simply do not make sense in the light of today's needs of the chapters."[935]

Given the directness of this challenge to the established order, it is not surprising that Carlson's efforts foundered, like so many before and since, on the rocky shoals of the ACM Council. His plans for the reform of the ACM were channeled into the establishment of three panels, each charged with the exploration of a different challenge. From these three panels (one of past presidents, one of their losing opponents, and one of non-office holding members), and an informal ballot of council members, he established a set of formal goals for the organization. This was, in essence, the ACM's first exercise in strategic planning. In strikingly managerial language, Carlson promised systems to, "define where we are going, to measure how well we are doing, and to decide how much to spend in getting there."[936] The resulting statement of "first rank" goals endorsed the establishment of, "ACM as the leading technical society serving the business data processing community," and committed it to "create member services on a sufficiently broad and flexible basis to attract and hold as an ACM member any qualified person considered professionally engaged in computer-related activities," and to, "establish and maintain one unified structure for the technical societies composed of individual members who are engaged in computing and information processing."[937]

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[935] Walter M. Carlson, "A Letter from the ACM President: Wither our Chapters", Communications of the ACM 14, no. 4 (April 1971):219-20. The suggestions of prizes was made in Walter M. Carlson, "ACM President's Letter: The Answer Is... Competence, Integrity, and Productivity... What is the Question?" Communications of the ACM 15, no. 2 (February 1972):69.

[936] Walter M. Carlson, "President's Letter: On ACM Goals", Communications of the ACM 14, no. 11 (November 1971):693.

[937] Walter M. Carlson, "ACM President's Letter: Unfinished Business: I", Communications of the ACM 15, no. 3 (March 1972):131-32.

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Unfortunately for Carlson and his allies, the ACM did not respond well to this exercise in corporate-style good management. In one of his parting letters to the members, Carlson noted that, "Council members have the flavor of a faculty senate rather than that of a board of directors" – something that more academically inclined members might not have considered quite so damning. For Carlson, however, the problem was, "a basic attitude that anyone elected to Council should have the right to nitpick on any agenda topic—whether he has experience in that particular subject matter or not, and whether his facts are correct or not."[938]

In March 1972, toward the end of his term, he was forced to tell the association's members that as a result of "a fundamental split" within the executive committee and the refusal of the council to place his strategic goals on its agenda for discussion, no action could be taken. Carlson was not happy: "It is simply beyond my comprehension that an organization of ACM's size and age should try to muddle along with no formal statement of its goals. The consequences are all too obvious. The day-to-day priorities become merely a reflection of the personalities and interests of the officers and of the headquarters staff. The budget becomes merely a scorecard of an ad hoc political contest conducted within the ACM Council each May." "[A]n ACM member," he concluded, "deserves more for his dues than a than a random walk through an un-programmed forest of programs, projects, and activities."[939]

Carlson also complained that the headquarters staff were poorly managed, that the three-person executive committee charged with day-to-day oversight was too small, and that its accounting and computer systems were a mess. Some gradual institutional reform of the ACM did take place. Changes to the council had begun under Carlson's predecessor, Bernie Galler, and despite several thwarted efforts, further adjustments took place under his successors. But financial

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[938] Walter M. Carlson, "ACM President's Letter: Unfinished Business: II", Communications of the ACM 15, no. 4 (April 1972):209-10.

[939] Carlson, "ACM President's Letter: Unfinished Business: I".

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problems and the hard-to-manage ACM Council continued to limit the effectiveness of any attempts to expand the ACM into data processing.[940]

George Glaser, another exponent of pan-computer professionalism, played an equally important role in brining the ACM and the DPMA closer together. Glaser's background was as an electrical engineer, but he spent the 1960s working for consulting firm McKinsey & Company – providing him with extensive experience in the problems of corporate administrative computing. He then went into business for himself as an independent consultant. Glaser was one of the most important figures pushing the ACM toward greater involvement with data processing.

From 1967 to 1969 he served as chairman SIGBDP -- the ACM's SIG (Special Interest Group) on Business Data Processing. As he admitted at the 1968 RAND Symposium, his constituency within the ACM did not differ greatly from that of the SPA, or of the forthcoming SMIS. The place of data processing within the ACM remained marginal. "Within ACM, there have been efforts to revitalize the business data processing group without too much success, because it isn't at all clear what we want to (or should) do.... I have been deeply involved with a great deal of help from a few people and little or no help from most."[941] Despite this gloomy prognosis, SIGBDP thrived under his leadership. It expanded rapidly beyond its heartland in southern California, began to play a more important role in the association's conferences, and initiated publication of <u>Data Base</u>, an important venue for discussion of corporate data processing during the 1970s.

At the same time, he had called upon allies within the DPMA to address themselves more to the computing community, and to recognize the existence of kindred spirits within the ACM. "For historical reasons," he said, "they look on people in ACM as a bunch of guys with their

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[940] Galler's own issues with the ACM council can be inferred from several of his presidential letters, including Bernard Galler, "President's Letter to the ACM Membership: The ACM Council", <u>Communications of the ACM</u> 11, no. 11 (November 1968):729.

[941] Stafford, "DPMA -- Minutes of Long Range Advisory Committee Meeting", 6.

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heads in the clouds worrying about Tchebyscheff polynomials and things like that. I think the influence of DPMA and SPA is important, and is not being felt."[942] Glaser himself served as national treasurer of ACM from 1968 to 1972, and as treasurer of AFIPS from 1971 to 1973. In 1973 he switched his primary focus to AFIPS, where he served as its chairman until 1975. Here he worked persistently, and ultimately successfully, to welcome the DPMA into AFIPS.[943]

## The Fall of Elliot

It will not surprise the reader to learn that with Elliot still ensconced in its headquarters, the DPMA made very slow progress during the early-1970s toward membership of AFIPS, or toward beginning serious discussion with the ACM toward the kind of intimate collaboration and eventual merger favored by Carlson. Yet despite Elliot's hovering presence, a new generation of DPMA leaders, among them its 1971-72 President Edward O Lineback, began to establish ties with Carlson and his allies in the ACM and AFIPS. During 1970 and 1971 Elliot grew, if anything, more strident than ever in his reactions to criticism and more resentful of constraints on his power. He had for some years been serving personally as editor of its Journal of Data Management, and in 1971 he "elected to devote an editorial to the criticism of Criticism," in which he laid down standards under which criticism would be accepted. The not-so implied message was that his critics should stop griping and shut up.[944]

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[942] Gruenberger, RAND Symposium 1968, 126.

[943] Glaser was elected president in June 1973 as a last-minute replacement for Bernie Galler. According to Glaser, Galler fell victim to the murky world of AFIPS politics, when representatives of the minor societies decided to oppose his candidacy. Various, "Perspectives on a Quarter Century: AFIPS Presidents", page 292.

[944] Data Processing Management Association, Executive Committee Minutes -- 15-18 Jan, 1969, contained in Data Processing Management Association Records, Minneapolis, 1110-129.

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At the June 1971 meeting of the Executive Board of Directors, the representative of the Chicago region (the DPMA's heartland) delivered a strongly worded and obviously rehearsed denunciation of the association's management.

> We are a professional society, and that status we must maintain. We are concerned with the poor publicity we have received not only for our Association but also for our CDP. As loyal, dedicated and deeply concerned members of DPMA we of Division 5 are compelled to question the leadership and direction of our Association in recent years.... We have grown in staff but not in productive and effective output.... We share with the majority of our fellow chapters a concern as to the competence of our Headquarters staff. We can attest as to the breakdown in communications and service. We also question with them the obvious lack of professional ability in many areas of Headquarters' activity.... DMPA has failed in great measure to effect its true purpose for being.... we have failed to gain the respect of our industry, our management and our members in a truly professional society and it is because of these failures, even while our membership grows numerically, that we may be well on an irreversible way to becoming a second-rate society.[945]

Word of the DPMA's troubles spread throughout the data processing field. Indeed, after delivering a damning summary of the ACM's own unwieldy and ineffectual structure, ACM President Carlson was able to find exactly one good thing to say about the managerial arrangements of his own society: "About the only advantage that ACM can claim for this situation is that the Executive Director has not become (as in most technical societies) the real

[945] Data Processing Management Association, Executive Board of Directors Minutes -- 20 June, 1971, contained in Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis, 127. His contribution took place during discussion of a motion demanding that the team set up to study and reorganize headquarters operations be made up largely of divisional representatives, rather than insiders and national leaders. James D. Parker, who as national president was chairing the meeting, ruled this motion out of order. He had earlier done likewise with a motion calling for the release of the individual salaries of all headquarters staff. However, a reworded and constitutionally valid version of the motion passed – hardly a good sign for the Elliot's job security. While the margin of its passage was not recorded, the divisional representatives made up only nine of the fourteen places on the new committee, the rest being filled by the association's most senior elected officers. Almost all of the divisional representatives must therefore have backed it, lending credence to a report in Business Automation that unhappiness among local chapters had reached such levels as to provoke plots for Elliot's ouster. Anonymous, "DPMA: Trouble in the Territories", Business Automation 18, no. 8 (June 1 1971):15.

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decision-maker, who tolerantly suffers each new group of officers and council members." It does not seem unreasonable to suppose that he had the DPMA and Elliot in mind.[946]

For Elliot, the end came suddenly. His July 1972 Data Management editorial was his last, and in it he announced "the close of my career as Executive Director of the Data Processing Management Association." To judge from his statement that, "I take this step with deep regret and a great sense of personal loss," his departure was neither voluntary nor planned. He took the opportunity to lambaste the board meetings one last time and to defend the "fine, well-trained, professional staff at Headquarters" against accusations of incompetence.[947]

The new team at headquarters did not share Elliot's high opinion of the existing state of affairs. Helen Milecki, the new editor of Data Management, for example, felt obliged to write in an early editorial that the journal would continue to exist. "Is this the appearance of a dying magazine? Past issues of the magazine might have been, but this issue does not! The new magazine design reflects Data Management's re-established goals for DPMA -- strength through unity."[948] The new executive director, Donn W. Sanford, was a young man with a business degree, but no background in data processing. He joined the DPMA following staff jobs with the American Chiropractic Association, Association Equipment Distributors and as executive director of the Independent Garage Owners of America.[949]

Elliot's fall had more to do the internal politics of the DPMA than with any burning desire on the part of the rank and file members to ally more closely with AFIPS. But a change in the association's relations with the outside world took place almost immediately. In 1975, toward the end of his relatively brief tenure, Sanford reflected on the changes made to the DPMA in the

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[946] Carlson, "ACM President's Letter: Unfinished Business: II".

[947] R Calvin Elliot, "Editorial", Data Management 10, no. 7 (July 1972):6.

[948] Helen M Milecki, "The Future for Data Management", Data Management 10, no. 11 (November 1972):5.

[949] Anonymous, "DPMA Names Donn Sanford Executive Director", Data Management 10, no. 11 (November 1972):6-7.

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three years following Elliot's removal. Having, "embarked two years ago on a vast rebuilding program," he claimed to have, "successfully put the DPMA on the map, on a National scale" by addressing "areas, frankly, which should have been addressed many years ago." These areas included AFIPS membership, new seminars, a better journal and programs to attract more desirable members. For Sanford, however, it all came down to professionalism – which he called "a way of life, a life-time of study, a state of mind, relentless striving for excellence."[950]

His agenda accorded, in large part, with that of Carlson and other exponents of pan-computer professionalism. He shared their concern for relations with government, and for the need to reach out to the public and take positions on social issues concerning computing. Sanford claimed that the

> DPMA... will help you gain greater recognition and respect as a true professional by making the public aware of the skills and intelligence required in Data Processing by publicizing the positive aspects of the equipment we control; by constantly striving to increase the professional stature of data processing developing certification and testing procedures to recognize competence; setting standards of conduct which when followed increase the public's trust in our profession; developing an image of the DPMA member as a leader in the business community; increasing the public's awareness of the social impact of automation and computers; and increasing our own awareness of the same impact and our responsibility in regard to it.[951]

## The DPMA in AFIPS and the ICCP

With Elliot no longer around, the DPMA moved quickly, and with comparative ease, on two long delayed topics. The first of these was the transfer of its certification program to a joint venture with other associations. The second was membership of AFIPS.

Progress toward collaboration on certification had finally begun to gather pace a year before Elliot's fall. Under Carlson's leadership, pan-computer professionalism gained a more prominent place within the ACM, and its relations with the DPMA began to thaw. In October

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[950] Donn W Sanford, "DPMA Tomorrow", Data Management 13, no. 3 (March 1975):32-34.
[951] Ibid.

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1971 an initial meeting of DPMA and ACM representatives took place, rapidly followed by a successful meeting between Lineback and Carlson.[952] The next year, the DPMA moved to establish a more formal Certificate and Testing Advisory Committee to ponder the future of the certificate. (This temporary body was not to be confused with its existing Certification Council or its predecessor, the Certificate Advisory Council). The new committee was composed of prominent data processing figures, among them representatives of the ACM and Association for Systems Management. It included renowned programming expert Grace Hopper, a pioneer of compiler techniques who maintained a high profile as a public speaker. It also included long-time CDP proponent John Swearingen, James D. Parker (recent DPMA President and one of its senior figures in both education and certification) and, as the ACM representative, Fred. H. Harris (the director of the computation center at the University of Chicago).[953]

This group endorsed the idea of an industry-wide body responsible for certification, and proposed the establishment of a Computer Foundation to take responsibility for existing programs and produce new ones. The idea was endorsed by a joint meeting with DPMA leaders and Anthony Ralston, Carlson's successor as ACM President.[954] The governing bodies of both associations endorsed it at their next meetings. In January 1973, Swearingen and Harris issued a proposal for the shape of the new foundation and then convened a meeting to gather support from other associations. The foundation was formally established in August of that year, as the Institute for Certification of Computer Professionals (ICCP). Swearingen was elected as its first President, and Harris as its vice president.[955]

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[952] Anderson, "The Data Processing Management Association", 135.

[953] Anonymous, "Certification and Testing Advisory Committee Formed for EDP Industry", Data Management 10, no. 6 (June 1972):47.

[954] Anonymous, "ACM and DPMA Approve Computer Foundation Concept for Certification Program", Data Management 10, no. 11 (November 1972):10-11.

[955] Anonymous, "Computer Foundation Information Meeting Draws Ten EDP Groups", Data Management 11, no. 3 (March 1973):34-35. These specialist groups included two small associations for teachers of data processing (the Association for Educational Data Systems, and the Society of Data

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In 1974, the DPMA officially transferred control of both the CDP and the troubled RBP to the new association. This must be counted as a major accomplishment for the pan-computer professionalists – getting the DPMA and the ACM to collaborate on anything was a triumph of diplomacy. In practice, however, the ICCP proved little more effective than the provisional governments set up through diplomatic initiatives in places like Bosnia. One problem was the rather half-hearted support that the institute received from its member societies over the next few years. It was never endowed, or capitalized enough to do very much. Although Herb Grosch and Dan McCraken backed the institute strongly during their terms in the ACM presidency during the late 1970s, neither was able to persuade the ACM Council to authorize additional support. In addition, the mandate of the institute appeared to overlap with that of the better funded AFIPS – a result of it having been established before the DPMA was admitted to AFIPS.[956]

The question of professionalization remained controversial. Arnold E. Keller, veteran editor of Infosystems, dismissed the CDP as "an inside joke" but saved his real fury for the idea

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Educators), a scientific society (the Association for Computational Linguistics), and two marginal and newly established groups for data processing workers (the Association of CDP Holders and the Association of Computer Programmers and Systems Analysts). Representatives of ten associations, including the ASM and a variety of smaller groups attended.

[956] Grosch discussed the controversy surrounding ACM's involvement with ICCP in his acrimonious "fireside chat" President's message. When Harris asked the ACM to forgive the seed-money it had supplied, Grosch recalled that, "Council was a shambles. New members thought there was some kind of covert rip-off going on. Old enemies of certification, having lost the battle to keep ACM off the ICCP rolls in the past, saw an opportunity to slow Institute momentum." Following the defeat of the motion, Grosch took his appeal to the association's members. "ACM made a move toward the Real World when it first supported ICCP; ACM members are helping to improve the quality of the work, and planning for extensions; the threat of indiscriminate licensing and unprofessional certifications still hangs over practitioners." Herb Grosch, "Fireside Chat", Communications of the ACM 20, no. 3 (March 1977):125-26. Grosch tended to use the regular "From the President" column to mock his enemies within the ACM leadership, making the late-1970s an unusually dramatic period in ACM politics. Matters degenerated to the point where, as an ACM Council member in 1980, he publicly threatened to sue the association to protest its editing of his election statement. The prompted the usually mild-mannered Daniel D. McCracken to write to Grosch, suggesting that his motives "appear variously irrational, self-destructive, and stochastic" and his actions "deplorable." "Numerous insulting and condescending remarks that you have made about me over the years," wrote McCracken, "might give a psycho-historian clues..." Daniel D McCracken, Letter to Herb Grosch, April 13, 1980, contained in Daniel D. McCracken Papers (CBI 43), Charles Babbage Institute, University of Minnesota, Minneapolis.

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of licensing data processing personnel. Licensing was promoted by Kenniston W. Lord, of the ineffectual Society of Certified Data Processors (an independent association of CDP holders of exactly the kind the DPMA leaders had feared might be set up if they did not do more on behalf of this community). Controversy engendered by Lord's push for licensing may have hurt the more careful efforts of Harris and Swearingen to win support for the ICCP. In addition, the reality of the CDP put off even some of those who generally supported pan-computer professionalism. Paul Armer himself reported that while he had great support for the goals of what became the ICCP, he was alarmed by "their implied assertion that the existing test leading to the Certificate in Data Processing is a meaningful one."[957]

One CDP holder replied to criticism of this kind with the claim that, "a CDP must demonstrate knowledge, hopefully gained though competent experience and education, in the full spectrum analysis, mathematics, accounting, systems analysis, programming and general business and EDP management." In as much as it was true, this made the CDP a useful qualification for data processing management. Yet the CDP, and the RBP (the other test transferred to the ICCP) were by design entirely specific to data processing. Creating new tests to span the range of work undertaken by all the occupations and fields spanned by the ICCP's sponsors would prove an enormous challenge. Two experts familiar with the attempts of AFIPS to produce generic job analysis "statements" for programmers and analysts warned of the work involved in such an undertaking, and cautioned that, "[i]n the AFIPS job analysis project, it became painfully evident that an example of an activity drawn from scientific programming did not clarify the general

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[957] Arnold E. Keller, "Wrong Way to Professionalism", Infosystems 22, no. 2 (February 1975):31. Keller was, however, prepared to give cautious backing to the possible future certification efforts of the ICCP. On the SCDP and licensing, see Anonymous, "Licensing/Certification", Infosystems 21, no. 4 (April 1974), Jens P Christensen, "In Protest", Infosystems 22, no. 5 (May 1975):6, 75 and Jack B Cover, "Licensing--the issues", Infosystems 22, no. 8 (September 1975):4. The topic has been explored in Ensmenger, "From Black Art to Industrial Discipline", 204-09 and in Shapiro, "Computer Software as Technology: an Examination of Technological Development", ch. 5.

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sense of the statement for a business programmer." As a result, the analysis project had been forced to draw up separate job descriptions for "the several programming focuses: (e.g., business, scientific, engineering, systems)."[958]

The ICCP's attempt to certify programmers, the 1977 Certificate in Computer Programming, met with even less success than the disastrous RBP. It included different modules for scientific, business and systems programmers – finally delivering some of the specialized tests planned by the DPMA a decade earlier. It was thus the first attempt to provide a certification for programming as a whole. The new qualification was strongly supported by then-ACM President and best-selling programming textbook author Dan McCracken, who considered it highly appropriate as a certificate for senior programmers.[959] As of 1986, however, just 2,750 people had attained it – one of whom was McCracken himself.[960]

The DPMA's entry into AFIPS met with surprisingly little objection from its members or leaders, and proceeded far more rapidly than the many earlier failures might have suggested. This time the push for AFIPS came from the top of the DPMA, and was backed by the association's headquarters staff. In mid-1973 a high-level DPMA committee was officially established to

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[958] Dan Remy, "Reader Feedback: CDP Opinions Based on Erroneous Premise", Infosystems 22, no. 11 (December 1975):7-8. Robert N Reinstedt and Raymond M Berger, "Certification: A Suggested Approach to Acceptance", Datamation 19, no. 11 (November 1973):97-100. Another defense of the CDP was made in Sam Patterson, "...Or Is That the Question?" Infosystems 22, no. 4 (April 1975):6.

[959] Daniel D. McCracken, "The Institute for Certification of Computer Professionals: A Call for ACM Action", Communications of the ACM 22, no. 3 (March 1979):145-46.

[960] Anderson, "The Data Processing Management Association", 139. The institute continued to work on new programs, including transfer of the Certified System Professional from the ASM, and the development of the lower-level Associate Computer Professional qualification in 1986, but these too met with limited success. It continued to update its qualifications – in 1986 it made periodic re-certification mandatory for those receiving new certificates, it added component examinations on new languages and technical topics, and in 1994 it finally replaced the CDP with a new Certified Computer Professional qualification. While it still exists, it appears to be fighting a losing battle with a constantly changing and fragmenting labor market for computer specialists. As of 2001, examinations on Java, the Internet and Object Oriented Analysis – the most important new development of the second half of the 1990s – remain at the planning stages.

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consider AFIPS membership.[961] While the only recommendation it could produce in time for the September executive meeting was one of "more study," harking back to the endless requests for more information produced under Elliot's influence, this time a positive recommendation was eventually forthcoming.[962] Editorials favorable to the plan were published, and the Executive Committee stood firmly behind it. Glaser, by then chair of AFIPS, was given space in the Journal of Data Management to put forward the history and goals of AFIPS, disarming suspicions among the DPMA membership. When the membership proposal finally went before the famously chaotic DPMA Board of Directors, it was approved unanimously. After the vote, Sanford contributed to the journal an article with the reassuring title of "But the 'A' Means American." In it he praised the board's decision, saying ""may well be the most far reaching action that the Board ever took. The action goes far beyond merely joining AFIPS. It shatters DPMA's crusty old inbred provincial shell and admits the light of recognition that the information processing profession and coordination of its diverse elements is, as they say, 'bigger than all of us'."[963]

Sanford was not alone in his opinion. The final entry of the DPMA into AFIPS, almost a decade after Gilchrist began his courting of the association, was a landmark achievement of pan-computer professionalism. The main data processing association was finally a part of the organization intended to represent and unite all the computing professions. In 1972, Carlson had used his presidential column in Communications of the ACM to make the willingness of AFIPS to admit new members into a crucial test of its legitimacy as "fully representative of the computer field." He blamed its continuing reluctance to admit new member societies on "a desire of the

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[961] Anonymous, "DPMA Committee Formed to Study Possible Membership in AFIPS", Data Management 11, no. 10 (October 1973):41.

[962] Anonymous, "DPMA Study Committee Recommends Further Exploration of AFIPS Membership Proposal", Data Management 11, no. 11 (November 1973):38-39.

[963] Donn W Sanford, "But the 'A' Means 'American'", Data Management 12, no. 8 (August 1974):4.

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three founder societies (including ACM) to control the proceeds of the Joint Computer Conferences."[964]

Aside from its statutory role within IFIP, by the early 1970s AFIPS served primarily as what the pan-computer reformers called "a money tree" – a conduit through which money flowed to its constituent societies. From 1970 onward, the AFIPS conferences began to provide large surpluses, which were seized upon by its major member societies to plug holes in their own budgets. They had little collective inclination to spoil this by allowing AFIPS to spend more on its own initiatives or by encouraging it to develop as a center of power in its own right. This bounty also made the entry of large associations, such as the DPMA, very hard to accomplish since this required existing beneficiaries to accept a small cut. The entry of the DPMA required lengthy and painful renegotiation of the conference charter.[965]

Friction between the founding societies and the smaller societies which joined later was another source of perpetual conflict. Different membership ranks were defined, the result of which was to give these societies less say in the direction of AFIPS, and usually no share in the proceeds of the JCC. As early as 1965, the Simulation Councils, Inc. (SCI) was pushing for a more formal set of criteria for the apportionment of power. SIAM, the Society for Industrial and Applied Mathematics, had a particularly rocky relationship with AFIPS. Turned down for full membership in 1970, ostensibly because its primary focus was not on computing, the rebuffs

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[964] Walter M Carlson, "Unfinished Business: III", Communications of the ACM 15, no. 4 (May 1972):299-300. Others AFIPS leaders remember Carlson as a key figure behind the entry of the DPMA into the federation. Ware, "AFIPS in Retrospect", page 293.

[965] On the mechanics of the DPMA entry, see Various, "Perspectives on a Quarter Century: AFIPS Presidents", page 292.The term "money-tree" was used, as a characterization of the reality of AFIPS, in Carlson, "A Letter from ACM's Past President: The Wonderful World of AFIPS". At this point, the best Carlson, one of its founders, could say for AFIPS was that, "In a nutshell, AFIPS has failed to reach many of the goals for which it was created. To do away with AFIPS, however, would create problems that only another AFIPS-like body could handle. Someone would have to invent another AFIPS." Willis Ware, the first AFIPS chair, viewed the money tree problem as the root of the failure of AFIPS to live up to its original agenda. Ware, "AFIPS in Retrospect".

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continued until it was rejected again in 1973 by what amounted to a veto imposed by the ACM Council over the top of Carlson's pleas. (The AFIPS admissions system was designed to make full membership hard to achieve. On this occasion, SIAM was rejected with 10 votes in favor and only 5 against). Following this latest "politically motivated" insult, representatives of SIAM and two other small societies announced their intention to "withdraw from AFIPS until order is restored." The tactic seemed to work –by the end of that year the ACM had withdrawn its veto and AFIPS was reconstituted to remove the distinction between full and associate membership.[966]

It was under this new wind that the DPMA finally breezed into AFIPS – its own application for membership was approved unanimously at the 11th May 1974 meeting of the AFIPS board. Glaser was "very pleased" at the outcome. But Bruce Gilchrist was no longer there to enjoy the long-delayed expansion he had worked so hard to accomplish. The June 1973 meeting of the AFIPS Board was his last. His term had marked considerable growth for AFIPS headquarters and its activities. By his departure its headquarters staff had grown to number sixteen, and it had launched a number of projects related to professional issues, including an exploration of certification and one of the first projects to explore the history of computing. Gilchrist's farewell address to the board gave little doubt that he believed the parochialism of the directors had robbed AFIPS of a chance to truly represent the collective interests of the individual members of their associations. It never effectively advanced the pan-computer professionalism issues so dear to the heart of its founders. According to the minutes of this meeting, he felt that, "biggest unresolved problem still facing AFIPS and its board was that it had never achieved what he felt was proper balance among (1) JCC matters, (2) procedural matters and (3) AFIPS

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[966] AFIPS, Minutes, Board of Directors Meeting, February 14, 1973, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis, 15. On the actions of the ACM council, see Carlson, "A Letter from ACM's Past President: The Wonderful World of AFIPS".

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activities. He stated that in his opinion the memberships of the societies would be far more interested in number (3) rather than efforts expanded toward (1) and (2)."[967]

Following its high-profile 1970 meeting on professionalism, AFIPS had made some moves to invest some of its new-found conference wealth in a certification program of its own. These did not get very far. Realizing that nobody really knew what skills or knowledge were required by programmers, analysts, and other computer-related occupations, AFIPS planned to begin by performing a series of job analysis studies. In 1973, the AFIPS board added the advancement of "professionalism" as a constitutional objective. In November 1974 the pilot analysis, a "Programmer's Job Description" was finally presented to the board. Although "a number of people questioned how useful [this] was," enough funding was released to continue work on an analyst job description. The slow progress of this effort reflected the limitations of AFIPS as a platform on which to erect a professional identity.[968]

The DPMA's admission to AFIPS does not appear to have changed this very much. Attention by AFIPS to topics such as professional standards and certification, the social impact of computers, publication of its own journals, and representation of the computer profession in Washington remained fitful. Projects were begun and abandoned according to the whims of an ever-changing board made up of society representatives, many of whom remained unconvinced that AFIPS should be conducting any activities other than the lucrative JCC. While member societies were sometimes willing to allow AFIPS to keep some of the conference money it generated to fund its own projects, they were ultimately unwilling to support pan-computer

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[967] AFIPS, Minutes, Board of Directors Meeting, June 9, 1973, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis, 6.

[968] AFIPS, Minutes, Board of Directors Meeting, November 29, 1973, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis, AFIPS, Minutes, Board of Directors Meeting, November 8, 1973, contained in American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

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activities from their own coffers. Its fortune waxed and waned with the JCC itself – weathering one crisis amid economic downturn of the early 1970s by consolidating two annual conferences into one[969], before succumbing to another in the late 1980s and expiring at the end of 1990.[970]

## Pan-computer Professionalism In Retrospect

In 1975, the pan-computer diehards of the RAND Symposium reconvened for a session entitled "Problems of the AFIPS Societies Revisited." Gruenberger and his friends were convinced that their 1959 meeting had played a key part in the original creation of AFIPS, and had returned to the same topics at their 1968 meeting. Older now, and somewhat more cynical, they remained eager to discuss the continuing problems of its member societies and of the computing profession as a whole. Gruenberger and Armer had both left RAND some years earlier, so the group met now at the Anaheim Quality Inn rather than in the RAND conference rooms in which their first discussions had transpired. The other guests included Glaser, Canning, Swearingen, Grosch, Carl Hammer and the current leaders of the DPMA, ACM, IEEE Computer Society, and AFIPS.

Surveying what had become of their dreams, many of them were willing to abandon the efforts toward federation that had spawned AFIPS. Instead, they supported the idea of a new pan-computer association by merging the membership of the existing associations (something only Grosch had firmly backed in 1959). This did not necessarily seem to them any easier, or more likely to happen, then it had sixteen years earlier. Rather, they were disappointed by the results of

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[969] Anonymous, "AFIPS Replaces SJCC, FJCC , With National Conference", Infosystems 19, no. 8 (August 1972):12.

[970] AFIPS received a rather tart "obituary" in Weiss, "Obituary: AFIPS". In memoriam, Weiss observed that "AFIPS's accomplishments were largely transitory… Its lasting monuments are few: the early conference proceedings, a few worthwhile volumes from AFIPS Press, and start-up support for the Charles Babbage Institute and the oral history project at the Smithsonian in the early 1970s."

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federalism and the unwillingness of the existing societies to act on social or professional issues. The need for a new society won endorsement from several there, including Jean Sammett (ACM president and programming language expert), who was rarely known to agree with Grosch on anything. The current societies, she suggested, would work like the ACM's own special interest groups as part of the larger whole. Glaser, however, suggested that such groups might eventually seek independence because they would come to resent the overhead expenses of the central association.[971] Grosch himself continued to promote this idea widely, using his keynote address to the DPMA conference that summer to call for a single society where "both the business people and the scientific people, both the technicians and the management types, manage to work together." Their skills, he felt, were complementary. "ACM has a large assortment of technical answers to questions that no one cares about. DPMA, on the other hand, has some very real and pressing problems -- problems that your employers are very anxious to have solved -- and to a considerable extent lacks the technical answers to them."[972]

While Glaser was not sure that a grand merger was workable, neither (despite his own work at AFIPS) was he filled with confidence in the future of AFIPS as the vehicle of pan-computer professionalism. He reported that its board, newly expanded to twenty-one members, was becoming unmanageable. Yet for it to become "truly representative of the industry" would demand the addition of more societies, resulting in a board of perhaps thirty-five directors, with a still wider range of interests. He also admitted that the current system led to considerable fragmentation and duplication at the local chapter level. "In the San Francisco Bay area," he said, "there are two ACM chapters, each with its SIGs, four DPMA chapters, an ASM chapter and an

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[971] Fred Gruenberger, Problems of the AFIPS Societies Revisited: 17th Annual One-Day Computing Symposium, 1975, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis, 1-4.

[972] Herbert R J Grosch, "A Time of Change", Data Management 13, no. 9 (September 1975):82-85.

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IEEE chapter. I recently got a letter for a man who had been chartered to start a local chapter of SMIS and wanted my help."[973]

For Grosch, the appeal of a unified society came (again by analogy to doctors and lawyers) from its ability to prevent non-members from practicing in the computer field. He called for strong national and state lobbying to assert control over professional legislation, and kill unwanted measures. Faced with this focus on politics and lobbying as the goals of a strong society, Richard White of Informatics was skeptical. "I dropped ACM when I felt that it wasn't doing anything for me. All I hear as an advantage for the proposed member society is more political clout; I hear nothing of what it might do for its members." Looking at recent issues of the Communications of the ACM, he suggested that there was "nothing at all that could be of use to a working computer person," though he did admit to finding chapter meetings useful on occasion. Tony Ralston, the ACM's immediate past president, admitted that it was "not offering tangible benefits" to many of the half-million or so people that Gruenberger believed to compose the computing field as a whole. Pithy as ever, Grosch observed that, "[e]verything in our industry is going up 15 percent a year except ACM membership."[974]

When Sammet defended her organization she did so in a rather abstract way, suggesting that, "if you consider yourself a professional, then at a minimum you should belong to a professional society." The argument seemed trapped in a kind of chicken-and-egg regress. Neither could they agree whether any computer related groups could yet claim professional status in the eyes of the public. When Grosch suggested that, "The public is coming to regard computer people also as a group that has the power of 'life and death'," Gruenberger countered, "Nonsense; they regard us at the same prestige level as bookkeepers." This illuminated not just the gulf

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[973] Gruenberger, RAND Symposium 1975, 7-12.
[974] Ibid, 10, 26, 30.

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between expectation and reality, but also the continuing failure of pan-computer concepts such as "computer people" to produce a coherent image even among those most committed to them.[975]

All present seemed to be puzzled by the relationship, or lack of it, between the certification and job analysis efforts sporadically conducted by AFIPS and those entrusted to the new ICCP. Swearingen, its head, admitted that the ICCP was chronically undercapitalized, under staffed and that its present situation as a "subset of 7 or 8 organizations" was "not too great." Swearingen felt that some kind of merger of the ICCP with AFIPS might help, a position supported by most of those present, but he had no idea how this could be accomplished. Glaser complained that, because of its divisions, the AFIPS board had never given it a clear mandate to address certification issues. He admitted that in the absence of any coherent charter from the AFIPS board, as AFIPS president he had never been able to sit down with Swearingen and really "talk seriously" about the options. John Harris, the other main ICCP founder, complained that, "AFIPS gives the appearance of not supporting ICCP by its inaction." Instead it had issued what Armer called "piddling amounts" of money for the job analysis project run by Donn Parker.[976]

AFIPS received what turned out to be a de facto postmortem a decade later in 1985, when most of the former AFIPS presidents (or chairmen as the first were known) came together to discuss the successes and failures of the organization. They were, as a whole, deeply disappointed. Unsurprisingly, those most strongly associated with the cause of pan-computer professionalism were the most critical. Other former current and former leaders, including all those from the 1980s, defended AFIPS as having done a good job with what they saw as its objectives. It had, after all, run its conferences effectively and represented the USA

[975] Ibid, 11,29.

[976] Ibid, 15-21. The participants continued to quibble about the differences between certification and licensing, and whether certification was valuable because it encouraged self-education or because it provided a means to enforce standards.

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internationally. A federation, they believed, could and should do nothing more. Yet those of its leaders who had assumed their posts with dreams of making real progress toward the establishment of a stronger professional identity for the computer field showed a degree of bitterness that clearly shocked some of the others. Willis Ware, its first chairman, placed primary blame on the "money tree" problem for having starved AFIPS of the resources to realize its ambitions. Armer however disagreed with this explanation, saying "I don't think that [money] would have made the least difference... I think it's the problem of the federation." He likened the structural problems of AFIPS to those of the United Nations. Others agreed, including Gilchrist, Glaser (who called the board a "quagmire"), Richard Tanaka, and Anthony Ralston. Ralston, who like several AFIPS presidents appeared to move closer to pan-computer professionalism while in office, complained that, "society politics in the year I was president gave me a new education in just what levels unprofessionalism and, quite frankly, dishonesty could rise to." It was, they agreed, above all a simple problem of "turf" disputes.[977]

Recent decades have not been kind to the dream of pan-computer professionalism, or to the particular vision of data processing professionalism espoused by the DPMA. Today there is no strong professional organization devoted to junior and mid-level managers of computer operations, programmers or analysts. The DPMA never fully recovered from its crisis of the late 1960s. Membership levels fluctuated during the 1970s, but failed to grow beyond their earlier peak. In the 1980s, stagnation began to give way to collapse, as the association's membership aged and it experienced increasing difficulty in recruiting and retaining new members. The problem was worsened by a gradual shift away from the mainframe computers with which the association's members were most closely identified. In 1992 the association changed its name to the unwieldy "DPMA, Association of Information System Professionals" and in 1996 finally

[977] Various, "Perspectives on a Quarter Century: AFIPS Presidents". One defense of AFIPS as a modest success was given on page 302. Armer's quote is from 281. Ralston's quotes are from 282 and 301.

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eliminated reference to data processing with another shift to the Association of Information Technology Professionals, or AITP. These changes were intended shake the old-fashioned image attached to data processing and to finally make clear its willingness to admit non-managerial staff. Since then it has achieved some success in the revitalization of student chapters, and many local groups remain vital and continue to perform their fifty year old function of providing a social venue for professional and technical networking. The national association, however, has only a fraction of its peak membership and is far from comprehensive in its geographical coverage, many chapters having vanished or dwindled to a handful of long-time members. The impression given is one of survival amid the ruins of lost glory. The Association for Systems Management, successor to the SPA, likewise faltered after its glory days of the 1960s, finally disbanding in the 1996.[978]

Where the DPMA collapsed, AFIPS imploded, and the ASM vanished, the ACM has endured. By 2002 it boasted 75,000 members, slightly down from the number it reached in 1987. This still represents a considerable expansion from about 25,000 members in 1969, but is nevertheless a shrinkage in the proportion of the total population of full-time computer specialist workers (and is actually below the five year target set by Walter Carlson in 1969 as he launched his push to turn the ACM into a true professional society). The ACM's strong system of special interest groups has allowed it to house a great variety of specialists groups in its large tent. Many of these groups operate largely independently of the ACM itself, publishing their own journals and in some cases hosting their own conferences and hoarding their own resources.[979]

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[978] The Association of Information Technology Professionals maintains a website at www.aitp.org. Regulations, reports, new items and its newsletter Information Executive are posted here. The dates and names given for the association's name changes are taken from Anonymous, "AITP's First 50 Dynamic Years Celebrated", Information Executive, January 2001.

[979] Walter M. Carlson, "ACM President's Letter: 100,000 in 1975!" Communications of the ACM 13, no. 7 (July 1970):395. The current (late 2002) membership level is taken from the ACM website, www.acm.org. Membership in 1987 stood at "almost 80,000" according to Weiss, "Commentaries on the Past 15 Years".

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With the ACM, its SIGMIS group (the current name for the SIGBDP group founded by in the 1960s) has grown to become one of its largest. Yet the academic focus of the association as a whole remains on computer science and the related disciplines of computer engineering and software engineering. Most of its members are holders of four-year computer science degrees – groups representing a rather small slice of the overall population of computer workers.[980] ACM leadership positions, particularly within its powerful special interest groups, are dominated by academics. Its conferences and journals are among the most highly regarded in the field, its awards the most prestigious and it plays an important role in the setting of the core computer science curriculum. On the other hand, its members have no monopoly in the broader professional field and so it has no real ability to set minimum professional standards, enforce ethical codes or perform the other functions of a professional association. It may be seen either as an academic society with a commitment to broader outreach, or as an inclusive group designed to deliver a package of directly useful services, publications and resources to its industrial members (not unlike the tangible benefits for which somebody might join, say, the American Automobile Association). While valuable, neither vision approximates a true professional body along the lines of the American Medical Association, or American Bar Association.

The IEEE Computer Society has pursued a similar strategy to broaden its appeal, today giving its mission as "to be the leading provide of technical information and services to the world

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[980] "Computer science" above is intended to include information systems, information technology, software engineering, and the dozens of other computer-related degree titles. According to Peter Freeman and William Aspray, The Supply of Information Technology Workers in the United States (Washington, DC: Computing Research Association, 1999), by 1997 there were more than two million "IT workers" and the number was growing around 10 percent annually. In contrast, during 1995 just under 33,000 bachelors degrees were awarded in computer science, computer engineering, management information science and data processing, and other business information systems combined. It is clear from these numbers that most computer staff do not hold bachelors degrees in computer science. We know that the computer field developed long before computer science was a widely available major, that the cumulative production of computer science graduates is much smaller than the number of computer workers employed today, and that the population of computer workers grew throughout the 1990s much faster than new computer science graduates were produced. We may therefore conclude that the proportion of corporate computer staff holding bachelors degrees in a computer-based discipline has never come close to 50 percent.

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computing professionals." In 2002 its membership stood at almost one hundred thousand, making it the largest computer-related organization.[981] While remaining strong in the fields of technical standards setting and hardware design for which it was known during the 1960s, it has added a variety of publications and interest groups to its roster to cater to software, security issues, multimedia, computer graphics and other interests. Its system of technical councils, committees and taskforces functioned in the same way as the ACM's special interest groups to accommodate specialist communities. Like the ACM, it has oriented its main monthly magazine toward the publication of glossy, non-academic articles on issues of interest to a broad range of practicing computer staff. It collaborates with the ACM to set new guidelines for the computer science curriculum and to set a "Software Engineering Code of Ethics and Professional Practice." Indeed, by the 1980s the ACM and the IEEE Computer Society had both broadened their membership and goals sufficiently to make them hard to tell apart. Plans to merge were scuppered only by the problem of combining part of one organization with the whole of another – and the two appear to maintain a peaceful coexistence.

Meanwhile, the Society for Management Information Systems (founded, as we saw, in the late 1960s) found it hard to balance the interests of its two founding groups: senior computer managers and academic researchers from business schools. Its journal, Management Information Systems Quarterly took a decidedly academic approach, and eventually severed its ties to the society. As SMIS co-founder Robert V. Head sees it, the group "moved increasingly away mass membership organization and found its niche as a relatively small grouping of large company chief information officers whose companies could underwrite the Society's hefty annual dues." It was renamed the Society for Information Management (SIM) and continues to organize conferences and maintain a network of local chapters. Today, SIM claims its membership to be

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[981] Anonymous, About the IEEE Computer Society (IEEE Computer Society, 2002 [cited November 20 2002]); available from www.acm.org.

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"nearly 2,500 of the world's premier IT leaders." Though SIM still offers academic membership, academics turn instead to the Association for Information Systems (AIS), which calls itself "the premier global organization for academics specializing in Information Systems." In an attempt to bridge the divide, MIS Quarterly Executive, an off-shoot of MIS Quarterly, was launched in 2002 to publish insightful research in a form "relevant to the thoughtful CIO."[982]

What is striking, however, is the extent to which corporate computer staff have succeeded in improving their status without attaining any of the traditional hallmarks of a profession. The number of people employed in the occupations formerly known as data processing has expanded rapidly and consistently throughout the past half century, forming one of the major areas of job creation during the past decade. Despite this growth, their pay has held up well, and during the 1990s many programmers and analysts with desirable skills saw their compensation increase considerably.

Corporate computing specialists need no specific college training, advanced degree or certification, follow no code of ethics, join no union and tend not to remain loyal to any particular employer. Many, of course, disprove every one of these generalizations, but none of these characteristics is a requirement for most administrative computing jobs in most organizations. It may be that the persistently good job market for computer workers has prevented a shakeout in which more qualified workers might have tried to erect barriers to the involvement of the less well credentialed. In addition, the pace of technological change and diversity of skills and jobs may have made it unusually hard for any coherent and general body of required knowledge to emerge for a substantial subset of the overall administrative computing field. The same conditions surely served to reduce the bargaining power of employers. Neither, however, should one romanticize the present-day pay, conditions or career prospects of a desktop support specialist or

[982] On SIM, see www.simnet.org. The AIS website is www.aisnet.org and details on MIS Quarterly and its spin-off publications can be found at www.misq.org. Head's comments are from Head, .

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cubicle-dwelling junior programmer. While by no means the deskilled underclass warned of by the Marxist analysts of the 1970s, neither are the rank and file of the corporate computing world any kind of self-governing elite. Corporate lawyers, and even accountants, command salaries and career prospects far beyond those available to talented programming staff. But, despite these disclaimers, computer staff in general, and programmers and analysts in particular, have done well enough for long enough to cause many to wonder whether they are the spearhead of a new kind of profession, the harbingers of a knowledge revolution in which the hidebound credentialism of the traditional professions has become obsolete.

One could just as easily imagine a scenario in which the comparatively privileged position of today's corporate computer staff comes to appear, with a broader historical view, the same kind of temporary shift that granted high wages and good career prospects to artisans and machinists familiar with other important new technologies, from paper-making machinery, through automobile production, to early electronics. The future relationship between technical and managerial expertise remains little clearer today than it did in the 1950s. We still do not know whether expertise in the structuring of computerized information systems will be a crucial skill for the manager of the future or a craft job to be performed by a technician.

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# SECTION V: BEYOND DATA PROCESSING, 1975-2000

## 13. NEW TECHNOLOGIES AND NEW IDENTITIES

In many respects, the corporate computing world of the 1980s and 1990s did not turn out to be very much like that that anticipated in the early 1970s. This chapter explores several crucial shifts, each of which began during the 1970s and saw its greatest practical effects during the 1980s. As before, changes in professional identity, management ideology, and organizational structures took place in tandem with changes in computer technology itself.

One important development was the arrival in administrative computing circles of "software engineering" as a new social movement and putative professional identity. This represented a distinct shift from both pan-computer professionalism and data processing professionalism. Unlike data processing professionalism, software engineering demanded much greater attention to the practices of programming, and the improvement of programming practices. It tried to integrate software design with project management methodologies. As such, the software engineering movement both mirrored and fostered an increased separation of the identities of programmers and analysts (as "software developers") from the other occupations of data processing (such as computer operation, scheduling, and data processing management).

The other three main developments reflected the interaction of new technology with the longer established uncertainties plaguing the management and organization of corporate computing. While software engineering (as manifested within administrative computing practice) was about the distribution of power between technical and managerial authority within the computer department, and within system development projects, the remaining shifts concerned the role of the computer department itself within the broader corporation.

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The first of these was one of ideology as well as technology. By the early 1970s, the ideas of the "data base" and "data base management system" were being discussed a great deal in computing management circles. In this literature, the data base was conceived as a single enormous repository of computerized facts, shared between all computer applications and instantly available for the answering of any managerial query. In many ways this was an evolution of earlier Management Information Systems (MIS) thinking, but the new focus on the data base was a turning point because it focused attention on what prominent computer management writer Richard L. Nolan called "the data resource" along side financial and human resources. Nolan formulated an elaborate theory of the evolution of the administrative computing department, in which its destiny lay with reorganization around data base technology as something he called the "data resource function."

The second shift, office automation, was triggered by the new availability of minicomputers, specialized word processing hardware, and video terminals. These machines dramatically lowered the cost of interactive computer use, and so made it practical to place computers within the office itself. Whereas earlier computers had moved ever larger volumes of clerical work out of the office entirely, and into the computer center, ordinary office workers were now dealing directly with computer systems. By the late 1970s, talk of the "paperless office" and the electronic automation and integration of all office tasks was rampant. Administrative computing managers and computer suppliers tried to present these machines as part of new integrated systems, tying office work directly to the automated mainframe systems for which they were responsible.

The final important development considered in this chapter the arrival of the personal computer (PC), another crucial innovation of the late 1970s the effects of which were felt more fully during the 1980s. As with office automation, in which the it eventually played a central role, the personal computer originally entered the corporation as a bottom-up extension of inexpensive

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technologies rather than a top-down imposition of traditional computer technology. It raised crucial questions about the role of the centralized computer department in a world where free-standing computers were appearing on the desktops of individual managers. The personal computer was accompanied by a new movement, "end user computing." Its proponents believed that the PC would set people free from the inflexible and unresponsive data processing department, and that the new technologies would allow small departments (or even individual managers) to program their own computer applications.

The movement during the 1980s and early 1990s, to create a new kind of corporate computer manager, the Chief Information Officer (CIO), was in many ways an attempt to deal with these last three issues. The CIO, a topic explored in the next chapter, represented an attempt to balance the new technologies of personal computing, office automation, and networking with the traditional roles of the data processing center. In redistributing authority between corporate computer managers and business groups, members of the CIO movement seized on Nolan's idea of the management and safeguarding of data (or as they called it, information) as the crucial responsibility of the corporate computer manager.

## Software Engineering

Since both data processing professionalism and pan-computer professionalism faltered during the 1970s, the most important attempt to produce a new identity for (some) corporate computing staff has been the movement to create something to be called "software engineering." The phrase emerged from a 1968 conference sponsored by NATO and held at Garmisch in Germany. This conference, at which a host of computer scientists, the leaders of corporate computing laboratories and military sponsors proclaimed the existence of a "software crisis," is firmly ensconced in the collective memory of computing academics and has received considerable attention from historians. Engineering, in this context, represented something that

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was theoretically grounded, reduced complex projects to simple rules of thumb, and required advanced degrees.[983]

The idea of software engineering penetrated the world of data processing only slowly, and has never entirely fulfilled its promise to revolutionize software production. It cannot, however, be ignored here. One reason is historiographic: though no comprehensive history of software engineering has ever been produced, the lion's share of all attention given to the history of programming (as opposed to the history of programming languages) has been devoted to software engineering. Some explicit discussion of software engineering will help to connect my work, in which most programming is presented as part of broader identities such as data processing, with the preoccupations of this existing literature. Perhaps more importantly, software engineering became an attempt to create a new profession and to shift barriers and blur distinctions between the technical and the managerial. In this sense its objectives were similar to those of pan-computer professionalism, data processing professionalism and the MIS movement – though it represented a major shift from these earlier approaches.

To deal with the historiographic issue first, it is notable that three of the five main papers presented at a recent workshop intended to "map issues" in the history of software were concerned primarily with the development of software engineering.[984] One looked at engineering as a model for software professionalism, one looked at software engineering as a means of controlling the labor of programmers, and the final one examined the attempts of software

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[983] J N Buxton and B Randell, eds., Software Engineering Techniques: Report on a Conference Sponsored by the NATO Science Committee, Rome, Italy, 27th to 31st October 1969 (Brussels: NATO Scientific Affairs Division, 1970), 7-8.

[984] James E Tomayko, "Software as Engineering", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002), Ensmenger and Aspray, "Software as Labor Process", Donald MacKenzie, "A View from the Sonnenbichl: On the Historical Sociology of Software and System Dependability", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002).

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engineers to reliability through the use of mathematical techniques.[985] In addition, the three most recently completed dissertations devoted to the history of software are all centered on the emergence of software engineering.[986] Given this comparative bounty of analytical riches there is no need to present again the contents of the key texts of software engineering or to dwell on the concept of the software crisis.

Much existing historical work has been limited by an attempt to address the categories of "software" or "programming" as a whole, without distinguishing between different kinds of programs. This focus on software engineering theorists and large systems software projects has distracted us from the reality that the great majority of programming work involved (and

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[985] By attaching primary importance to software engineering techniques in the understanding of the work of programming, much of this work engaged with the agenda laid down in the 1970s by Philip Kraft, who believed that software engineering represented a coordinated and successful effort to fundamentally reorganize software production. This, Kraft wrote, was the inevitable response of monopoly capitalism as it sought to deskill all work, and so impose the conditions of the automated assembly line on the skilled craftsmen of the data processing department. Kraft's work on computing is best known from Kraft, "The Industrialization of Computer Programming: From Programming to 'Software Production'", though he gave fuller and earlier expression to his ideas in Kraft, Programmers and Managers: The Routinization of Computer Programming in the United States. One point, in response to this hypothesis, obvious yet rarely stated in the historical literature, is that a great deal of programming work was indeed been routinized and entirely deskilled, but that this did not reduce data processing staff to the status of assembly line workers. Any programming job simple enough to reduce to a list of rote instructions had thereby been transformed into an algorithm that a computer could follow more reliably and infinitely more rapidly than any assembly line drone. From the assembler (which eliminated the routine work of specialist coders) onward, we have seen that many technologies were expected to trigger the death of the applications programmer. Each has tended, instead, to reduce the amount of drudge work performed by the human side of the human-computer partnership, and so lower the cost of programming and raise the demand for programmers. Economic forces may yet reduce the status, pay and autonomy of programming staff, and thanks to new software technologies more and more non-specialists undertake some programming as part of their jobs, but no technical developments is likely to transform programming into a specialized clerical chore.

[986] The most recent of these, Ensmenger, "From Black Art to Industrial Discipline", looked primarily on the late 1960s and early 1970s, a period during which considerable attention was paid to programmer productivity and the "software crisis" common in software engineering rhetoric appeared in its modern form. Much of the same ground is covered with a focus on the development of programming languages and operating systems in Valdez, "A Gift From Pandora's Box: The Software Crisis". A detailed intellectual history of software engineering from the early 1970s on, Stuart Shapiro, "Splitting the Difference: The Historical Necessity of Synthesis in Software Engineering", IEEE Annals of the History of Computing 19, no. 1 (1997):20-54, includes a splendid bibliography. This article is based in part on the earlier Shapiro, "Computer Software as Technology: an Examination of Technological Development". However, the most coherent attempt to synthesize the history of software engineering theory and software development practice remains Friedman and Cornford, Computer Systems Development: History, Organization and Implementation.

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continues to involve) the production and maintenance of applications for well-defined tasks in corporate administration. David Hounshell, for example, has suggested that, "firms that employed a large number of programmers created dual ladder systems for truly talented programmers," and granted them the equivalent of academic tenure.[987] Hounshell's larger point, that most programmers did not enjoy such privileged status and could rise only into supervisory jobs, is insightful. This was not, however, just an issue of programmer talent, or of computer department size, but of fundamental differences in identity between corporate computer science and software engineering researchers and on one hand and application programmers on the other. Most programmers worked within the data processing departments of organizations whose primary business had nothing to do with computers, and whose leaders saw computing as clerical automation rather than science or engineering. In such departments, computer programming and other kinds of corporate IT work were technological means deployed in pursuit of administrative ends, and so the only career ladder in a data processing department led into analysis and thence to management.

Little immediate connection was made between the world of data processing and the research-oriented proponents of software engineering. Academic computer scientists, the heads of large system software projects, technical computation specialists and data processing departments were writing different programs, for different reasons, in different ways. Indeed, at the seminal NATO conference of 1968, representatives of the corporate computer departments within which most programming took place were conspicuous only through their absence.[988] Attention focused

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[987] David A Hounshell, "Are Programmers Oppressed by Monopoly Capital, or Shall the Geeks Inherit the Earth? Commentary on Nathan Ensmenger & William Aspray", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002), 171.

[988] For a full list of participants, see Peter Naur and Brian Randell, eds., Software Engineering: Report on a Conference Sponsored by the NATO Science Committee, Garmisch, Germany, 7th to 11th October 1968 (Brussels: Science Affairs Division, NATO, 1969), 213-17. Not only were data processing experts missing, but none of the leading exponents of pan-computer professionalism were included.

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on the problems faced by the programming teams of computer manufacturers in producing ever more complex compilers and operating systems. (The term "software" was at this point still taken by many participants to refer to operating systems and compilers rather than to programs of all kinds).

While this focus seemed "industrial" rather than academic to the participants, it was hardly representative of the use of computers made by corporations. Little reference was made to the problems faced by life insurance companies, banks or manufacturing firms in their computer operations. Participants noted in passing that there were ,"lots of good data processing applications running quite steadily," and that, "there are many areas in which there is no such thing as a crisis – sort routines, payroll applications, for example." The problem lay with "certain classes" of "large systems," and in particular with third generation operating systems and time-sharing software.[989] Perhaps as a result, discussion of this software crisis was conspicuous by its absence over the next few years in managerially-oriented data processing publications such as Business Automation and in the general managerial press.[990]

At the 1968 NATO conference, the term software engineering was used to mean different things by different participants. They agreed, for the most part, that something worthy of the name software engineering was urgently required. But while the assorted researchers agreed that an engineering approach to the production of software was badly needed, they were unable to

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[989] Ibid, 110-21.

[990] Of course, these publications talked at lot about problems in data processing, but neither the phrase "software crisis" (prominent in historical accounts) nor the particular construction of it adopted by the NATO attendees gained much recognition here. Business Automation first acknowledged attempts to introduce software engineering in Jerry L. Odgin, "The Mongolian Hordes versus Superprogrammer", Infosystems 19, no. 12 (December 1972):20-23. This article, by a consultant working for a specialist software company, introduced its readers to the main ideas of the NATO Conference and summarized some of the most important early literature on the subject. Datamation had paid attention to the management of programming earlier, and published articles by several software engineering pioneers. Even here, however, the software crisis phrase did not appear with enormous frequency – and when it did, it was often in another context. See, for example, Head, "Twelve Crises -- Comments on the Future of the Software Industry" which lists no less than a dozen separate crises – all of them related to specialist software firms.

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agree on the contents of such a discipline – a problem that crippled a follow-on conference held in Rome the following year. The "communication gap" between academic computer scientists and the leaders of large system software projects appeared too broad to bridge when discussing more specific techniques.

As the 1970s wore, matters became still more confused as the "software engineering" tag was freely borrowed and applied to a broad range of different ideas and products. Chief among the ideas marketed as software engineering were structured programming, new analysis and charting methodologies, and new software project management techniques. This left many of the original enthusiasts thoroughly disillusioned. Brian Randell, one of the editors of the original NATO reports, later recalled that despite the collapse of the original efforts, "the software engineering bandwagon began to roll as many people started to use the term to describe their work, to my mind often with very little justification."[991]

To simplify matters a little for the present discussion, the occupants of this bandwagon may can be divided into two groups. The first, closer to computer science, was concerned with providing new and more rigorous methods of programming. These techniques included the mathematical verification of program logic, the use of formal specification languages, the creation of more transparent programming languages, and attempts to create re-usable blocks of program code called "software components." (Ideas of this kind were eventually packed in object-oriented programming languages such as C++ and Java for easy consumption by the unwashed masses). [992]

[991] Brian Randell, "The 1968/69 NATO Software Engineering Reports" (paper presented at the Dagstuhl-Seminar 9635: "History of Software Engineering", Schloss Dagstuhl, August 26 - 30 1996).

[992] The component idea, much discussed by historians, was presented at the NATO Conference as M D McIlroy, "Mass Produced Software Components", in Software Engineering: Report on a Conference Sponsored by the NATO Science Committee, Garmisch, Germany, 7th to 11th October 1968, ed. Peter Naur and Brian Randell (Brussels: Science Affairs Division, NATO, 1969). One of the seminal articles on formal proof of program correctness is C A R Hoare, "Proof of Correctness of Data Representations", Acta Informatica 1(271-281 1972).

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Some advocates of these approaches projected an elitist arrogance toward actual programmers. According to leading computer scientist Edsger Dijkstra, a self-appointed scourge of fuzzy thinking and "soft" science, the following propositions were irrefutable:

> (1) good programming is probably beyond the intellectual abilities of today's 'average programmer'
>
> (2) to do, hic et nunc, the job well enough with today's army of practitioners, many of whom have been lured into a profession well beyond their intellectual abilities, is an insoluble problem
>
> (3) our only hope is that, by revealing the intellectual contents of programming, we will make the subject attractive to the type of students it deserves, so that a next generation of better qualified programmers may gradually replace the current one.[993]

Not surprisingly, calls of this type were slow to find acceptance by most practicing programmers. One 1975 article in Infosystems suggested that, "few data processing managers today even know of Dijkstra." It conceded that "since many of the original articles about structured programming either came out of scientific or software programming environments, the question of how well structured programming would work in commercial data processing has remained unanswered in many people's minds." Many promoters of structured programming combined these idea with new principles for laying out, indenting and modularizing code. This was tied to a new interest in what was amorphously termed the "style" of a good program, which itself implied that programs should be read and critiqued by humans as well as executed by machines. That, in turn, reflected a modest increase in academic attention given to the training of programmers and the improvement of programmer productivity.[994]

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[993] Edsger W Dijkstra, "EWD 611: On the Fact that the Atlantic Ocean Has Two Sides", in Selected Writings on Computer Science: A Personal Perspective, ed. Edsger W. Dijkstra (New York: Springer-Verlag, 1982).

[994] Dijkstra's famous article is Edsger W Dijkstra, "Letters to the Editor: Go To Statement Considered Harmful", Communications of the ACM 11, no. 3 (March 1968):147-48. The quotation is from Kenneth T. Orr, "Structured Programming: Not a Fad", Infosystems 22, no. 11 (November 1975):36-38. For one of the first discussions of structured programming in the data processing literature, see Edward F Miller and George Lindamood, "Structured Programming: Top-Down Approach", Datamation 19, no. 12

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The second school shifted away from the details of coding styles and toward the best ways to manage a programming project and structure a programming team. Sensational claims were made by representatives of IBM for a new approach they called the, "chief programmer team." This was supposed to combine "recent technical advances in programming," with, "a fundamental change in managerial framework which includes restructuring the work of programming into specialized jobs, designing relationships among specialists, developing new tools to permit these specialists to interface effectively with a developing, visible project; and providing for training and career development of personnel within these specialties." The concept, ostensibly modeled on the surgeon, placed a virtuoso programmer in the role of system architect and chief coder. He would be assisted by a number of backup programmers, librarians, secretaries, etc. to handle the less creative parts of the job and – metaphorically speaking – hand over scalpels and scrub up while keeping out of his way.[995]

In his Psychology of Computer Programming, a cult classic, Gerald Weinberg offered another widely discussed team structure for software projects with his more egalitarian concept of the "egoless" programmer. This swung to the other extreme of team organization. Egoless programmers would work in small, "democratic" team, a submission of the individual to the

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(December 1973):55-7. For a discussion of the relevance of these ideas to programmer training see Edward L Schulman and Gerald M Weinberg, "Training Programmers for Diverse Goals", Data Base 5, no. 2-3-4 (Winter 1973):16-26 and Fred Gruenberger, 16th Annual One-Day Computing Symposium (RAND Symposium 16), 1974, contained in RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis. The importance of human-readable programs as a centerpiece to the socialization and management of programmers was given an influential early statement in Gerald M. Weinberg, The Psychology of Computer Programming (New York: Van Nostrand Reinhold Company, 1971). Similar issues had been raised by the RAND Symposium discussants back in 1963, when M.D. McIlroy (later an influential participant in the NATO Conference) complained that nobody read programs, and that they were "not written with flair, style, elegance, and what have you.... I'd like to see one programmer say of another's program 'that's good; he has a nice style.' We never seem to talk about style in programs, and we ought to." Gruenberger, RAND Symposium 1963, 43.

[995] The quotes come from F Terry Baker and Harlan D Mills, "Chief Programmer Teams", Datamation 19, no. 12 (December 1973):58-61, in which the chief programmer team concept was presented to the world of data processing – though the ideas had circulated previously in an internal IBM report back in January 1970. The concept was also featured prominently in the classic Brooks, The Mythical Man Month: Essays on Software Engineering.

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collective which appeared to echo the countercultural thinking of the late 1960s.[996] They would freely share responsibility and information with their fellows, welcoming constructive criticism of their coding style and defending their design decisions. He thought that programming projects worked best when lead in a low-key fashion by a skilled programmer. For Weinberg, programming was a complex and important human activity, a craft best overseen by those skilled in its mysteries. His work signaled the beginning of a new focus on programming practices and their improvement. In what one might think of as a "programmer pride" movement, efforts began to justify programming as a profession (or at least a skilled craft) in its own right rather than as a (low-status) part of data processing, business, scientific work, or computer science. This reinforced the general push for "structured programming" (particularly in the very vague sense this concept was used in the data processing press) and the new interest in program code as an engineered artifact or aesthetic object.[997]

The 1970s also saw attempts to give programmers their own professional society, the Association of Computer Programmers and Analysts (ACPA). This, too, reflected a new attention given to programming as the possible basis for a new occupational identity. As the report in Infosystems made clear, the ACPA was intended to be, "a protector of programmers and analysts, filling a need not met by the DPMA or ACM." Its founding President, Paul Notari, complained that the "hierarchy" of the former consisted, "almost entirely of EDP managers, many of whom have never been a programmer or analyst," while the latter was, "founded by and still caters very heavily to the needs of the scientific programmer, much to the exclusion of the business analyst/programmer who by far is in the majority." Its founding Chairman, William M. Newell, thought that an understanding of programming should be an essential qualification for the data processing manager. He complained that, "[t]housands of EDP installations today are being

[996] I am indebted to Emily Thompson for this observation.
[997] Weinberg, The Psychology of Computer Programming.

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headed by managers who came up through the ranks of accounting, finance, [punched card machine] administration and the like, and who are befuddled by the complexities of modern EDP systems analysis and programming."[998]

While neither egoless programming nor the chief programmer team ever achieved widespread usage, the publicity given to them did trigger a new interest in the integration of design and analysis work with specialized approaches to software project management. Consciously or unconsciously, advocates of this school of software engineering sought to emulate the 1950s projects such as Atlas and Polaris, from which systems engineering and engineering project management techniques had sprung. Techniques for flowcharting and analysis were merged with management tools like PERT charts to create pre-packaged methodologies intended to package the latest practices. Building on the new enthusiasm for structured programming, by late 1970s, people like Edward Yourden, Michael Jackson and Tom De Marco had built thriving careers as speakers and writers promoting their own trademarked methodologies for "structured" programming, design and analysis.[999]

To adopt these "structured" methods implied a shift toward a project-oriented, engineering approach to management and, more importantly, implied that effective data processing management would demand a body of highly specialized knowledge and a firm understanding of the latest ideas in programming and analysis. Interest in these techniques, and in engineering as a model for data processing careers, represented a new vision of professionalism. Like data processing professionalism, software engineering suggested that a would-be professional programmer should acquire managerial skills. The difference was in the kind of

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[998] Anonymous, "Latest Association: Programmers and Analysts".

[999] Michael A Jackson, Principles of Program Design (New York: Academic Press, 1975), Tom DeMarco, Structured Analysis and System Specification (Englewood Cliffs, N.J.: Prentice-Hall, 1979) and Edward Yourden, Techniques of Program Structure and Design (Engelwood Cliffs, NJ: Prentice-Hall, 1975).

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management. While DPMA was deeply committed to the establishment of management as the natural career path of data processing staff, it saw management more as the operational challenge of scheduling jobs, dealing with suppliers, and supervising the work of specialists. This was management as experienced by a plant production manager, rather than an exercise in high-technology project management. Software engineering, on the other hand, was all about managing a complex development process that would require different skills and methods during each of its many stages. This harkened back to the systems engineering projects of the 1950s or, more prosaically, the kinds of techniques long used in the construction industry to define, estimate, schedule and manage the construction of an office building or residential development.

In some senses, software engineering extended the techniques of the systems analyst upward into project management and downward into code writing. The systems men of the 1950s had also paid attention to flowcharting and analysis, having invented many of the charting techniques modified by the new generation of software engineering gurus. However they had focused their attention on the "higher level" and putatively technology-neutral task of designing business processes. They believed that the actual details of programming could be delegated. Software engineering, on the other hand, paid a great deal of attention to the interplay between the technical architecture of the system being developed, the specific programming techniques used, the analysis techniques adopted, and the managerial methods by which the project was coordinated.

Much prior discussion of the topic, following Kraft, has implied that the programmers of the 1950s and 1960s were skilled, independent artisans and that software engineering techniques represented a push by capitalist managers to degrade their work and remove their autonomy. (In fact, creative mystique of programming appears very rarely in the data processing literature, and then always as a foil – invoked as a symbol of the bad old days or as something about to be banished. No authorities of the 1950s or early 1960s were ready to concede that administrative

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programming was either mysterious or artistic, and few believed it unmanageable). It is true that many software engineering advocates promised to bring industrial discipline to the unruly crowds of programmers they believed were getting in the way of an efficient development process. More fundamentally, however, to view software engineering solely as a managerial device for the control of programmers is to miss at least half the point. Software engineering was also supposed to be a technocratic device for the imposition of engineering rationality on corporate management. As well as pushing techocratic control downward onto programmers, it pushed a concern for the technical qualities of good program design upward into middle management. Software projects would be headed by qualified software engineers with practical experience and advanced degrees – not by fuzzy generalist managers.

As such, software engineering might be expected to hold considerable appeal to programmers seeking a managerial path in which their experience and world-view would prove an asset rather than a liability. Though these ideas failed to reshape programming as a whole, their spreading may have served to limit the appeal of earlier conceptions of data processing professionalism and of pan-computing professionalism. Many software engineering methodologies involved an implicit blending of technical and managerial responsibilities. This followed in part from their initial focus of software engineering on the production of large system software products (IBM's travails with its flagship OS/360 serving as a much recounted parable), projects with some similarities to large scale industrial research and development. As with the management of a industrial research and development group, one could reasonably suggest such an undertaking could only be overseen by someone with expert knowledge in the field able to command the respect and evaluate the work of the specialists involved. For this reason, interest in software engineering was strongest in organizations (such as IBM, or systems firms TRW and SDC) for whom the production of software was a primary goal: software houses, consulting firms and computer manufacturers. (Even here, it was far from unproblematic).

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Even though many of the software engineering methodologies of the late 1970s and 1980s were explicitly designed to improve the management of ordinary application development projects, they were slow to win acceptance in the non-specialist firms in which most system development work took place. While some administrative programming supervisors may have picked up on fads, such as the elimination of the GOTO statement, or the need for particular code indentation techniques, they usually lacked the power or conceptual tools to reorganize more fundamental aspects of the development process. Senior managers did not view the internal development of a new data base or accounting application as something akin to research and development. Instead it remained an administrative overhead, and the pressure placed on data processing managers was to provide better service, control costs and show more awareness of corporate issues rather than to turn themselves into engineers. In turn, university trained computer scientists and aspiring software engineers have been less likely to seek out jobs as corporate application programmers, which were more likely to be filled by the self-educated, community college graduates, and the commercially trained.

On a pragmatic level, use of the various tools and techniques associated with software engineering has undoubtedly improved the effectiveness of software development efforts – though the ever-increasing scale and complexity of programming projects has ensured that failure and disappointment remain common occurrences. Consulting firms and government agencies were particularly likely to adopt elaborate, standardized methodologies to provide a fixed series of stages, checklists, feedback mechanisms, and tools for each software development project. On the other hand, widespread attempts to produce Computer Aided Software Engineering (CASE) tools to automate such methodologies, and go directly from requirements and flowcharts to code in an integrated environment, proved disappointing. During the 1980s, many believed such systems were about to deliver the decades-old dream of automatic transformation of flowcharts into programs, thus eliminating traditional programming altogether. Though programmers are still

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needed, and the most ambitious hopes were not realized, computerized tools are now widely used to diagram and document program designs, and modern code editing environments (Integrated Development Environments, or IDEs) include powerful features to automatically check and format code.[1000]

Hopes for software engineering as the basis for a new profession, however, have been disappointed. Despite periodic pushes, software engineering has not won recognition as a "true" engineering discipline, relatively few programmers would identify themselves as software engineers, and fewer yet would have anything approaching a rigorous academic training in its principles. Indeed, attempts to define a suitable core of software engineering knowledge have proved highly fractious.

The appeal of software engineering has remained strongest to academics and those with advanced degrees working on complex systems software projects. In the academic world, the term software engineering has been applied to research centers, conferences, journals and degree programs concerned with techniques for the effective production of computer software. In the academic world, software engineering represented a coordinated attempt to bridge the gap between the theoretical concerns of computer science and the managerial orthodoxies of corporate practice. Computer science, as many software engineering specialists saw it, had pursued a few narrow and mathematically interesting avenues which had little bearing on the practical problems of huge development projects.[1001] Yet traditional management techniques had equally little to offer these projects, because generalist managers insisted that there was nothing special about computer projects. Though "software engineer" has appeared as a job title or self-description beyond the university, its use had largely been confined to systems software

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[1000] On the history of CASE, see Fred Happgood, "CASE Closed?" CIO Magazine, April 1 2000.
[1001] On the distinction between software engineering and computer science, see David Lorge Parnas, "Software Engineering Programmes are not Computer Science Programmes", Annals of Software Engineering 6, no. (14) (1998):19-37.

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specialists, and to computer experts seeking credibility within technical organizations dominated by engineering culture.

Software engineering has so far developed more as an academic field than as a unifying professional identity for programming as a whole. It has served as a useful umbrella under which academics have been able to research the processes of programming and design, and produce new tools and methodologies intended to support them. Many of the key software engineering ideas of the 1970s and 1980s have gradually percolated into common practice, and been embedded in the practices and software tools used by ordinary corporate application programmers. Even those who would claim the title of software engineer lack clear professional standards or a generally accepted certification or licensing program of the common in engineering disciplines.

This perceived failure to match the accomplishments of established engineering disciplines has, in fact, been a source of perpetual lamentation in software engineering circles. Advocates of professionalization remain convinced that some crisis or slowdown will soon force a shakeout in which only educated and professional programmers deserving the title of software engineer will survive. They provide romanticized capsule histories of the civil and mechanical engineering professions, lingering over descriptions of the collapsing bridges and exploding boilers which prompted reform. They insist that the "craft-based" practices, reliance on individual genius, and "emotional" attachment to long-debunked techniques will soon be swept away. A recent and much-discussed book by Microsoft programming manager Mitch McConnell, After The Goldrush: Creating a True Profession of Software Engineering combined all these arguments into an easy to swallow form and appeared just as the Internet boom ushered in the biggest goldrush of all.[1002] Yet the same arguments have been presented for more than thirty years, and neither the adoption of engineering as a professional model for rank-and-file corporate

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[1002] If he was intent on naming his book after a Neil Young album, McConnell would have better captured the prevalent mood among programmers of the late 1990s with Young's next one: Harvest.

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programmers nor the mandatory licensing of technical project managers as engineers would appear to have grown any closer to realization during this period. McConnell acknowledged this, when he suggested that, "the current state of the software industry is as if leading-edge doctors had tested penicillin, found it to be effective, and integrated it into their practices, only to have 75 percent of doctors continue to use leeches and mustard poultices." Indeed his implicit suggestion that the term "software industry" could encompass all programming activity indicates the continuing gulf between ordinary programmers and the reformist elites of software engineering.[1003]

At the time of writing, moves are afoot to bring to software engineering the kind of professional credentialing found in established engineering disciplines. Building on its engineering heritage, the IEEE Computer Society has made the most serious foray since the 1970s into the treacherous ground of professional certification. In 2002, it launched its Certified Software Development Professional (CSDP) examination.[1004] As of November 2002, around 200 people had already received the qualification during its testing period. The examination is intended for "mid-level software professionals" and so covers "the software engineering profession" rather than computer science, data processing, or programming as a whole.[1005] Nevertheless, its development bears striking similarities with earlier efforts. As had been the case with the Certificate in Data Processing (CDP) devised by the Data Processing Management Association, its proponents (among them McConnell) began by inventorying the attributes of

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[1003] Steve C McConnell, After the Goldrush: Creating a True Profession of Software Engineering (Redmond: Microsoft Press, 1999).

[1004] On the initial announcement of the plan, see Stacy Saul, "Certification Program for Software Development Professionals Approved", Computer 35, no. 1 (January 2002):99.

[1005] IEEE Computer Society, News Release: IEEE Computer Society Announced New Agreement with STC 2003 (19 November, 2002 2002 [cited 26 November 2002]); available from http://www.computer.org/certification/CSDP_STC_PR.pdf.

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established professions and then attempted to duplicate each of these.[1006] Likewise, the CSDP requires a university degree and several years of work experience. Its requirement that applicants sign a code of ethics as "proof of professionalism" corresponds to the CDP's "good character" requirement.[1007] Like those involved in the AFIPS certification plans of the 1970s, they sought to begin with rigorous job analysis projects.[1008] Today, just as forty years ago, even proponents of certification are for the most part opposed to state licensing of practitioners. Few states have so far moved to license software engineering, though Texas has been pioneering here through the extension and interpretation of its existing engineering regulations.[1009]

## The Data Base and the Data Resource Function

One important and enduring concept to emerge from discussion of Management Information Systems during the 1960s was that of the "data base." Early MIS proponents had often finessed the question of how to integrate stored data from different subsystems. In the beginning, the Management Information System concept was seen merely as an extension of an earlier approach known as Integrated Data Processing, in which the outputs of one computer or punched card process would be reused as the inputs to another. At first, many hoped that if an automation drive was based on careful examination of management's information needs then all these smaller systems could be joined together, supplemented with a set of advanced mathematical models, and used to inform every manager of exactly (no more, no less) they needed to do their jobs. The assumption was that if information needs could be specified with

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[1006] Steve McConnell and Leonard L Tripp, "Professional Certification: Fact or Fiction?" IEEE Software Magazine 16, no. 6 (November-December 1999):13-18, reproduced prominently on the SCDP website as http://www.computer.org/certification/FactorFiction.htm.

[1007] Anonymous, Certification Requirements (IEEE Computer Society, 2002 [cited November 26 2002]); available from http://www.computer.org/certification/education.htm.

[1008] Anonymous, Certification Examination Development (IEEE Computer Society,, 2002 [cited November 26 2002]); available from http://www.computer.org/certification/ExamDevelopment.htm.

[1009] John R Speed, "What Do You Mean I Can't Call Myself a Software Engineer", IEEE Software Magazine 16, no. 6 (November-December 1999):45-50.

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sufficient precision that the inputs and outputs of hundreds of more specialized systems with their own little stores of data could be woven together to create a suitable web. This assumption mimicked the existing methods of reporting, in which figures from different sources were pulled together by clerks to produce weekly, monthly, quarterly and annual reports of different kinds. The computer, they hoped, could do this faster, cheaper, more effectively and more selectively.

By the late 1960s, the more thoughtful advocates of MIS had realized that there was no way of discovering, years before a system was finished, exactly what information a manager would need when it was operational. There was also little chance that this would stay the same for very long. If it was impossible for system designers to specify in advance the information needed by a manager, then they should focus instead on producing a shared pool of data and making sure that each manager had the electronic tools needed to extract whatever information he or she required. One very early statement defined this "body of data, a veritable 'bucket of facts'," as "the source into which information seeking ladles of various sizes and shapes are thrust in different locations."[1010] As a result, increasing attention was paid to the storage and structuring of this data.

A new term, "data base" appeared to describe a repository of standardized data that could be accessed by different application programs. Its origins apparently lay in the world of military on-line systems. From 1964 onward, the Systems Development Corporation (SDC), a key supplier of software for military command and control systems, made a major push to commercialize its "data management systems" for business use. The approximately 185

[1010] Milton D. Stone, "Data Processing and the Management Information System: A Realistic Evaluation of Data Processing's Role in the Modern Business Enterprise", in Data Processing Today: A Progress Report -- New Concepts, Techniques and Applications -- AMA Management Report Number 46, ed. American Management Association (New York: American Management Association, Finance Division, 1960).

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participants at a 1965 SDC sponsored symposium included high-ranking military officials, business data processing celebrities, and corporate and academic researchers. Among them were Richard G. Canning and Robert V. Head, both of whom spread awareness of the concept into civilian discourse. Reporting on the event in Datamation, the leading trade magazine of business computing, Robert V. Head observed that data bases had already unleashed the "biggest single strike" of new jargon "since the great time-sharing goldrush of 1963," leaving potential users "sullen and down-trodden." He concluded by wondering whether it was "possible that users, led by the military, will surrender to these data base systems without a shot being fired in anger."[1011]

By 1965, Harvard professor John Dearden was using "data base" to describe the truly important set of corporate facts and figures that had to be shared between functions. The term crept into more technical data processing literature, emerging in discussion of total systems as a means of pooling information from different data files. Its great advantage would be, "to permit categories of information to be added, deleted, expanded and otherwise revised, without completely redesigning the file or reprogramming the retrieval routines."[1012]

By the time the Society for Management Information Systems was formed in 1968, Head believed that structuring and development of the database was the most crucial problem in MIS development. This idea fitted nicely with the general shift then underway from tape to disk storage as the primary medium for the current copies of key electronic records. All application programs dealing with operational and administrative tasks (payroll, inventory, accounting and

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[1011] The quotation is from Robert V Head, "Data Base Symposium", Datamation 11, no. 11 (November 1965). On the symposium itself, including a list of registered attendees and participants, see System Development Corporation, Preprint for Second Symposium on Computer-Centered Data Base Systems, Sponsored by SDC, ARPA, and ESD, 1965, contained in Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis.

[1012] Dearden, "How to Organize Information Systems" is an early use of the term "data base". The quote is from Leonard Simon and Roger Sisson, "Evolution of a Total System", Total Systems Letter 1, no. 11 (January 1966):1-4, page 4.

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the like) would work directly with this single, shared pool. Because records stored on disk were always accessible, different programs could share them. Existing application programs each maintained their own data files, usually on tape. This meant that data was stored in many different places, and that specific facts were often duplicated, and that each file could give only a fragmentary depiction of reality. Consolidating data from several different files was a slow, expensive and sometimes impossible task. Managers were regularly issued with voluminous reports full of raw data, but getting summarized information in response to specific questions required manual analysis or special programming, while knitting together information from several different files was a major undertaking.

The data base was often called a "reservoir" of information - showing the extent to which MIS's champions perceived information as a resource in short supply, which could be husbanded and piped to where it was required.[1013] Using the magic of the terminal, executives could work directly with the database. One such author called it "the collection of all data that are relevant to executive decision making." This data would be stored in its most elementary form - individual orders, costs and items of inventory. Managers would then be free to interrogate the database on an ad-hoc basis to perform cost analysis of the smallest decisions.[1014]

Head and his colleagues assumed that once a comprehensive, disk based data base had been established the creation of an equally comprehensive management information system would be relatively straightforward. As Head showed in graphical form (see the earlier Figure 30 as well as the figure immediately below), he believed the information needed by top managers to

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[1013] For an early reference to MIS as an information reservoir see C. Clifford Wendler, "What are the Earmarks of Effective Total Systems?" Systems & Procedures Journal 17, no. 4 (July-August 1966):29-31, page 30. Paul Kircher, "Breakthrough in Management Information Systems", Journal of Data Management 7, no. 2 (February 1969):28-31. Robert V. Head, "MIS-II: Structuring the Data Base", Journal of Systems Management 21, no. 9 (September 1970):37-38. The centrality of the data base to much MIS thinking of the 1970s is nicely demonstrated in Walter J Kennevan, "Structuring and Managing a Management Information System", Data Management 10, no. 9 (September 1972):58-62.

[1014] The definition is taken from Morton and McCosh, "Terminal Costing for Better Decisions", page 150.

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make strategic decisions was nothing more than a summarized, processed version of the operational data held in the database. The data base was the foundation on which the entire MIS pyramid would be erected. (By calling the data base a data base, rather than an information base, they continued to respect the earlier sense that a collection of facts was not in itself information).

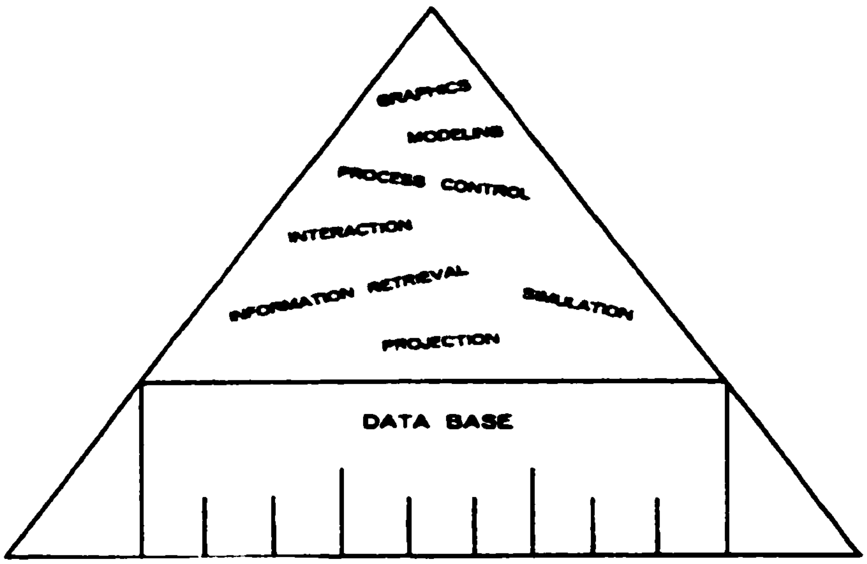


**Figure 42: The Data Base was seen as a foundation upon which the rest of the MIS could be constructed.**[1015]

Attention turned to techniques of facilitating this sharing of information. One much-hyped idea was the "data dictionary," a central registry of the data gathered and produced by different parts of the business. By standardizing different representations of the same information, and establishing clear rules about who was responsible for each piece, companies could eliminate duplication and lay the groundwork for greater integration. According to an IBM advocate of this approach, "[o]nce management realizes the relationship of reliable data to corporate well-being, they will treat their data with the same care used to handle their cash."[1016]

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[1015] Head, "Management Information Systems: A Critical Appraisal", page 24.

[1016] John J. Cahill, "A Dictionary/Directory Method for Building a Common MIS Data Base", Journal of Systems Management 21, no. 11 (November 1970):23-29, page 23.

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Meanwhile, utility software designed to make it easier to program and maintain applications storing information on tape and disk files had emerged as one of the most successful niches within the early software industry. File management software had a long history. Early computer programs included all the instructions necessary to specify the minute details of reading and writing information from tape or disc. Programming groups soon hit on the idea of producing a single set of well written comprehensive routines to handle these chores. Application of the same principle to more complex operations produced "report generation" programs, to which a programmer could feed a description of the output desired of the organization of the data inside the file and be rewarded with the desired report without needing to write a new program. Further extensions gave these packages the ability to store as well as retrieve data, so that they mediated between the application programs and the disk or tape itself. As disks became commonplace, the need to carefully design and index information became more acute and the dangers of having programs write data to it directly more severe. By the end of the 1960s every major computer manufacturer offered at least one piece of file management software, known also as "information management systems" and "file management systems." Indeed, one such program, Informatics' Mark IV, was the most successful product of the nascent packaged software industry.[1017]

The grand managerial vision of the data base and the somewhat more limited technical accomplishments of file management systems existed side by side for some time. During the late 1960s manufacturers promoted their file management systems as supporting, or even being, Management Information Systems. The packages slowly acquired more advanced capabilities - most importantly the ability to link together records in different files (such as a customer record

[1017] On the problems posed by disc files see (the disc files book). On generalized file management systems, see Canning and Sisson, The Management of Data Processing, 91-93. For a roundup of available packages and their capabilities see CODASYL Systems Committee, Feature Analysis of Generalized Data Base Management Systems (New York: [n.p., Distributed by the Association for Computing Machinery], 1971). The Mark IV is discussed in Campbell-Kelly and Aspray, Computer.

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and all the associated order records) and interactive interrogation capabilities. By the early 1970s, the term data base had been adopted as part of the name of the Data Base Management System (DBMS), a new kind of software tool defined by the computer industry standards group CODASYL (Committee On Data SYstems Languages). DBMS systems made it much easier to share data between multiple applications, to maintain data files on disk rather than tape, to produce one-off reports, and to alter data formats without rewriting application programs. For the rest of that decade, DBMSs were by far the most commercially important products for the newly created packaged software industry. Today they are the foundation of almost all corporate computer applications and lie behind all large-scale commercial websites.[1018]

Publicity given to the DBMS concept gave still more prominence to the idea of a data base. A lot of discussion of the "data base" from an organizational perspective still ignored such implementational details. It functioned almost as a synonym for MIS. As Richard L. Nolan, a Harvard Business School professor and one of the highest profile experts on computer management during the 1970s, noted that, "[w]ritings on MIS have waned recently and have largely been replaced by writings on the Data Base. If the term Data Base or DB is used to replace the term MIS, the titles of recent articles are remarkably similar to the titles of MIS articles of several years ago."[1019] Like Nolan, many managerially oriented authors assumed that a single huge centralized database could be created to integrate all computer readable data throughout the company. In a 1973 Harvard Business Review article entitled "Computer Data Bases: The Future is Now," he suggested that the company-wide data base had become a practical and necessary step for forward-thinking companies, because "upper levels of management are

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[1018] The origins of the database management system are explored in Thomas Haigh, "'A Veritable Bucket of Facts': Origins of the Data Base Management System", in Proceedings of the Second Conference on the History and Heritage of Scientific Information Systems, ed. Mary Ellen Bowden and Boyd Rayward (Medford, NJ: Information Today Press, 2003).

[1019] Nolan, ed., Managing the Data Resource Function.

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seeking information that can be generated only from properly structured, companywide pools that include data from the narrower applications...." This, he believed, demanded a fundamental conceptual shift so that "the data computer programs use are considered an independent resource in themselves, separate from the computer programs."[1020]

Nolan suggested that a new corporate group, the "data resource function" should be "carved out of the general management function" to manage this new asset. He viewed this as something distinct from the existing data processing department, going so far to urge that managers avoid handing responsibility for the corporate data base to data processing managers with a "purely technical" background.[1021] He claimed that data was a crucial corporate resource, just like the more commonly recognized material, financial, and human resources. (Indeed, he explicitly cited the broad concept of "resource" employed by human resources theorists in support of his idea).[1022] Despite Nolan's effort to promote the "data resource" term, including a book entitled Managing the Data Resource Function, few others adopted it. However, when re-branded slightly and associated with the idea of information rather than data, these same ideas were widely adopted in the 1980s.

The job title "data base administrator" (DBA) proposed around the same time as the "data resource function" did win more general adoption. The DBA was originally seen as a powerful new kind of managerial technician. One of its earliest promoters was John K. Lyon, a manager responsible for the creation of DBMS software at Honeywell (then a mainframe computer producer). Lyon suggested that the data base administrator would have to combine responsibilities currently "scattered among the users, operations, and the data processing staff."

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[1020] Richard L. Nolan, "Computer Data Bases: The Future is Now", Harvard Business Review 51, no. 5 (September-October 1973):98-114. For discussion of the data base as a tool for "decision support" see Andrew B Whinston and William D Haseman, "A Data Base for Non-Programmers", Datamation 21, no. 5 (May 1975):101-7.

[1021] Nolan, "Computer Data Bases: The Future is Now".

[1022] Nolan, ed., Managing the Data Resource Function, 3.

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The DBA would need technical qualification, diplomatic instincts, an eye for detail, and be forced to "represent both managers and the users simultaneously; he must be all things to all people at all times."[1023] Nolan argued that the, "most important manifestation of the institutionalization of a data resource function is the appearance of the Data Base Administrator position in organizations."[1024] Others went still further, suggesting in language clearly influenced by Nolan that the DBA would be responsible for "data as a resource… much broader than just computer-readable data" and be, "something of a superstar."[1025]

But in the end this dream too was to fade. By the time data bases finally entered wide use during the late 1970s the data base administrator was just another technician, tweaking and configuring the system. The "management" in data base management had little to do with executive responsibility. The data base did prove immensely valuable in simplifying the development and maintenance of corporate application programs, but ideas of making it the single repository of all corporate information proved utterly unworkable. As one of the first practically oriented textbooks on the subject explained, a "much-publicized but impractical idea of a data base says that a corporation keeps all its processable items of data in a large reservoir in which a diversity of data users can go fishing."[1026]

Nolan, meanwhile, was turning the shift to data bases and the "data resource function" into key elements in a grand theory of the evolution and destiny of the corporate computer department. We saw earlier that the early 1970s were a troubled time for computer departments, as the cost and complexity associated with advanced third generation computers failed to bring

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[1023] John K Lyon, "The Role of the Data Base Administrator", Data Base 3, no. 4 (Winter 1971):11-12.

[1024] Nolan, ed., Managing the Data Resource Function, 5.

[1025] Ibid, 39. John W. Luke, "Data Base Systems: Putting Management Back In The Picture", CSC Report 9, no. 1 (1975):8-12.

[1026] James Martin, Computer Data-Base Organization (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977), 22.

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promised improvements in efficiency and breakthroughs in MIS. Some critics called on data processing managers to put their own house in order and focus on improving the quality of the service they provided, making the computer operation more like an efficient production line. Others felt that the problem was failure to apply computers to important problems in managerial decision making, rather than mere clerical automation.

Nolan cleverly combined these two critiques, and suggested that they reflected seperate stages through which each computer department must pass on its way to the nirvana of the data management function. His article "Managing the Four Stages of EDP Growth" introduced the so-called "stage model" of data processing development. While an early version of the idea was published in Communications of the ACM in 1973, it was a Harvard Business Review article in 1974, that really launched the model Nolan was to promote and refine for decades to come.[1027] Nolan's phased model proved controversial. While it was presented as an empirically based and scientifically testable theory of the progression of individual firms (albeit one initially based on only three organizations), other researchers failed to duplicate his precise results. It remains, however, an important snapshot of data processing management ideology during the 1970s and an interesting illustration of the way in which the history of data processing became a resource on which management theorists could draw.[1028]

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[1027] The model received its first public outing in the single-author paper Nolan, "Managing the Computer Resource: A Stage by Stage Hypothesis". None of the three companies studied had actually reached stage 4, so Nolan's comparison with Marx's model would seem unintentionally apt. Nolan's work appears to be a development of a study reported in N C Churchill, J H Kempster, and M Uretsky, Computer-based Information Systems for Management, A Survey (New York: National Association of Accountants, 1969). The HBR paper was co-authored, and unlike the original paper does not describe the research on which it is based – however there is no evidence that the three firm sample was broadened. In this article the names of the stages have been changed and managerially-oriented discussion of the problems of data processing added. Gibson and Nolan, "Managing the Four Stages of EDP Growth".

[1028] Nolan himself soon replaced his initial four stages with a new six stage model (Initiation, Contagion, Control, Integration, Data Administration and Maturity). Richard L. Nolan, "Managing the Crisis in Data Processing", Harvard Business Review 57, no. 2 (March-April 1979):115-26. It had turned out that the transition late in the third stage to database technology and on-line information was liable to usher in a new era of uncontrolled growth, rather than immediate maturity. Two additional stages had been

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According to Nolan, each firm was destined to make its own progression along a fixed trajectory. Along the way, it would pass through three "turning points" and thus through a total of four stages. During the first of these stages, Initiation, it automated simple accounting and clerical applications. As the range of applications broadened to encompass budgeting, inventory, forecasting and other operational tasks it entered the second stage, that of Expansion (or as Nolan called it elsewhere, Contagion).

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added to reflect this, but the destination remained much the same. Indeed, Nolan himself continues to use the theory. In its most recent version, all mention of MIS and the original mainframe vision of maturity have vanished. Instead, Nolan depicted a single DP Era, stretching from 1960 to 1980, followed by a Microcomputer Era and a Network era. Each of these eras had four stages. For Nolan's recent attempt to use stage theory as a description of corporate computing from 1960 to 2010 see Nolan, "Information Technology Management Since 1960". In a note on page 331, Nolan includes a list of Harvard case studies utilizing this approach. For an excellent summary of the origins of the stage model, its assumptions and the literature concerning it see Friedman and Cornford, Computer Systems Development: History, Organization and Implementation, 21-36. Freidman concludes that most of the studies aiming to test the literal truth of Nolan's model had failed to support it (pages 30-33).

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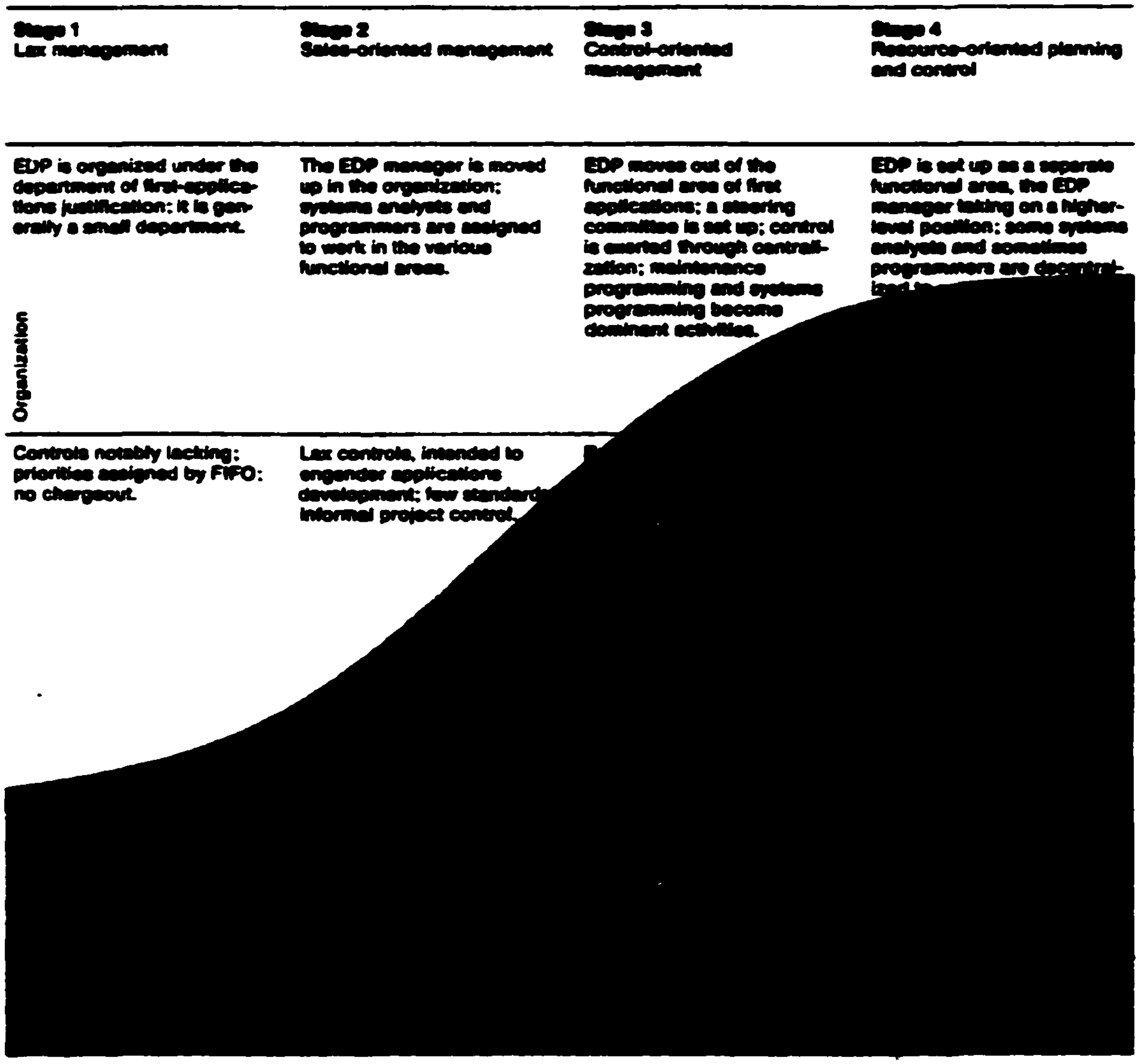


**Figure 43: Gibson and Nolan's idea of "Management techniques currently applied in each of the four stages." The shaded area represents the overall EDP budget.**[1029]

As the expansion stage continued, the company faced chaos, loss of control and decentralization in its computer operations. Systems analysts would become over confident, projects would cost far more than anticipated and the number of specialists would multiply, triggering self-reinforcing growth. Nolan acknowledged the critiques made by Dearden when he warned that in this stage "fascination with the computer and its applications as a symbol of

[1029] Gibson and Nolan, "Managing the Four Stages of EDP Growth", page 79.

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progressive management techniques or as a status symbol for a department or individual. This fascination breeds an enthusiasm not moderated by judgment." He was also critical of data processing staff and their search for professional status.

> Many of these personnel come into the company with a primarily professional orientation, rather than an understanding of or sympathy for the long-term needs of an organization. Like the EDP specialists already employed by the company, these people will be far more interested in tackling technically challenging problems that in worrying about computer payback. If they are allowed to pursue their interests at will, the projects potentially most valuable from the company's viewpoint may never be worked on.[1030]

These problems triggered the third stage, Formalization (sometimes called Control). The data processing manager would be reined in or fired, as management imposed stringent controls on the runaway department. Control would be recentralized, and the data processing staff would chafe under elaborate reporting systems, formal planning of new applications, chargeout systems and quality control measures. Nolan cautioned that harsh measures might be needed: "[t]rying to introduce needed formalization of controls with the same personnel and the same organizational structure more often than not encourages conflict and reinforcement of resistance rather than a resolution of the crisis; by refusing to fire or enforce layoffs, senior management may simply prolong the crisis..."[1031]

Although stage three represented a wholesale reversal of the uncontrolled proliferation of computerized systems associated with enthusiastic attempts at "total" system building, Nolan did not view it as a return to simple automation. Indeed, it was with the discipline and centralization introduced here that he expected the establishment of a shared data base and its use to support managerial planning. Indeed, he mentioned that the EDP department might well be renamed the MIS department during this stage, and that "the MIS manager should expect to assume a stronger role in general management councils." Thus the path of the successful data processing manager

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[1030] Ibid, page 81.
[1031] Ibid, page 84.

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lay toward a stronger managerial attitude, rather than a misguided attempt at a professional orientation.

Further rewards lay in the fourth and final stage, "Maturity." Nolan admitted that he had never observed a company arrive at this stage, but did not feel that this detracted from the empirical nature of his research! Like Karl Marx, Nolan employed the logic of historical materialism (and in fact credited Das Kapital as an intellectual justification for this method in his first presentation of the stage model, though not in the Harvard Business Review article). Each firm passed inevitably through a succession of stages, each one creating the conditions for its own replacement. In both cases, the final, utopian, stage was yet to arrive but was expected to appear shortly. In the fourth stage the department remained well managed but was able to relax somewhat. It grew closer to the needs of its users, and shifted from an orientation on individual projects to one on business processes. Most analysis work was decentralized and shifted to the control of individual departments – leaving only research and longer term work with the central group. When this plateau was reached, he predicted, the MIS manager would finally be a corporate Vice President.

## Office Automation

Throughout the 1970s, corporate computing staff paid much more attention to the potential of microelectronics in specialized office automation technology than to the pathetically underpowered hobbyist toy that was the microcomputer. As we saw, the term office automation enjoyed a brief vogue in the 1950s before largely vanishing until the early 1970s. As computer technology spread beyond the machine room and moved back into the office itself, it returned with a vengeance. Indeed, office automation, rather than the personal computer as such as such, was the highest profile and most hyped development innovation of corporate computing during the second half of the 1970s and the first few years of the 1980s. Using slogans such as "the

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office of the future" and "the paperless office," a host of computer companies from stalwarts such as IBM to upstarts like DEC and specialists like Wang served up virtually identical visions of a future in which clerical workers, professionals and managers alike performed their daily work on networks of interconnected terminals.

In its technical structures and organizational implications this was in many ways a radical departure from the world of mainframes and batch jobs, and from the abortive vision of the total MIS. But in other important ways it was a continuation of trends going back to the 1950s. Its promise was as old as the computer or scientific office management: finally we have the machines and the techniques to do for the office what we long ago did for the factory, to replace labor with capital and substitute machines and systems for inefficient routines.

The term "word-processing" suddenly entered wide usage in 1972. Unconfirmed reports suggest its origins lie in the German word Textverarbeitung or text processing, a term associated with the use of Selectric (or "golf ball") typewriters in the mid-1960s. One version of the Selectric, the MC/ST could be controlled by magnetic cards. Another, the MT/ST (Magnetic Tape/Selectric Typewriter) recorded keystrokes onto magnetic tape. Trained operators could use these typewriters to produce letters and other documents at high speed by triggering the tape to automatically retype prerecorded paragraphs. Unlike computerized systems, these typewriters did not allow interactive editing – for one thing they had no screens. Instead, editing a recorded document required the use of two MT/STs connected together. The operator needed several months of experience and had to learn many special control sequences to become fully productive.[1032]

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[1032] A good technical summary of the history of word processing is given in Daniel Eisenberg, "History of Word Processing", in Encyclopedia of Library & Information Science -- Vol. 49 (Supplement 12), ed. Allen Kent (New York: Marcel Dekker, 1992). For a more contemporary discussion see John R Hansen, "Word Processing Report", Infosystems 22, no. 10 (October 1975):29-32.

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Despite these shortcomings, the MT/ST formed the backbone of most corporate word processing centers well into the 1970s. In its earliest days, word processing was a way of organizing clerical work as much as a technology. Its advocates echoed Leffingwell and other 1920s advocates of dictating machinery when they insisted that the true benefits of the new order came through the centralization and specialization of work that the new machines would require. As Business Automation claimed in 1972, "[t]he personal relationship of bosses and secretaries will be changed though the elimination of dictation and typing as we know it today. Secretarial duties will change greatly as transcription of dictation and the production of letters and documents is shunted more and more into a central word-processing center, freeing the secretary of much present-day typing drudgery." The expense of the new hardware and the specialized skills required were used to justify this centralization of typing.[1033]

The word processing center suffered from many of the same disadvantages as the centralized dictating pool of a half-century before. In response to Business Automation's first coverage of the topic, the magazine published a letter written by a word processor operator from Evanston, Il. identified only as D.W.. She complained about her physical conditions: MC/ST machines were very noisy and the word-processor staff were left to spend their entire working day in cramped conditions looking directly at a wall. But her bigger complaints were more cultural. She was paid the lowest salary in the office and cut off from its social life, writing that, "the people in the office regard those of us who run the machines as part of the machines rather than as human beings like themselves!" The work required people who were good typists, could spell and would not become bored – a combination she found rare. "Word processing removes nearly all of the remaining rewards of secretarial work... In the last year two-thirds of the word

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[1033] Anonymous, "Word Processing-- Hardware/Software", Business Automation 19, no. 9 (September 1972):44-46, 48.

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processing personnel in my office have left." She was particular prescient in her suggestion that the new technology would trigger endless rewrites, dashing hopes for paper savings.[1034]

Advocates of word processing usually had something grander than the MC/ST in mind for the future. An Administrative Management editorial in January 1970 set the tone for the rest of the decade. "By the end of the 1970s," it suggested, "we should have climbed out of the Gutenberg rut. Paper—memos, letters and other business forms—will have been replaced to a large extent by electronic communications devices." This bold claim was based on the potential of dictating machines, calculators and microfilm, rather than any clearly articulated expectations for the use of computers in the office. However, the author did anticipate computerized word processing with the claim that, "[t]ypewriters will continue to become more automated. They will be hooked into a growing number of EDP systems."[1035]

Despite its eventual eclipse, the timesharing business gave people outside the data processing department their first real chance to work directly and interactively with computers. It was therefore the medium by computers were first applied to text processing. Given the high hourly rates charged by timesharing companies and telecommunication firms, coupled with the slow teletype machines used by most people to access them, this was not a particularly compelling application. This did not stop Administrative Management from promoting the idea in another 1970 article, when it suggested that "automated text processing" was "a recently

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[1034] D. W., "Reader Feedback: Is Boredom Necessary?" Business Automation 19, no. 11 (November 1972):8.

[1035] Anonymous, "Management and the Information Revolution", Administrative Management, January 1970, 28.

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developed office application for time sharing.... Revisions and editing are quickly and easily accomplished without having to retype the entire document."[1036]

It was the minicomputer that made word processing practical. Office automation offered minicomputer vendors an enormous new market. Unlike larger computers, minicomputers could be sold directly to small companies or to small departments within larger companies. Business Automation profiled a Boston law firm that replaced its three MT/ST typewriter based systems with a locally produced DEC PDP 8/E minicomputer in 1970. It initially continued to use Selectric typewriters (rather than video screens) as terminals, but even so the new system had several advantages. Because it was interactive it could warn when errors were made and prompt the user for input, making it much easier to learn than the MT/ST. Although typewriters were used for editing and input, output of whole documents was much faster thanks to a high speed printer. And because it used disk rather than tape to store documents and standard paragraphs, a much larger library could be maintained and accessed with greater ease. The firm latter added a second disk drive and a video terminal, allowing on-screen editing of documents. Of course, the minicomputer had the additional advantage that, as a computer, it could also run software to perform other tasks such as accounting – a potentially telling sales point to a small company still performing such tasks manually.[1037]

Law firms were among the most enthusiastic adopters of such systems. Their work centered on the regular production of long and intricate technical documents incorporating standard elements. This had to be done quickly and accurately. The expensive and novel technology of word processing could pay its way more easily here than in almost any other environment. Lawyers charged high hourly rates, and legal secretaries and paralegals were much

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[1036] Anonymous, "Time Sharing: An Update Report", Administrative Management (March 1970):20-22.

[1037] Robert A. Hendel, "Minicomputer Word Processing: A Two-year Case History", Business Automation 19, no. 8 (August 1972):35-37.

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better paid than typical office staff. For such firms word processing was what would later be called a "killer application" – a piece of software so compelling that it justified the purchase of a complete minicomputer system merely to run it. By 1982, more than two thirds of law firms had installed wordprocessing systems.[1038]

These minicomputer based systems soon faced stiff competition from the new market for video based specialized wordprocessing hardware. Dozens of firms could match a screen able to display a full page of text with floppy disc drives to store documents, a microprocessor chip, a printer, and a few handfuls of cheap, off the shelf support and memory microchips to produce proprietary systems. The word processing software was burned onto chips so that it would run instantly and automatically when the machine was turned on. Each user had a special-purpose computer to his or her self, rather than a share of a larger, general purpose computer. Among the most successful of these specialist machines were those produced by Wang Laboratories and IBM's own Displaywriter systems. Companies continued to use the expense of these machines and the new skills required to operate them to justify the establishment of large typing pools.[1039] One consultant reported having done research in an organization where "all of the typewriters were removed from the floors between a Friday and a Monday to make sure the everyone would have to use the new processing center."[1040] The results were disappointing for many companies, especially where the work involved was complex and non-routine.

By the early 1980s, the producers of minicomputers, word processing systems and even microcomputers were targeting the same strategic goal: integrating word processing systems with

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[1038] International Data Corporation, Major Vendor Strategies in the Electronic Office -- Part I (Framingham, MA: International Data Corporation, 1983).

[1039] Garson, The Electronic Sweatshop : How Computers are Transforming the Office of the Future into the Factory of the Past.

[1040] Thomas M. Lodahl, "Designing the Automated Office: Organizational Functions of Data and Text", in Emerging Office Systems, ed. James H. Blair Robert M. Landau, Jean H. Siegman (Norwood, NJ: ABLEX Publishing Corporation, 1982).

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networks and other kinds of data to knit them into more broadly based office automation systems. As of 1982, Wang had captured just over half the market for "clustered" word processing systems, and faced little competition there. But IBM, DEC and Xerox were all competing with it to set standards for office automation as a whole. DEC, for example, was selling its All-In-1 integrated office system, including email and filing capabilities as well as wordprocessing. IBM had announced a grand initiative called SNA to network together all its varieties of computer for the smooth exchange of documents and data between office computers and large mainframes. All the major players were exploring new technologies such as video scanners and hybrid documents containing text, charts and graphics.[1041] Wang, with its reliance on special-purpose machines, was widely seen as the best placed of these firms to succeed here. In 1984 a leading computer industry analyst praised the firm as the "Orient Express of Office Automation," remarked on its high R&D spending and its technological creativity and suggested that, "Wang has both management and marketing to go the distance." He forecast that by 1990 Wang would be the third largest firm in the computer industry. (By that year it was, in fact, the tenth biggest, but poised for oblivion rather than growth).[1042]

As interest in office automation shifted beyond wordprocessing and toward the construction of elaborate, networked systems able to file, process and transmit documents of all kinds it became far more important to data processing departments. The relationship of office automation to central computing departments had previously been a question more of theory than practice. As a 1983 report put it, until quite recently the, "importance of integrating data processing capability was discussed in the abstract, or in the context of relatively empty

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[1041] International Data Corporation, Major Vendor Strategies .

[1042] McClellan, The Coming Computer Industry Shakeout: Winners, Losers, and Survivors, 299-303.

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arguments about whether WP [word processing] or DP managers would become the 'information managers' of the future."[1043]

A crucial problem remained, as always, the organization arrangements under which such a task might be accomplished. Exxon, for example, had formed a joint team between its computers and systems group and its administrative services group back in 1976 as the convergence of computer technology and office work became apparent, thus avoiding the turf disputes between the two that plagued many companies. By 1980 a permanent Office Systems Technology Division employed 23 people and had the construction of a single integrated system as its explicit goal. Office automation was, in many ways, a return to the MIS dream of an all-encompassing system in which new and more efficient administrative procedures were built into a single integrated system – what the leader of Exxon's effort defined as a fully automated system "having work stations in every manager's, professional's, and secretary's office, tied together into a network via appropriate communications."[1044]

But as a central, functional group the Exxon team's practical authority over the firm's many offices was limited. This problem must have been compounded by its conviction that, "the real target for office automation was the managerial and professional worker." This justified a focus on things like shared calendar systems and project control tools. The argument that the computer could most effectively be used to improve the productivity of managerial rather than clerical workers was hardly new. But, as dictating machine promoters had discovered back in the 1920s, managers were much better placed than typists to resist the efforts of a staff group to

[1043] International Data Corporation, Major Vendor Strategies .

[1044] Robert M. Dickinson, "Can Centralized Planning for Office Automation Ever Work in a Large Corporation", in Emerging Office Systems, ed. Robert M. Landau, James H. Blair, and Jean H. Siegman (Norwood, NJ: ABLEX Publishing Corporation, 1982).

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reorganize their work habits. In addition, technology was changing fast enough to render long term planning a waste of time, despite attempts to plan for five or even ten year programs.[1045]

## The Personal Computer and End User Computing

As it turned out, the crucial technology in the distribution of computing power throughout the office was neither the special-purpose wordprocessing system nor the minicomputer, but the personal computer. This did not, however, become fully apparent until the mid-1980s, a full ten years after its debut. No historian can afford to endorse the triumphalist belief that the marketing of the first commercially successful personal computer (in the shape of the MITS Altair electronic kit) in January 1975 marked a sudden discontinuity in the practices of corporate computing. The effects of the personal computer, while ultimately very significant, were felt only slowly. By the time it became truly central to the practice of corporate computing, around 1990, the existing cultures and technologies of corporate computing had transformed the personal computer far more than they were transformed by it.

Most data processing experts of the mid-1970s had been convinced that the rate of technological change in computer hardware was finally slowing to a manageable pace. As the IBM /360 series was succeeded by the compatible /370 machines and on-line, real-time operation finally moved into the mainstream, it seemed that Nolan's promised fourth and final stage in the evolution of data processing (know either as "maturity" or as "user/service inclination") was finally attainable. Meanwhile, data base technology and the rapid expansion of the market for packaged applications focused attention on software rather than hardware.

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[1045] Ibid. The idea that, "the cost figures for secretarial services compared with management and professional services suggest, however, that it is in these areas the real benefits lie." was also expressed in Ltd. Xephon Technology Transfer, Office Automation: An IBM User Perspective (Stamford, CT: Gartner Group, 1982).

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Few anticipated the challenge posed by the personal computer. At the 1974 Rand Symposium, devoted largely to the future of programming and of the computer field in general, Dan McCracken went so far as to shock his colleagues with the announcement that, "he had brought along a computer with him," in the shape of a microprocessor chip. As McCracken pointed out, "90 percent of all processors ever made were shipped by Intel in the last two years." The luminaries (among them Glaser, Gilchrist, Hamming and Bromberg) glimpsed some of the implications of this – for example that most people who used computers in the future would probably be using something like a word processing program and might not be professional programmers. Yet they had no idea of the impact the microprocessor was about to have on the number of general-purpose, programmable computers in the world. Much of their discussion centered on a controversial report predicting that in 1985 the world would hold a total 375,000 computers (up from 70,000 in 1970), served by 640,000 programmers. They were entirely unprepared for the reality that individual computer models would sell more than a million units each by the early 1980s, or that computers would greatly outnumber full-time programmers.

Not until well into the 1980s did personal computers begin to impinge to a significant degree on the awareness of corporate computer staff and data processing managers. This failure to foresee the personal computer was not as myopic as it might appear. The importance of the integrated circuit (silicon chip) itself was widely understood. What was not understood was the implications of the microprocessor as the building block of small, general purpose computers. Even before the announcement of the Altair in 1975, chips had already found their way into computer memory units. Inexpensive microelectronics began to appear in printers, disk drives and other peripherals. Chips made it easy to put buffer memory into terminals, communication controllers and other devices – lowering the cost of video displays and increasing their flexibility. Indeed, during the early 1970s many expected the key contribution of the new technology to be the ease with which custom logic units could be fabricated – blurring the distinction between

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hardware and software and transferring many tasks then performed with software onto specially tailored circuits.[1046] Few expected that these would be used to create thousands of completely independent computer installations. Instead, corporate computing experts predicted that these technologies would provide the tools needed to finally deliver on the promise of MIS – putting terminals throughout the corporation, gathering data in every office and providing universal access to huge data bases.

The first personal computers were, after all, entirely useless. The Altair itself came in kit form, requiring weeks of skilled assembly. If and when its owner succeeded in this task, he or she was the proud owner of a box able to do little more than flash its lights in sequence. In a story told many times, a small army of electronics hobbyists embraced the new technology, and created many expansions options such as interface boards for audio tape players and video monitors. Dozens of small personal computer firms were founded, and by 1977 Apple had introduced the first mass produced personal computer. It was nicely packaged, and could be connected with ease to floppy disk drives and printers. Hundreds of thousands were soon sold.

From an administrative viewpoint, however, the Apple II initially appeared almost as useless as the Altair. Unless fitted with special modifications its screen could display only 40 characters and its keyboard could type only upper case letters – making it useless for word processing and other office automation applications. This, and a lack of the appropriate hardware and software, also denied it a possible market as an "intelligent" terminal – a low cost and flexible contender in the burgeoning market for video terminals. It had too little RAM to run any data processing job of note, and its (optional) floppy disk drives stored little more text than a

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[1046] Smith, "Projecting Tomorrow's Information Systems". Gruenberger, RAND Symposium 1974, 6. The impression that hardware and software were becoming increasingly intertwined was supported by the new technology of ROM (Read Only Memory) chips onto which programs could be burned, and the appearance of microcode programs as an additional layer between the main instruction set of a processor and its actual hardware.

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single manila folder stuffed with papers. It seemed an expensive toy to the most of the professional computer staff of the era. Videogames and amateur programming were probably the two most popular uses for the machines – and because the programming took place for the most part in the introductory language BASIC or in machine-specific assembly language, even these programming skills seemed to have little bearing on a data processing career.

The new machines found some support among scientists and engineers. This had been the main market for both timesharing services and minicomputers during the 1960s. In the early 1970s, Hewlett Packard had begun to exploit an enormous market for programmable, handheld electronic calculators among engineers. As we have seen, technical computer users had long been doing much of their own programming work, and welcomed any innovation likely to make computer time cheaper and more accessible. Their programs were less likely to be run repeatedly than those of administrative programmers, and many of them much smaller volumes of input and output data.

The personal computer made its breakthrough into the administrative world with the first spreadsheet program, VisiCalc. The spreadsheet was a powerful yet easy to use tool, allowing managers with no programming experience to set up elaborate networks of data and formulae. Any aspect of the spreadsheet could be changed at will – allowing what-if calculations, and making it possible to tweak the (hidden) equations until the model supplied the desired answer. Generic spreadsheets could be reused for different clients or situations merely by keying in new values. Although it was used by general managers, financial specialists and professionals the spreadsheet had many of the characteristics that had made so many engineering jobs well-suited to timesharing services and minicomputers. It needed only modest computational resources and involved very small volumes of data – usually entered by hand from paper. But unlike previous computer systems for modeling or financial analysis – of which there were indeed many – it exploited the interactive capabilities provided by even the most modestly equipped Apple

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computers. Financial managers were never going to learn programming, but they were prepared to enter formulae and build balance sheets. While only senior managers were able to command the time of staff assistants to run calculations manually or program them for large computers, a copy of VisiCalc and a computer to run it on could easily be squeezed from the office budget of a small group.

The spectacularly successful double act of the Apple II and VisiCalc was followed by the still more popular pairing of the IBM PC (introduced in 1981) and Lotus 123. By 1987, four years after its introduction, Lotus had sold more than three million copies of its spreadsheet software and had the highest revenues of any personal computer software firm. Journalist Steven Levy went as far as to attribute the 1980s mania for financially driven corporate acquisitions and restructuring on the new availability of convincing, inexpensive, and computer generated projections. Although the spreadsheet remained the most important single application, the new generation of personal computers was able to compete effectively in many other areas with office automation systems based on minicomputers or on dedicated hardware. Most featured screens able to display complete lines of text, challenging dedicated wordprocessing systems. Many sported hard disk drives, allowing the construction of modestly sized personal databases. With additional hardware, a personal computer could even be used to emulate a video terminal and connect to a larger computer – brining the best of both worlds. But in practice very few personal computers were networked. They held personal pools of data, cut off from the growing oceans of information held in mainframe data base systems. File sharing within the office was generally performed over "sneakernet" – a combination of floppy disks and comfortable walking shoes.

The immediate effect of the personal computer was therefore to undermine attempts to make the computer into a tool of corporate control and communication. The irony is considerable. Spreadsheets put computers on the desks of millions of managers and financial specialists. They were used on a daily basis, and underpinned an increasing tendency toward quantitative,

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financially based approaches to management. This was exactly what proponents of MIS, systems thinking and management science had been pushing for since the 1950s. The terminal on the executive's desk had been a cliché of managerially-oriented computing for decades, but on the rare occasions such a device had actually materialized it was more likely as an expensive ornament than a practical tool. Of course, spreadsheets were used largely for financial modeling – so that the personal computer ultimately reinforced the very dominance of financial and accounting techniques over other approaches to information and decision making that proponents of MIS and decision science had spent so much time attacking. This was only a symptom of a broader issue: each personal computer was an island, cut off from whatever corporate databases and modeling tools might have been developed. MIS enthusiasts had imagined a world in which decisions would be based a consistent and expertly designed set of models, erected on top of a single, constantly updated storehouse of corporate data. The systems that managers actually used were balkanized, fragmentary and homemade – rather than elevating management into the realm of objective science, the computer had ultimately been dragged down into mud of managerial politics.

Data processing managers of the early 1980s saw the sudden and uncontrolled proliferation of personal computers as the harbinger of a new dark age. The threat to centralized control of corporate data was only part of the problem. Millions of personal computers meant millions of users who, sooner or later, might demand support when they ran into difficulties. Users might entrust months of vital work to error-prone disks without a thought of backup procedures. New application development programs could be launched at any level of the firm, raising the specter of thousands of enthusiastic amateurs churning out badly written, un-maintainable application programs. Such grassroots efforts would reduce the interest of individual departments in broader programs, while pilling up future messes for the data processing department to support. Any departmental initiative rejected or placed a long way down the queue

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for implementation by the central computing group might resurface as a bonsai Frankenstein's monster running on microcomputer hardware. The very existence of powerful, user friendly software such as Lotus 123 created new pressures on data processing groups whose own efforts appeared creaky and outmoded in comparison.

The question of how best to cope with the personal computer came from nowhere during the early 1980s to occupy a central place in the discussion of corporate computing managers. By 1985, market research firm IDC could report that when it came to selecting permissible personal computer hardware models "the word of the MIS department [by this point the accepted euphemism for the corporate computing department] is law in many cases. In IDC's potential client base, the role of MIS acceptance for personal computer purchase is critical. Corporate purchasing does play a significant role, however, in many cases the role of corporate purchasing is merely to determine terms, conditions and delivery dates, rather than what brand or model is chosen." 42 percent of computer users polled at large firms named the MIS department as the driving force behind computer purchasing, 29 percent said the matter was left to the department concerned. Only 2.8 percent allowed the individual who would be using the computer to decide.[1047]

The same report found that large firms valued hardware compatibility over all other factors – they "have already found their software; now they need more systems to run it on." That gave enormous support to IBM, a firm with which corporate computer staff felt comfortable dealing. The survey found that Apple's share of the personal computers used in large corporations had dwindled from 27 percent in 1984 to 8 percent 1985 -- a quite spectacular disintegration of its once commanding position. This shift was driven more by the availability of software and the

[1047] International Data Corporation, Microcomputer Buying Patterns in Corporate America: Small, Medium, and Large Computers Hardware and Peripheral Analysis (Framingham, MA: International Data Corporation, 1985).

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power of the IBM brand than by any immediate plan to connect the computers to corporate networks – communications was cited as the deciding factor by just 5 percent of the companies. Neither modems nor networks were yet widespread among personal computer users.

A 1984 survey performed by MIT researchers painted a less orderly picture when it examined the use made of personal computers by a selection of non-computer specialists, most of them in staff management jobs. It found that most relied on their own efforts to learn about computing, rather than expecting support from specialist computer staff. The researchers examined ten companies, and found that, "[c]ontrary to what users would prefer, strategy formulation for personal computers in most firms is rather isolated from strategy formulation for other end user computing (time-sharing) and office automation. This is true mainly because responsibility for these areas has been assigned to difficult groups within the information systems organizations." Most users seemed to have been able to chose their own computers, and they gave access to spreadsheet software as the leading reason for the decision to purchase. (The third most important, after cost, was "freedom"). Although most were developing spreadsheets with their personal computers, few were using conventional programming languages such as BASIC.[1048]

Winning the right to set official purchasing policy for personal computer hardware and software came relatively easily to corporate computing managers. Producing and enforcing any kind of coherent plan for using the machines proved more difficult. One popular idea was enshrined in the new concept of "departmental computing." It rearranged some of the ideas previously tied to office automation, distributed computing and MIS into an attractive but schematic idea of how personal computers, mainframes and minicomputers could all complement each other. Personal computers on the desktops of individual users would connect directly to

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[1048] Judith A. Quillard and John F. Rockart, "Looking at Micro Users", in The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology, ed. John F. Rockart and Christine V. Bullen (Homewood, Illinois: Dow Jones-Irwin, 1986). Reprinted from Computerworld OA 18, no 33A (August 15th, 1984).

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larger departmental information systems running on minicomputers. The minicomputer was supposed to supply shared files and peripherals to the personal computers, act as a communications gateway and run applications programs. Minicomputers, in turn, would interconnect with corporate level mainframes, so that, "[c]ommunications ties between each tier act as a unifying force, bringing together an information system that extends throughout an entire organization." The idea was particularly attractive to minicomputer producers such as DEC, whose ability to sell minicomputers for more straightforward office automation jobs such as word processing was being destroyed by rapid strides in personal computer technology. An increased emphasis on communications would play to their strengths, and also reinforce the importance of existing corporate computing staff.

This idea spread rapidly, though it failed to save the minicomputer firms. Renamed "client-server" computing, it was the driving force behind most corporate computing efforts during the late-1980s and early 1990s. Wonderful as this sounded in theory, it was slow to materialize in practice. A 1986 IDC report suggested that computing managers faced considerable problems in imposing their ideas.

> The MIS executives we contacted are well aware of the uncontrolled state of their information systems and the problems they face in brining about a 'unified architecture' throughout their organizations. An often cited concern was that of politically balancing the growing demands of departmental users with the constraints of shrinking budgets. Other important management problems include controlling the spread of personal computers, determining who should be responsible for managing departmental systems, and getting renegade departments to adhere to established standards. Overriding these concerns is the clear need to halt the sacrifice of long-range planning in favor of meeting short-term objectives.[1049]

The same report found that applications for this new framework lagged some way behind the spread of suitable technology. 82 percent of the sixty-eight large firms and federal agencies investigated claimed some "departmental processors" (networked minicomputers), 73 percent had

[1049] Frederick M Haney, "The Architecture of Software", Data Base 5, no. 1 (Fall 1973):5-10.

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installed a local area network, 73 percent had connected at least one minicomputer to a mainframe and 71 percent had hooked at least one personal computer up to a minicomputer. So far, so good. But when asked what they were doing with these new links, their answers were less than impressive. Word processing remained the only application commonly executed on a minicomputer and accessed by a personal computer – though this held few advantages over running the word processing program directly on the personal computer. Only one of the groups mentioned using their minicomputer as a file server, a task complicated by the lack of standard software to facilitate this. Though 44 percent claimed to have an "integrated office system," further questions revealed that most had only two or three personal computers connected to it, and were using it for evaluation purposes. With one exception, "no one expressed an intent to implement integrated office systems on a strategic basis."[1050]

"End user computing" was another idea that came to the fore with the spread of the personal computer. Only during the early 1970s did the idea of the "user" (sometimes called the "ultimate user") appear in discussion of corporate computing. The discovery of the user followed the experimental use of video screens and other interactive technologies in administrative and managerial applications. Computer systems had previously had customers or consumers – the managers who received regular printed reports from them. They also had programmers, who designed and configured application programs, and operators – the women who punched data onto cards and the men who tended to the computer itself. With an interactive MIS or Executive Information System, a manager might be both the consumer of the data and, via a terminal, an operator of at least part of the computer. Rockart and others at MIT's Sloan School who had been studying managerial use of interactive computer systems were quick to transfer their attention to the personal computer.

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[1050] Ibid.

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The personal computer took this much further – a managerial or professional worker now assumed responsibility for operating his or her own computer, and by using standard spreadsheet and database software might even be perform simple programming jobs. End user computing was therefore much discussed, though like every other big idea in corporate computing it was rather difficult to define. At a 1986 meeting of corporate computing experts devoted to end user computing, participants found themselves unable to agree what the idea might or might not encompass. James Kinney, Director of Information Management at General Foods, held an expansive view: "[s]ince end-user computing is the implementation of information technologies in any form for business professionals, office automation, microcomputing, and timesharing should be considered end-user computing." Others were more restrictive, suggesting that only "creative" (rather than routine) use of computers counted, or only a project "user-developed and initiated independent of other systems, and primarily used by one person rather than a group." One suggested that, "[e]nd-user computing is training, educating, and supporting professionals who have not been previously involved with computers." It was thus unclear whether end-user computing could only refer to projects run by users themselves, or if one could try to proceed with a traditional centrally mandated MIS or office automation program and simply call it end user computing to get it funded.[1051]

Most of those promoting the end user computing concept stressed the latter version. According to William H. Imon, author of the 1986 book <u>Managing End User Computing in Information Organizations</u>, "putting user's destiny into their own hands has the promise of solving many of the age old problems in the data processing/end user relationship." He saw the use of "fourth generation languages" or 4GLs as the central tool in end-user computing. This term was then common to tools such as spreadsheets and database query systems that made

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[1051] Anita Micossi, "MIS Executives Ponder the End-User Question", <u>Computer Decisions</u>, December 16 1986.

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programming easy and rapid for non-specialists because they were closely tailored to particular kinds of task. Its use faded rapidly; perhaps because most people working with spreadsheets did not think of themselves as programming, perhaps because use of menus and graphical interfaces diminished the amount of "language" involved, and perhaps because artificially intelligent "expert systems" were both the most heavily promoted form of 4GL and the biggest flop of the era.[1052]

Citing Nolan's stage model (in its six stage, 1979 variant), Imon warned that the arrival of end-user computing had thrown firms into another unanticipated cycle of initiation and contagion. Instead of reaching maturity in the land of the database, companies were instead facing another period of exponential growth in their computer spending. Despite this, Imon welcomed the accountability this would ultimately bring and did not seem to doubt that the plateau of "maturity" would ultimately be reached. If departments managed and paid for their own system development projects, they would soon evolve cost control systems and learn to make effective use of iterative development techniques, improving an application until results were good enough to satisfy them.

Imon surveyed end user computing from the viewpoint of senior management, and suggested that it would prove beneficialin the long term despite the immediate chaos in might produce. Others looked at the technology from a more personal level, and seized on it as a force for empowerment and liberation. One of the strongest statements of this view came in a rather unusual 1988 book The Information Jungle, written by two academics specializing in decision science, management and computer science. The book revived the once-popular genre of instructional and inspirational business fiction. Its everyman hero, a sales manager, had achieved

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[1052] The problems faced by researchers in trying to commercialize expert system technology are discussed in Alex Roland and Philip Shiman, Strategic Computing: DARPA and the Quest for Machine Intelligence (Cambridge, MA: MIT Press, 2002), 184-214.

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enormous personal success through his mastery of a microcomputer. During the course of the book, he instructed his less fortunate colleagues (and by extension the readers) in hardware, software, spreadsheets, databases, and in more esoteric subjects such as decision support and expert systems. By the end of the book, his colleagues were computer experts and he had won the love of a good woman through a series of double entendres he delivered along with his personal instruction. At no point, however, did the authors imply that any of this computerized data would be pooled or networked. Instead, each person was to set up their own little computerized universe. The hero received no assistance of any kind from specialist computer staff, and the authors did not appear to expect that their readers might be subject to corporate standards or be able to draw on expert staff to set up or support their systems.[1053]

Yet in the real world, this libertarian idea of self-sufficient yeoman users struck most corporate computer staff as neither realistic nor desirable. Their challenge was to defend the long-held dream of total information systems that spanned and united mighty corporations against those who believed that end-user computing was turning data processing departments and their mainframes into expensive curiosities. The solution was, by the late 1980s, generally viewed as the creation of a new approach to corporate computing. A new kind of computing department, usually known as the "Information Systems" or IS Department would be headed by a new kind of computer executive, the CIO or Chief Information Officer. The origin and fate of the CIO is the topic of the next chapter.

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[1053] Clyde W. Holsapple and Andre B. Whinston, The Information Jungle: A Quasi-Novel Approach to Managing Corporate Knowledge (Homewood, IL: Dow Jones-Irwin, 1988).

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## 14. THE CHIEF INFORMATION OFFICER IN THEORY AND PRACTICE

By the mid-1980s, the data processing department was in trouble. Personal computers, office automation and end-user computing began to sweep away its traditional monopoly on administrative computing. Distributed computing and office networks seemed to offer exciting opportunities for new kinds of corporate applications, but it was by no means clear that traditional data processing approaches were well-equipped to exploit them – struggling as they were under the weight of mounting volumes of applications to implement, a never-ending battle to maintain existing applications, and an often strained relationships with their users.cBut to a growing number of vocal commentators the rapid spread of personal computers and departmentally controlled minicomputer servers started to look more like an opportunity than a threat for the computer department; an opportunity to free itself from the constant operational pressures of "fire-fighting" and the crushing weight of user expectations.

The idea was simple: centralized computer departments would stop trying to provide all computing services to all users. Instead, they would set overall standards for hardware and software while leaving decisions on individual systems in the hands of divisions and departments. This required a new kind of computer department, headed by a new kind of computer manager. The manager of data processing, or vice president of MIS, was to be reborn as the Chief Information Officer. The CIO was intended to be a kind of hybrid: the head and torso of a strategically nimble and forward-looking business executive joined to the powerful lower body of a computer expert. Just as the Chief Financial Officer was responsible for every aspect of the corporation's relationship to money (from structuring financial strategies to overseeing accounting systems), so the Chief Information Officer would be responsible for every aspect of the corporation's relationship with information. As well as overseeing the operation of centralized

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computer centers, this meant husbanding information itself, setting information technology standards, identifying strategic opportunities for the application of information technology and educating other top managers to see information as a resource.

The new name for the department over which he (or occasionally she) presided was at first proposed as the "information resource management department" but was in practice more likely to be known as an "information systems" or "information technology" department. This shift symbolized a new focus on information rather than machinery. The crucial systems administered directly by central computer departments were identified as the databases and networks through which the information vital to the corporation as a whole would flow. This updated Nolan's concept of the "data resource function" for the widely heralded Information Age. This conception of information as a resource represented a decisive moment in the construction of a new conception of information, quite different from anything present in business thought before the creation of the computer.

From the very start, the CIO movement was controversial and its achievements questionable. The blending of business and technology, in the person of a hybrid executive, proved a hard thing to pull off, putting as it did so much weight on the ability of individual ability to transcend deep structural and cultural divides. CIOs struggled to gain the respect of other executives, and have rarely achieved the broad responsibilities they hoped for. They changed jobs more frequently than other top managers, and they earned less money. Few CIOs have gone on to lead major companies. Probably none has ever truly established an authority over information equal to that a chief financial officer enjoys over finance. Yet, viewed in most other ways, the CIO movement has been an enormous success. By the end of the 1990s almost every large corporation had created a CIO. Computer budgets continued to rise, and computer managers continued to ascend the organization chart. Today, corporate computer departments almost

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always include the word information, as do the job titles of many of the more junior and senior computer people working within them.

## The Information Executive for the Information Age

Just like the late 1950s/early 1960s, the late 1970s/early 1980s saw a remarkable surge in the creation and adoption of new business-related information concepts. The earlier wave had seen the coinage of information systems, information processing, information retrieval, information science, data base, and information technology and the origination and broad diffusion of the management information system concept. The later wave saw the coinage of the chief information officer, the information age, and the information society. In addition, the formerly esoteric terms information technology and information systems were for the first time widely used in the general business press.

The re-designation of the most senior administrative computing manager as the Chief Information Officer took advantage of this new vogue for information. When they coined the term information technology back in 1958, Leavitt and Whisler had used it to denote the combination of computers, operations research methods and mathematical simulation.[1054] Its authors believed these were poised to revolutionize management and reshape organizations. Though the article was quite influential among researchers, the term lapsed into obscurity as it became apparent that no managerial revolution was underway. In the 1980s, however, it was revived with a different meaning: the union of computers and communication technologies. Neither The Economist nor Business Week, nor U.S. News and World Report printed the term "information technology" once in any story published in 1977. This did not reflect a lack of interest in business computing, since they included reference to "data processing" in seventy-

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[1054] Leavitt and Whisler, "Management in the 1980s".

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three stories. By contrast, in 1983 the same three publications included the now-fashionable term information technology in a total of fifty different articles. [1055]

A similar upsurge took place in their use of the terms "information revolution" and "information society." The idea of an "information age" and the association of computers with information had finally become a staple of general discussion. As Victor Millar, an Arthur Andersen consultant, put it in a 1983 article extolling the virtues of the Chief Information Officer, "[t]he focus on the information age has caused some senior executives to realize that information is a competitive tool..."[1056]

Within the computer industry, the word information was being applied ever more widely. As computer departments grew ever larger, and gradually ascended corporate organization charts, they were often renamed as Management Information Systems divisions rather than Data Processing departments. This nominal upgrade did not always reflect the kind of fundamental shift called for by those who believed in MIS as a fundamentally new approach to management. It did, however, mirror an increasing sense that data processing was old fashioned and that information was futuristic. In 1972, the leading computer magazine for corporate managers changed its name from Business Automation to Infosystems. In 1973, the Data Processing Management Association renamed its annual conference "Info/Expo" and gave it the theme "Stay on Top of Tomorrow."[1057]

The eagerness of the general business press to apply terms like information processing and information technology to computers reflected the heavily promoted idea that the computer

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[1055] These counts are all based on searches of the full text of these publications, as accessible through the Lexis-Nexis data base during January 2003. Only in the late 1980s did use of the term data processing really begin to trail off – for most of the decade it coexisted with information technology. IT seemed more popular in Europe, and with intellectuals and politicians.

[1056] John Rymer, "Executives to Unlock Technology's Promise", Computer Decisions, 15 September 1983.

[1057] Anonymous, "INFO/EXPO: June 23-26", Data Management 11, no. 12 (December 1973):38-39.

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industry and the communications industry had become two aspects of the same thing. This idea was not new, even then. In 1964, a famous article in The Atlantic Monthly had proposed the construction of enormous "information utilities," in which millions of terminals spread across homes and office were hooked into a handful of huge, centralized time-sharing computers (on the model of the telephone and power utilities). Proposed applications included catalog shopping from home, on-line editing, classroom instruction and the sale of specialized data.[1058] The association of information with on-line computer systems was further strengthened in 1968, when the Information Industry Association was founded to bring together companies interested in establishing on-line data base services.[1059]

Although computer terminal use and on-line publishing both developed more slowly than expected, by the late 1970s the expected proliferation of home data terminals, creeping deregulation of the telecommunications industry, and arrival of cable television finally seemed to mark the convergence of the two industries as a conceit whose time had come. In 1979 Business Week decided to group its coverage of telecommunications, personal computing, hardware and software together as subsections in a new "Information Processing" department. While it had printed this term only once in 1977, by 1984 it appeared above no less than 415 different articles.[1060] By that point, firms as diverse, and respectable, as Fidelity Investment, the New York Times, Knight-Ridder Newspapers, McGraw-Hill and Chemical Bank had each lost millions of dollars, invested to build new systems on the assumption that millions of Americans were ready

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[1058] Greenberger, "The Computers of Tomorrow".

[1059] Information here seemed to have crossed-over from library science and scientific publishing, as the association's name was chosen by Eugene Garfield, who had built up a successful business publishing indexes and abstracts from his Institute for Scientific Information. (Garfield recalls it having been created because of the exclusion of commercial firms from the National Federation of Abstracting and Information Services).Robert V Williams, Transcript of Interview Conducted by Robert V Williams (Chemical Heritage Foundation, 1997 [cited January 13 2003]); available from www.chemheritage.org/HistoricalServices/eminentchemists/Garfield/Garfield2ALL.pdf.

[1060] Like the earlier counts, this figure comes from searches of the full text of Business Week, as accessible through the Lexis-Nexis data base during January 2003.

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to trade stocks, read the newspaper, shop, send electronic mail, and do their banking with the aid of personal computers or specially constructed "viewdata" terminals.[1061]

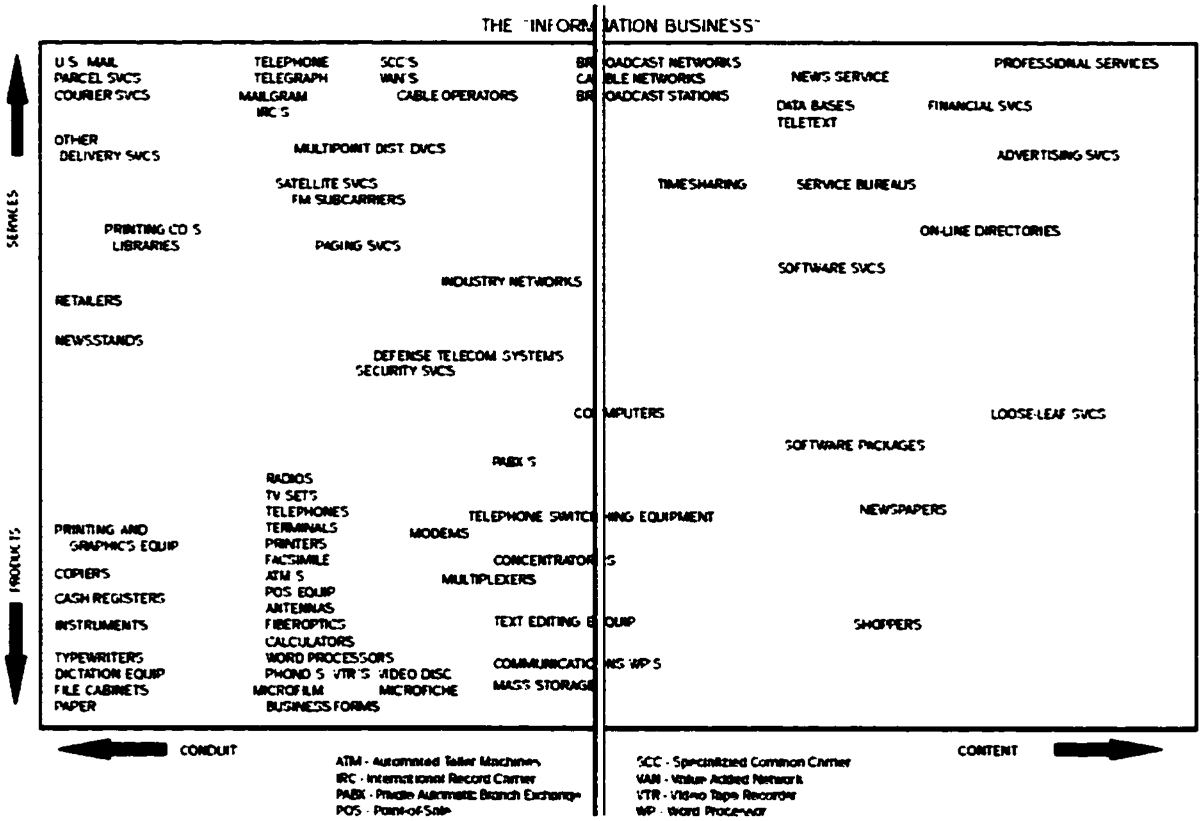


**Figure 44: An unusually broad vision of the "Information Business." Note the central position of the computer.**[1062]

Broad definitions of the "information business", such as the one shown above, served rhetorically to bundle an enormous variety of important products and businesses into a single new sector. The people promoting these definitions were usually either consultants or business authors claiming special expertise in this new field, or companies (such as Xerox, AT&T and Digital

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[1061] Anonymous, "Electronic Publishing Moves off the Drawing Boards", Business Week (August 8 1983).

[1062] This chart is reproduced from Freeman and Aspray, The Supply of Information Technology Workers in the United States, 26-27. The original source is given there as "John McLaughlin and Anne Birinyi, 'Information Business,' Harvard College, 1980."

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Equipment Corporation) seeking to persuade customers and investors that actual field of business was information rather than a narrower and less exciting field such as copiers or telephones.

Just as the first surge of interest in information coincided with the initial spread of computers into large corporations, the second took place as the new technology of microprocessors and silicon chips brought computers into the homes, offices and classrooms of millions of Americans. Managers were well primed for the idea that widespread use of computer technology was imminent, and would trigger some kind of fundamental upheaval. Anyone reading the business magazines or newspapers of the early 1980s was exposed to an endless stream of articles celebrating the success of the personal computer and electronics industries. Silicon chips played a starring role in a host of new consumer technologies, including video arcade games and Atari home consoles, electronic toys, digital watches, cheap music synthesizers and pocket calculators. By early 1980s, firms like Commodore, Texas Instruments, Apple and Atari were darlings of the business press and favorites of investors. Competition drove down prices at an astounding rate. To sell one and a half million of its ill-fated 99/4A home computer, Texas Instruments was forced to lower its price from $950 in 1980 to $99 in early 1983.[1063]

Readers did not have to look far to learn about the Microelectronic Revolution, the Information Technology Revolution, the Information Society, the Computer Revolution, the Post-Industrial Society and the Leisure Society.[1064] One popular book, <u>The Micro Millennium</u> by

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[1063] Anonymous, "The Price TI is Paying for Misreading a Market", <u>Business Week</u>, September 19 1983. As with the recent Internet bubble, which in may ways it resembled, hundreds of firms rushed to enter this exciting new market, excited by forecasts of growth which turned out to be fantasy. Texas Instruments, for example, had increased production on the assumption that it could sell 3.5 million computers in 1983 alone.

[1064] The post-industrial society, the most academically respectable of these ideas, was proposed in Bell, <u>The Coming of Post-Industrial Society: A Venture in Social Forecasting</u>. The phrase information society seems to have shown up a little later, and may have entered English language discourse via "Plan for the Information Society", a futuristic and utopian vision produced by a Japanese group in 1972. See Joneji Masuda, <u>The Information Society as Post-Industrial Society</u> (Tokyo: Institute for the Information

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Christopher Evans, was published in 1979 and promoted with a quote from Playboy that it "could well be the most important book of the next two decades."[1065] Evans presented his vision as the inevitable outcomes of the exponential growth in power of inexpensive computer technologies.[1066] He predicted that during the 1980s the computer would end the monopoly of established professional groups over information, and so destroy the power of doctors and lawyers. Thanks to the impending arrival of artificial intelligence, by the end of the century the human race would focus its efforts mainly on leisure and learning, working perhaps twenty hours a week for fifteen years during a lifetime.[1067]

The Third Wave, probably the most influential of these books, was written by a former Fortune editor, Alvin Toffler. Toffler, who had established himself as a mainstay of the futurology business with his earlier Future Shock, argued that the economic and political instabilities of the late 1970s, were symptoms of the death of one civilization and the birth of a new one. Within a few decades, the titular wave would "sweep across history and complete itself in a few decades... Tearing our families apart, rocking our economy, paralyzing our political systems, shattering our values." His star exhibit was computer-based communication technology.

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Society, 1981). The titles readers on the topic produced by Tom Forester give a nice example of changing rhetoric, from Tom Forester, The Microelectronics revolution : the complete guide to the new technology and its impact on society (Oxford, Eng.: B. Blackwell, 1980) to Tom Forester, The Information technology revolution (Cambridge, Mass.: MIT Press, 1985). An excellent critique of the information utopianism of the 1980s is given in Langdon Winner, "Mythinformation in the High-tech Era", in Computers in the Human Context, ed. Tom Forester (Cambridge, MA: MIT Press, 1991). Theodore Roszak, The Cult of Information: The Folklore of Computers and the True Art of Thinking (New York: Pantheon Books, 1986) is concerned with computers in general, but makes some relevant points. Webster, Theories of the Information Society gives an insightful summary of the relationship of major social theorists to post-industrial society.

[1065] Evans, The Micro Millennium.

[1066] Evans anticipated much writing of the late 1990s in which Moore's law, usually expressed as a rapid doubling in the performance/price ratio of microprocessors, was used to justify all kinds of predictions about the growth of Internet-related businesses. Although Moore made the observation to which his "law" is attributed back in the 1950s, it reached general awareness much later.

[1067] Evans was a little too wild for the business press. Business Week suggested that, though "highly readable and imaginative" the book had strayed "into wishful thinking that borders on science fiction." It did, however, review it. Margaret L Coffey, "Do We Want Machines That Can Outthink Us? Review of 'The Micro Millennium' by Christopher Evans" Business Week, April 21 1980

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The widespread use of home terminals would move most work out of offices and into the "telecottage." "Virtual organizations" would react flexibly to the unprecedented rate of change in a world of electronic information. Athenian democracy would be reborn when electronic referenda replaced representative democracy.[1068] Similar claims were made by John Nasbitt in Megatrends, the other major commercial success for futurology in this period. Nasbitt processed his vision of the future into ten easy to digest trends. "None," he suggested, "is more subtle, yet more explosive… than this first, the megashift from an industrial to an information society." In this society, "we have systematized the production of knowledge and amplified our brainpower." Information, he suggested, had replaced capital as the most important "strategic resource" of business.[1069]

Such thinking was fuelled by the enthusiastic reporting of the business press, and in turn these ideas fed back into business, through executive seminars, best-selling books, newspaper reports and profiles in publications like Business Week and Fortune. By the early 1980s, therefore, even business people and senior managers with no particular interest in these topics would have been well aware that computer technology was developing rapidly, that its consequences for business and society were expected to be profound, and that all of this had a lot to do with information. This was fertile ground in which to promote the computer as an information panacea.

The phrase "Chief Information Officer" was defined and promoted by William R. Synnott, who was at that time head of the Information Systems and Services division of the First National Bank of Boston. Its first documented use in print was in a Computerworld report on

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[1068] Otis Port, "Riding in on a Wave: A Welcome New Age. Review of 'The Third Wave' by Alvin Toffler", Business Week, March 31 1980. Business Week praised his accomplishment, saying that "in integrating the developments in communications, energy, manufacturing, biotechnology, and other fields to create a comprehensive vision of a world to come, Toffler succeeds brilliantly."

[1069] John Nasbitt, Megatrends: Ten New Directions Transforming Our Lives (New York: Warner Books, 1982).

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Synnott's address to the INFO'80 trade conference in 1980, and the first detailed description of the CIO was provided in a book entitled Information Resource Management written by Synnott with consultant William H. Gruber the next year.[1070] The main argument of the book was that the computer must be applied to management rather than clerical operations, and that this demanded a new kind of computer department. Upgrading Nolan's ugly sounding conception of the computer department as a "Data Resource Function," they called this the "Information Resource Management function."[1071] This department was to be headed by the CIO, defined as a "[s]enior executive responsible for establishing corporate information policy, standards, and management control over all corporate information resources." They admitted that no such figure currently existed in any major corporation, saying that the "CIO role does not yet exist except in the minds of imaginative leaders today. It remains to be created by information managers committed to harvesting the management of information as a resource in the years ahead."[1072]

This concept of information as a resource to be managed was at the heart of the book. As its introduction stated "[a] quiet revolution is occurring in the data processing industry. The computer era of the 1960s and 1970s is giving way to the information era of the 1980s."[1073] "What needs to be sold," they claimed, "is the fact that information is a valuable corporate resource that must be managed as a total entity" by a CIO "in order to exert a broad corporate

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[1070] William R. Synnott and William H Gruber, Information Resource Management: Opportunities and Strategies for the 1980s (New York: John Wiley & Sons, 1981). An excellent review of the early CIO literature and the origins of the concept is included in James I Penrod, Michael G Dolence, and Judith V Douglas, The Chief Information Office in Higher Education (Boulder, Colorado: CAUSE: The Association for the Management of Information Technology in Higher Education, 1990).

[1071] The book does not hide its indebtedness to earlier ideas, particularly Nolan's stage model and concept of "data resource management," and Rockart's discussion of managerial computing. Both men were quoted extensively in the book, and each supplied a glowing testimonial for its back cover. Indeed, Synnott had previously employed Rockart as a consultant to apply his idea of critical success factors to the introduction of an MIS system at the bank.

[1072] Synnott and Gruber, Information Resource Management: Opportunities and Strategies for the 1980s, 66.

[1073] Ibid, 3..

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perspective and a leadership role in bringing together and managing information as a corporate resource."[1074] This reflected a subtle yet extremely important shift in the meaning given to information. Whereas management information systems were originally conceived as systems to inform management, Synott and Gruber's formulation reflected the newer idea that information was a discrete quantity existing quite apart from any specific act of communication. (In other words, the same thing Nolan and others had meant by data). The job of the new department was not to inform management, but to manage information.

Information was now seen as something (like money) which could be accumulated, pooled, and husbanded. Synnott and Gruber themselves stressed the analogy, saying that"[t]he CIO concept should not be very hard to sell. Top management certainly understands the role of the chief executive officer (CEO) and the chief financial officer (CFO). Why not a chief information officer?" As a relatively new arrival in the corporate ranks, the CFO was a particularly tempting target for emulation.[1075]At the end of the book, they suggested that CIOs might be as well placed to rise to the CEO position during the 1980s as financial managers had been in the 1970s.

They saw the new mantle of information as a powerful claim to broader organizational power, writing that "'Data Processing' is a limiting title! For example, the issuance of corporate responsibility can be a responsibility of the IM [Information Management] function. This is logical, because the issuance of corporate policy and instructions is, in fact, an information service. On the other hand, it would make no sense to say 'Corporate policies will be issued by

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[1074] Ibid, 66.

[1075] By the 1960s, the overall responsibility for the duties of controllers (more accounting and administrative) and treasurers (more oriented towards finance) was increasingly combined in the person of the Chief Financial Officer (CFO). During the final decades of the century, the CFO emerged in many large corporations as one of the most senior members of the managerial team, as the "bean-counting" aspects of accounting were increasingly subsumed by a recognition of the vital role of financial skill in running companies, keeping investors satisfied and producing the financial results required.

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the data processing division'." "Data processing," they continued, "connotes a technical limitation....." It was, he reiterated, "important that the right identification be established" before proceeding to consolidate control over corporate information.[1076]

Synnott and Gruber's manifesto was at ambitious data processing managers more than at the general or financial managers to whom they were subordinated, and so emphasized self improvement. They claimed that, "Information managers will need a solid understanding of both business and technology in the future.... they will need to rid themselves of their technical image—not their technical expertise, only the aura of mysticism associated with the DP managers of the past." Each "must make every effort to demonstrate his or her management role, not only to avoid being stereotyped, but to avoid being overlooked when a promotion opportunity occurs for a top executive general manager."[1077]

Beyond this shift in rhetoric, their contribution was more one of synthesis and salesmanship than original thought, but he packaged the results skillful and illustrated them with stories from his own experience. As well as the their acknowledged debts to Nolan and Rockart, the job and powers ascribed to the CIO were strikingly similar to these originally envisioned for the VP of MIS twenty years earlier. "What needs to be sold is... the fact that information is a valuable corporate resource that must be managed as a total entity" by a CIO "in order to exert a broad corporate perspective and a leadership role in brining together and managing information as a corporate resource. The job of the information manager is to educate senior management as to what can be done to make more effective use of information resources through the development of technological deliver systems to bring needed information quickly to those who need it, when they need it, and in the form they need it." Both the management of information as

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[1076] Synnott and Gruber, Information Resource Management: Opportunities and Strategies for the 1980s, 34-35.

[1077] Ibid, 49.

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a "total" entity and the trinity of the right information, time and people had figured in every overblown definition of MIS produced in the early 1960s. Likewise, data processing managers had been attempting to "educate" senior managers since the 1950s, though the results had been disappointing.[1078]

MIS, however, had put the stress on the "system" part. While the "systems approach" was enormously powerful during the late 1950s and 1960s, its credibility had largely withered by the 1980s. Closer to home, MIS was tagged with the twin taints of failure to deliver on its original bold promises and of its widespread use as a new name for the existing data processing department. Both "Information Management" and the "Chief Information Office," in contrast, downplayed systems in favor of information itself.

## The Spread of the CIO Concept

Despite the enormous ultimate success of the CIO (as a job title at least), it spread slowly at first. Although Synnott's ideas received some attention on their initial presentation in 1981, the CIO term remained quite rare, even in the discussions of groups devoted to the management of computers, until the mid-1980s. From about 1986 the title moved rapidly into general usage – a vogue both reflected in and assisted by the launch of the glossy CIO Magazine in 1987. Just as Ms. Magazine raised the consciousness and shaped the dreams of a generation of women, so CIO Magazine pushed an activist and executive vision of computer specialists as powerful managers while reflecting both the vanities and insecurities of its audience. In every issue, readers received admonition as well as affirmation.

The main idea to be picked up from Synnott's formulation was that the CIO should think as a corporate leader first and a technician second or not at all. This was, according to its boosters, an entirely new idea. One of the earliest articles to publicize the CIO concept, a 1983

[1078] Ibid, 67.

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piece published in a corporate computing magazine, was titled "Executives to Unlock Technology's Promise." Its author, John Rymer, opened with an imaginary advertisement: "Wanted: Chief information Officer. Prerequisites: general management experience and ability to implement the latest in information technologies. Technicians need not apply." He went on to suggest that such figures "are beginning to take their places among the most senior executives of major corporations. Their rise coincides with the recognition of information as a powerful competitive resource." Just in case there was any doubt left in the reader's mind, he continued, "[u]nlike their predecessors--the chief data-processing operating officers--CIOs are business managers first." The point was hammered home with quote after quote from corporate computing managers eager to boost their own status, who insisted that the management of information was truly an executive rather than a technical concern. Their new job was setting strategy, creativity, managing people and "teaching everyone, even the CEO, how to use these weapons."[1079]

According to Rymer, the CIO position had thus far been created in only a few corporations. He admitted that, "The rise of the CIO is more of a forecast than a trend," but insisted that the concept was winning acceptance in sectors such as financial services, airline travel and insurance companies. In these areas, information was a "life-or-death" issue. However, he also implied that technological change would insure that this trickle became a major trend. Until the 1960s, he claimed, the controller had been the default CIO – because all information systems had been financially oriented. The profusion of computer systems, and the more recent spread of inexpensive computers and data bases, had eroded this monopoly, bringing corporations to the edge of chaos. "No one had replaced the controller as chief information officer," said an

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[1079] Rymer, "Executives to Unlock Technology's Promise". The idea of "information as a strategic tool" was reported in Anonymous, "Business is Turning Data into a Potent Strategic Weapon" <u>Business Week</u>, August 22 1983.

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Arthur Andersen consultant Rymer interviewed. "Nobody is responsible for information--everyone has a piece of it..."[1080]

The power of the CIO concept also stemmed from its reinterpretation of the old dream of a single, powerful executive in charge of administrative systems (a dream which can be traced back to the office management movement of the 1910s) in the newly emerging world of data bases, office automation and end user computing. "Above all," Synnott and Gruber wrote, "the information manager of the future must be an effective integrator...." They suggested that the traditional hold of data processing managers over centralized computing facilities was fast being eroded, but that those who could make the transition to information management would hold more influence and prestige than ever before, though their power would increasingly be shared with users. The roles he listed for the information manager included planner, change agent, information manager, proactive (sic), businessman, politician, integrator, information controller, strategist, staff professional, manager, and futurist. He or she would work alongside executives, educating them on the power of information technology and collaborating on exciting projects. Synnott called on information managers to work more like consultants – selling their services, surveying user satisfaction and agreeing service levels with users and then monitoring the results rigorously. He suggested more subtle strategies, such as the gift of small projects as "Trojan horses" to win the collaboration of recalcitrant departments.

Synnott advocated a new balance between centralization and decentralization – arguing that, while processing power might now be spread out across departments, it remained essential to retain centralized managerial control over information. Thus, while CIOs could no longer hope to exercise direct control over every computer, or even every departmental level application system, authority over information would give greater respect from fellow managers and a powerful

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[1080] Rymer, "Executives to Unlock Technology's Promise".

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justification for the control of key networks and databases. As he saw it, "To give up central management control is to move not to distributed processing but to distributed incompetence."[1081] While minicomputers were now cheap, they were just as complex and hard to manage as the mainframes of the 1970s, and as a result "[p]utting this power and sophistication in the hands of inexperienced users, unless they are carefully managed and controlled, can lead to higher costs, loss of control, and chaos."[1082] However, he also advised against attempts to use office automation to centralize control over clerical work or to impose organizational shifts. He saw the solution in a blend of centralization and decentralization – what he called "centralized professing with dedicated resources" in which machines were operated and systems developed by centrally coordinated computer staff on long-term assignment to a particular corporate department.[1083]

The same point was made strongly in a 1983 symposium presented by MIT researcher John F. Rockart. Rockart had became an early exponent of the idea of "end user computing." This would demand wholesale reconstruction of the corporate computing department, to serve individuals rather than departments. With this shift, the CIO would be "no longer a line head of a computing organization, but a staff person in the corporation. With ever more widespread computing, he must give up his role as the direct czar of computer resources.

Like the systems men of the early 1960s, he worried that direct responsibility for the management of computer operations was not compatible with broad staff responsibility for the

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[1081] Synnott and Gruber, Information Resource Management: Opportunities and Strategies for the 1980s, 323.

[1082] Ibid, 109.

[1083] Synnott seized on the then-fashionable concept of matrix management as a panacea – an "information resource product manager" would be assigned to each department within the firm. This specialist would command dedicated computing resources and a team of programmers and analysts, and would have two bosses – one in the information management hierarchy, the other the manager of the department concerned. The blurring between line and staff relationships involved in matrix management mirrored something that many systems men had called for during the 1960s when they sought direct rather than advisory authority over operational matters. (In practice, matrix management introduced its own problems and most of the firms experimenting with it found these to outweigh its benefits).

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improvement of business systems. Rather, he must move into a role of providing staff expertise, guidelines, and policies so that almost totally decentralized computing organizations will be able to carry out their tasks and support their end users in appropriate ways." Rockart also believed that a "major segment" of the job would consist of giving advice to top executives on the strategic potential of information technology.[1084] Proponents argued as to whether the CIO should work alone, head a small department, or command the entire corporate computer operation. But they agreed that the arrival of microcomputers and the profusion of database technology demanded a new way of dividing responsibility between different levels of the corporation, and they expected a renewed focus on the combination of business and technical skills to assist in this restructuring. As Rymer had reported, "The CIO's job is to turn a revolution into an orderly transition to a new era."[1085]

Propelled in part by professional groups such as the Society for Information Management (as the Society for Management Information Systems renamed itself), discussion of the CIO spread rapidly through the networks of senior corporate computing staff and into the mainstream business press. In 1986, Business Week devoted much of the space in a special feature issue on "office automation" to the CIO. It printed three articles profiling CIOs of firms such as Firestone, American Airlines and General Foods. Many of them claimed to have boosted overall performance of their firms by reorganizing sales operations or cutting production costs. Like earlier reports, this one included in its definition that the CIO would "oversee all the company's technology," report directly to the CEO or chairman and "concentrate on long-term strategy and planning while leaving the day-to-day operations of the computer room to subordinates." The

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[1084] John F. Rockart, "The Role of the Executive in the New Computer Era", in The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology, ed. John F. Rockart and Christine V. Bullen (Homewood, Illinois: Dow Jones-Irwin, 1986).

[1085] Rymer, "Executives to Unlock Technology's Promise".

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CIO of First Boston Corporation suggested modestly that a job such as his own "calls for a Renaissance man."[1086]

Intensive discussion of the CIO concept during the late 1980s and early 1990s exposed several areas of disagreement. Perhaps the most debated of these was the question of how to produce a true CIO. Where might one find such a Leonardo of information? Was it best to take a computer expert and broaden her into a corporate manager, or should one take a proven manager with no previous computer experience? Articles pitched at computing staff, such as the 1983 Rymer article, tended to suggest that they stood a decent chance of filling the role – but only if they could break out of the technical culture that hung over data processing installations like a toxic cloud. The article presented a long list of CIOs who had done time in the data processing trenches, but cautioned, "[t]o move into senior management, they had to transcend their technical backgrounds...." Just in case any ambitious young computer people might miss the point, he added that, "[t]he transition was easiest for those who were not enamored of the technical details of their operations to begin with."[1087]

Others, keen to emphasize the truly executive nature of the CIO role, suggested that having worked in a data processing department might actually be a disqualification for the job. As a report in a drug trade magazine put it the next year, the central message of the era was, "[t]he data processing manager is dead.... Long live the chief information officer." It quoted an Arthur Andersen partner suggesting that the CIO would handle not just "corporate data processing but corporate strategic planning." [1088] Indeed, as the buzz spread it was not just computer managers who were eyeing the CIO title. A 1987 article in American Libraries suggested that, "there isn't

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[1086] Gordon Bock, Kimberly Carpenter, and Jo Ellen Davis, "Management's Newest Star", Business Week, October 13 1986.

[1087] Rymer, "Executives to Unlock Technology's Promise".

[1088] Anonymous, "Chain information managers face expanded role; data processing managers will be forced to become CIO's: chief information officers", Drug Topics, January 2 1984.

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anyone else out there who is better qualified to meet the challenges of the CIO roles than librarians. Data-processing folks certainly don't have the broad understanding of the problem, the user understanding needed to perform this function; nor do the business school people." The author did, however, concede that few librarians currently had the ambition or ambition for risk needed to land the job – and this attempt by corporate librarians to sell themselves as the true experts on business information seems to have fared little better than that of their predecessors in the 1950s.[1089]

The question remained unresolved in 1991, when CIO Magazine found that only mythology could provide a suitable image: "the CIO must be a centaur - part IS horse, galloping beside the fast-paced changes in technology, but from the waist up a savvy general manager". It even suggested that, "[t]echnology can be delegated, as several experts and CIOs put it - usually to MIS types who are stuck on the technical career track." (Note that MIS was by this point synonymous with the plodding technician, rather than the capable manager). A sample of business gurus interviewed seemed divided on whether the CIO position would ultimately remain a specialist post or vanish as computer technology passed into the mainstream of management. Tom Peters, the most famous of them all, was hostile to presence of computer experts in the CIO position, saying that, "[t]oo many of today's CIOs have come up through the ranks of the MIS bureaucracy, and their touch with the real world is not all it should be."[1090]

The idea that people without computer experience might make better CIOs than would experienced computer experts was expressed repeatedly, but remained rare in practice. The 1990 Datamation survey found that only 20 percent of CIOs had shifted from non-computer positions within the same company. (6 percent had previously been operations managers, and 5 percent

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[1089] Richard R. Rowe, "You, the CIO; can librarians make the jump to "chief information officer"?" American Libraries 18, no. April (1987):297.

[1090] Thomas Kiely, "The Once and Future CIO", CIO Magazine 1991.

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finance managers). 50 percent were hired from the computer departments of other companies, and the remaining 30 percent moved up internally. A different 1990 survey, carried out by a consulting firm, found that 74 percent of CIOs had risen from a background in the computer department.[1091] The rush to garland data processing managers with the CIO title, often without even granting them a say in strategic decision making, earned the ire of Synnott (who had himself abandoned hands-on computer management for a job as a consultant). He remarked that, "[t]here are a lot of fake CIOs.... It's like Santa Claus. They're on every street corner, but you know they're not all real." Although Synnott probably didn't intend it to, his analogy raised another question: were any of them real?[1092]

## The CIO in Practice

By the end of the 1980s, many others were also complaining that the CIO title was simply being slapped onto existing corporate computer managers without the fundamental shift in role, attitude and executive support it implied. A 1988 editorial in Infosystems suggested that, "the push for a CIO portfolio comes from IS people and much of it seems like self-serving hype." Innovative ideas on the strategic use of information technology, it suggested, were more likely to come from line managers than from specialist staff – while computer managers were still focused on the production of routine reports. Its conclusion was echoed by many skeptics in the years to come: "In an atmosphere where the ability to provide basic service is in question, perhaps the more prudent posture is to produce first and lobby for exalted status later."[1093]

The same year Datamation, the leading magazine of the computing field, used new survey data to lambaste the CIO as a "myth" or "cult" promoted by self-interested managers,

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[1091] Brad Edmondson, "Hail to the Chief (Chief Information Office Statistics)", American Demographics 12, no. 2 (1990):11-12.

[1092] Marilyn Stoll, "CIO Position Emerges as a New Strategic Force", Datamation, October 20 1987.

[1093] Wayne L. Rhodes, Jr., "It's A Long Fall", Infosystems 35, no. 3 (March 1988):8.

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consultants and professional groups. Very few top computer managers then held the CIO title, though the survey found that 57 percent of computer managers in major corporations considered themselves "de-facto CIOs." However, only 27 percent met the most basic qualification, that of reporting directly to a top level manager – suggesting most of those who viewed themselves CIOs were guilty of inflating their own importance. It debunked the idea that CIOs would follow CFOs into the top corporate spot – reporting survey results that only 7 percent of current CIOs believed they might one day head their company. It called most CIOs "toothless," noting that they generally lacked the political skills needed to ally with line managers and get things done. CIOs, it suggested, were outsiders – having arrived in their companies to serve in that position rather than being promoted internally. Many were hired to correct the mistakes of previous computer managers and contain spiraling IT costs. They were far more likely to leave to take a similar job elsewhere than to be promoted internally. The author suggested that a combination of resentment of other managers to the sweeping mandate claimed by the CIO and an unfortunate focus of financial staff on short term returns rather than long term investment meant that this job hopping was liable to continue for the foreseeable future.[1094] The problem actually worsened in 1989, during which year 13 percent of CEOs were dismissed – most commonly to contain budget growth or as a result of failure to meet promised results. This prompted Business Week to ask whether CIO now stood for "Career Is Over."[1095]

In 1990, Datamation published another survey of CIOs at Fortune 1000 companies. It found that their average age was 47 and they had spent an average of 20 years working with computers. 51 percent of them had held the CIO post at three or more companies – a trend it

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[1094] Ralph Emmett Carlyle, "CIO: misfit or misnomer?" Datamation 34:15, no. Aug 1 (1988).

[1095] Jeffrey Rothfeder and Lisa Driscoll, "CIO is starting to stand for 'career is over'; once deemed indispensable, the chief information officer has become an endangered species." Business Week, Feb 26 1990. A close look reveals that their sample of CIOs was actually of top computer managers – 19 percent of whom held the CIO title, and another 35 percent of whom held the rank of vice president. In the same vein, see "More CIO Departures Are Not Done by Choice," Computerworld, February 18, 1991, p. 6.

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linked to the rapid inflation in CIO salaries. It concluded that CIOs remained "their own worst enemies" – more likely to be "self-deluded outsiders" than "in-touch agents of change." They had almost no contact with their firm's customers, and spent more time with members of their own computer organization than with computer users or other managers. It faulted them for identifying more closely with their profession than with their companies. Yet a pop quiz on computer technology revealed that their technical knowledge was also lacking.[1096]

The gap between theory and reality was to remain conspicuous for the rest of the decade. CIO Magazine ran a series of annual surveys headed "Are We There Yet?" The answer, invariably, was no. Yet it always presented reasons to hope that progress was being made and that, with sufficient effort, the goal could be achieved. The 1991 installment, for example, asked senior executives how they felt about their CIOs. The survey team discovered that executives paid lip-service, but nothing more, to the idea of the CIO as a partner in forming corporate strategy. While "a majority of the executives... said that CIOs should participate in strategy formation; at the same time, they admitted that their CIOs had not yet been offered the opportunity to do so." They also reported that, "the number of executives who consider the CIO to be senior line-management material is actually shrinking."[1097]

As John Diebold, then entering his fifth decade as a quotable authority on automation, was quick to observe: "the CIO has primarily represented a change of title rather than a change in functions. The CIO of today is yesterday's view president of IS" rather than hoped-for "broad-gauge information executive of tomorrow." Diebold assigned blame equally between corporations who refused to pay more than lip-service to the notion that, "information is crucial to

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[1096] Robert Carlyle, "The Out of Touch CIO", Datamation, August 15 1990.
[1097] David Freedman, "Are We There Yet?" CIO Magazine 1991.

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their success" and to introverted computer managers who had failed to develop "the skills, the knowledge and the organizational clout to wear the CIO mantle."[1098]

Long ago, before even Diebold had billed his first client, Leffingwell had issued a similar warning to his beloved office managers. Writing at the end of his own career he suggested that the office manager, like Diebold's CIO, was "charged with a vitally important responsibility, without which business cannot long exist." Executives, however, were slow to recognize this. Like Diebold he lamented current realities -- "the so-called 'office manager' is the lowest priced executive in the concern." Like Diebold, he urged executives to acknowledge the true importance of the role – while simultaneously challenging his disciples to make themselves worthy of it by acting like managers. "The office manager is entitled to a place and voice in management councils, and if he is the right kind of executive, who knows what is due his position, he will demand and get it."[1099]

The problem remained the same. Firms were willing to invest large sums in administrative technology, but not to charter technically minded upstarts to trample on the traditional prerogatives of general managers. Neither were they willing to accept the executive credentials of the managerial technicians. The most fundamental questions remained those of organizational culture and politics rather than technology: how should control over the design of (what we would now call) information systems be apportioned between expert specialists and operational managers, and between centralized bureaucracies and decentralized divisions. Although disagreements over these two basic issues have often been conflated with choices between specific technologies, a broad historical perspective makes clear that these underlying issues have retained their potency long after the specific technological disputes with which they were conflated have vanished.

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[1098] Kiely, "The Once and Future CIO".
[1099] Leffingwell, Textbook of Office Management.

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This has not gone entirely unnoticed. During the early 1990s, Thomas Davenport, a consultant and academic, and long-time corporate and governmental computer manager Paul Strassmann were two of the most visible advocates of a new way of thinking about the CIO's role. As co-author of a 1992 article "Information Politics," Davenport suggested that the most appropriate classification system for the information management practices of different organizations was based on political systems of government, citing "technological utopianism," anarchy, feudalism, monarchy and federalism as the different options available.[1100]

The theme was picked up by Strassmann in his 1995 book The Politics of Information Management and a number of related articles. He likened traditional centralized data processing departments, which he called "central computing hubs," to the defunct bureaucracies of the Soviet Union. Yet Strassmann was also critical of many of the other ideas advanced during the 1980s. He insisted that it was neither possible nor desirable to entirely decentralize data processing – both because of the enormous investment in current systems and the continuing need for a central group to standardize software engineering methods, reuse common elements between different systems and ensure that different systems fit together properly. He insisted that the necessary transition was not a technical one to client-server technology but a political one. As he put it, "Lurking behind much of the networking, integrating, downsizing, reengineering, and client/server talk are unreformed technocrats who keep speaking the language of technology instead of the more controversial dialect of power politics." The most important thing was who

[1100] Thomas H. Davenport, Robert G. Eccles, and Laurence Prusak, "Information Politics", Sloan Management Review 34, no. 1 (Fall 1992):53(13). Grindley, Managing IT At Board Level: The Hidden Agenda Exposed is also exceptionally insightful and well supported. Tony Johnson, Time to Take Control: The Impact of Change on Corporate Computer Systems. (Newton, MA: Butterwoth-Neinemann, 1997) makes a provocative, if rather utopian, argument that new technology makes the corporate computer department obsolete.

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controlled the design and operation of an application system, not whether the processors it ran on were concentrated in one box or spread across a network.[1101]

He suggested that many CIOs were failing because they "were spending too much time chasing corporate visions, strategic uses of technology, and business reengineering, while their computer shops continued to be too expensive, unpredictable and unresponsive." This, he said, was "directly traceable to a few persuasive thinkers whose ideas were first disseminated in the late 1970s and early 1980s. Most of these people were academics who subsequently became consultants, although none had ever managed any sizable business opportunity." Strassmann appeared to have Nolan and his ilk in mind with this comment, and he went on to say that, "By analogy, information was everywhere, just like money, and therefore the CIO could claim comparable status to someone who presided over accounting and finance. This sort of thinking diverted an entire generation of systems executives into an unrealistic search for status and a position on the board of directors."[1102]

Instead, he suggested, the solution was for the CIO to establish an "information constitution" structured along Federalist lines. This would establish a "viable balance between central coordination and local initiative." Only by admitting that the problems of information management involved power relations between departments, and must therefore be solved by political compromise and negotiation, could a CIO hope to deliver successful systems, and so garner the credibility and support among other managers necessary for a successful career. "The time," he wrote, "has come for the CIOs of this world to get back to basics and clean up their

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[1101] Strassmann, The Politics of Information Management, 256, xviii.
[1102] Ibid, 322-25.

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noninteroperable, redundant, obsolete, overpriced, error-prone, schedule-lagging, and credibility-lacking systems."[1103]

Critiques such as those made by Diebold and Strassmann dogged CIOs for the rest of the decade. Yet, weighed by other criteria, the rise of the CIO was quite spectacular. The title spread with great rapidity during the 1990s. The vast majority of major firms had granted the title, some of them quite liberally. According to the former CIO of Dell, "[a]t some large corporations, every division (every department) has a CIO. Siemens, for example, has a global CIO, two corporate CIOs, central office CIOs, operating company CIOs and over 50 regional CIOs."[1104] By the end of the 1990s, CIO Magazine boasted a controlled circulation of over 130,000. As with MIS, the title of CIO spread widely but the original vision was seldom implemented. Some of the mystique remained through the 1990s, assiduously cultivated by CIO magazine and a sizable industry of newsletters, consulting services and conferences aimed at the CIO. After a certain point, for a firm to insist on calling its chief computer person a "VP of EDP" or even a "VP of MIS" came to seem positively reactionary. The CIO title was a free perk for the manager on whom it was bestowed, and it provided evidence that the company concerned was doing something about keeping up with trends.

The pay and organizational rank of CIOs had also improved. The 2002 CIO Magazine survey found that, for the first time, a majority (51 percent) of the sample reported directly to the CEO. (As the magazine noted, this remained an obsession among CIOs, indicating continuing status anxiety).[1105] These improvements may have been more a function of the spectacular increase in the size of computer budgets than of an intellectual triumph for the arguments of the CIO lobby. Whereas corporate computer budgets had been quite small in 1980, by the end of the

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[1103] Paul A. Strassmann, "CIOs should get back to basics", Datamation 40, no. 18 (September 15 1994):70(3)

[1104] Jerry Gregoire, "Hail to the Chiefs", CIO Magazine 2002.

[1105] Tom Field, "The State of the CIO: Executive Relationships", CIO Magazine, 15 March 2002.

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century they had risen to account for a very significant chunk of all corporate spending. North American businesses spent around six hundred billion dollars on computer hardware, software and services in 2001.[1106] According to the Gartner Group, one of the leading computer industry research groups, large corporations devoted an estimated 5 percent of their revenues to information technology, representing an expenditure of around eight thousand dollars per employee (up from three thousand in 1988).[1107] As well as an increased use of computers in areas established in the earlier decades, this reflected some fundamental shifts in the areas to which computers were applied.

## Total Systems Return: BRP, ERP, CRM

Four particular classes of project drove these increases in IT spending and the consequent expansion of the domain of the CIO: Business Process Reengineering (BPR), Enterprise Resources Planning (ERP), data warehousing, and the establishment of Internet and intranet systems (e-business). Each was often promoted as a simple, technological fix to business ailments of all kinds. Each represented a revival of one or another of the claims originally made for "total" information systems back in the 1960s.

One might expect the total systems thinking of the 1960s, with its wide-eyed faith in cybernetics and general systems theory, to appear quaint today. Belief in the practicality and desirability of the totally integrated management information system represented a high water mark in a particular approach to corporate management. This approach stressed centralization, integration, a technocratic, "systems based" approach to management, tight integration of

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[1106] Robert De Souza et al., IT Business Spending to Recover in Late 2003 (GartnerGroup, 2003). I have excluded a further four hundred million dollars for telecommunications equipment and services.

[1107] For recent spending figures, see Kurt Potter, 2000 Spending and Staffing Survey Reports (GartnerGroup, 2000). About 6% of this figure is for voice communication, the rest is computer related. The figure from 1988 is taken from Paul Strassmann, The Squandered Computer (New Canaan, CT: Information Economics Press, 1997), 92.

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functions, entry into unrelated markets, the transfer of power from divisional line managers to corporate staff experts and the denigration of "seat of the pants management" and "intuition" in favor of formalized models and procedures. It was marked by a faith in the virtues of bigness, central planning, rationality and technology to solve all problems. Nothing could be less fashionable today. With the fall from grace of the systems approach and the by-modern-standards miniscule capabilities of 1960s computers, the whole idea now seems as absurd as the warnings of imminent Soviet economic dominance sometimes issued by its proponents. Management scholars and populist gurus have given us instead a cornucopia of liberation, teamwork, decentralization, entrepreneurs, inspirational leadership, corporate culture as a competitive tool, intrapreneurs, dancing giants, and a tight focus on core competences. In 1990s corporate headquarters were disposed of, peripheral businesses divested, and support functions outsourced.

Despite this, the thinking of the systems men was in many ways strikingly similar to the management orthodoxies of the 1990s. The 1950s-era promises of Leavitt and Whisler's "Management in the 1980s" were revived around the widespread idea that increased computerization would create a flatter, more flexible organizational structure. Business spending on computer technology in the 1990s dwarfed that of the 1960s, but many of the most important goals of recent corporate computing were direct continuations of parts of the MIS agenda. They themselves anticipated many of the most powerful recent critiques of excessively technical computer use in their critical discussion of the "artisans" and "technicians" of data processing. They promoted the administrative technology expert as an "internal consultant" long before the term became fashionable; they critiqued the failure of computers to provide economic returns a quarter century before Robert Solow noticed the impact of computers everywhere but in the productivity figures and the "productivity paradox" became a catch phrase; they defined the true purpose of the computer as information and organizational transformation rather than automation

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three decades before Shoshana Zuboff gave us the verb "to informate"; they spoke of "re-engineering" firm-wide business systems three decades before consulting firms made their Fortune with the same idea. [1108]

Business Process Reengineering (BPR), the leading management fad of the mid 1990s, was an inadvertent but remarkably faithful return to systems movement of the immediate post-War period. The key promoters of BPR were Michael Hammer (a former MIT computer science professor) and James Champy (a management consultant). Their idea was that existing organizational structures and practices were often inefficient, and that any use of computer technology merely to automate what was already there was a recipe for stagnation. Instead, the existing structures should be thrown away. Hammer's love for the rhetoric of violent revolution is captured in the title of his best known article, a Harvard Business Review piece called "Reengineering Work – Don't Automate, Obliterate." The business revolutionary would sweep away the existing order (or, as Hammer put it, take a machine gun to the organization chart and shoot dissenters) and recreate business processes, structures and culture on a clean sheet. This granted enormous technocratic authority to the "engineer" carrying out this process. [1109]

Because CIOs already claimed to have a special understanding of the potentials of information technology to transform business, BPR offered an apparent mandate to apply their ideas to other parts of the company whether incumbent managers were pleased or not. Many firms, however, preferred to grant this authority to external consultants who appeared less technically oriented and more in touch with the culture of management. A boon for consulting companies, BPR was the single most important factor in transforming the management consulting industry from a relatively small sector focusing primarily on advice to a much bigger industry

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[1108] The distinction between automating and informating is central to Zuboff, In The Age of the Smart Machine: The Future of Work and Power.

[1109] M Hammer, "Reengineering Work -- Don't Automate, Obliterate", Harvard Business Review 68, no. 4 (July-August 1990):101-12.

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focused mostly on designing and building computer systems of various kinds. By the mid-1990s, BPR started to lose its allure, in part because Hammer's posturing had been taken by many firms as a license to apply BPR to any reorganization resulting in layoffs.[1110] As Paul Strassmann noted, the term re-engineering "conveys an obsolete metaphor in which someone who has superior knowledge 'designs' and 'engineers' something and then passes the blueprints to operators who have little to say about the content and methods." In other words, Taylorism.[1111]

The idea was not, of course, as novel as Hammer thought it was. Thomas Davenport, a far more nuanced promoter of BPR, went so far as to acknowledge historical antecedents in the title of his own Sloan Management Review article "The New Industrial Engineering." Yet even Davenport did not seem to be aware that organized attempts to apply industrial engineering techniques to administrative processes were then more than forty years old. As early as 1954 a punched-card systems man wrote "a machine system should never be simply imposed on an existing manual system. Instead, we are told, there should be a complete re-engineering of procedures." Both 1950s re-engineering and 1990s reengineering empowered experts outside the normal managerial hierarchy to "engineer" superior procedures, to reorganize work around new technologies, to design systems that crossed traditional functions, and to indiscriminately dismantle existing organizational structures. The terrain abandoned by the systems men as they drifted from administrative generalism into computer work has therefore been occupied with great success by armies of management consultants – though the mystique and apparent elevation

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[1110] On the backlash to BPR, see Thomas H. Davenport and Donna B. Stoddard, "Reengineering: business change of mythic proportions", MIS Quarterly 18, no. 2 (June 1994):121, Thomas H. Davenport, "The Fad That Forgot People", Fast Company 1, no. 1 (1995):70, Art Kleiner, "The Battle for the Soul of Corporate America: Hammerism Battles Demingism for How the Corporation (or society) Should Be Governed in the Information Age." Wired 3, no. 8 (August 1995) and Paul A. Strassmann, "The Hocus-Pocus of Reengineering", Across the Board (June 1994). On the involvement of the CIO, see Strassmann, "CIOs should get back to basics".

[1111] Strassmann, The Politics of Information Management, 226, 41.

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from internal politics enjoyed by consultants was perhaps always impossible to replicate in a staff group. [1112]

BPR was not the only source of the boom in computer-related consulting during the 1990s, and neither was it only familiar idea dressed up in new clothing. MIS thinking during the 1960s centered on the construction of a single enormous system to coordinate the operations of multinational, multidivisional corporations. While impossible to construct at the time, during the mid-1990s this idea returned to center stage in the guise of Enterprise Resource Planning (ERP) systems.[1113] The term was attached to software packages designed to integrate financial operations, human resources, sales and logistics on a global scale. The most successful of these, SAP R/3 was produced by the German firm SAP. Access to consistent financial, personnel and management information across divisional and international boundaries were key justification for the installation of an ERP system, just as they had been for the initiation of a total MIS project in the 1960s. Companies pursuing ERP also appear to have been motivated by the promise of improved operational efficiencies and smoother internal coordination. ERP promised to solve the "integration nightmare" faced by firms with hundreds of crumbling, internally developed systems by replacing them with a single proven, reliable and externally maintained system.[1114]

While ERP was concerned more with operational matters than grand strategic decisions, on a technical level it went a long way toward fulfilling the 1960s dreams of a single enormous and integrated computer system spanning the entire business. ERP turned out to introduce some

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[1112] Thomas H. Davenport and James E Short, "The new industrial engineering: information technology and business process redesign", Sloan Management Review 31, no. 4 (Summer 1990):11-27. G. E. Killian, "After the Honeymoon", The Hopper 5, no. 9 (October 1954).

[1113] The name Enterprise Resources Planning is not particularly descriptive. Enterprise has come to attach itself as an adjective to computer systems designed to span the entire corporation. Resource Planning appears to be a hold-over from the earlier Materials Requirements Planning (MRP) inventory management techniques, which were extended to form Manufacturing Resources Planning (MRP II).

[1114] For a relatively early description of the attractions and pitfalls of ERP, see Christopher Koch, "The Integration Nightmare: Sounding the Alarm", CIO Magazine, 15 November 1996. For a journalistic account of the SAP story see Gerd Meissner, SAP--Inside the Secret Software Power (New York: McGraw-Hill, 2000).

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new nightmares of its own. Configuring an ERP package to match the needs of any given business, and integrating it with existing computer systems, demanded the services of large teams of very expensive consultants for several years. To realize the business benefits of ERP, firms would have to standardize accounting techniques, part numbers, and other coding schemes across a multinational corporation. While flexible, the ERP package would also force a firm to adapt its business processes to fit the generic versions programmed into the software. According to one study, ERP systems took an average of almost two years to implement, and even technically successful implementations caused an immediate and serious decline in efficiency during the period immediately after they were switched on. The total cost of a typical successfully installed system (including training, computer expenses, consultants and internal staff), measured over the development period and first two years of use, has been estimated at more than fifty thousand dollars per user.[1115]

By the late 1990s, the appeal of ERP was starting to tarnish a little. Writing in the Harvard Business Review, Davenport revealed disasters at firms such as Mobil, Dow, and FoxMeyer Drug. While stressing the potential benefits of ERP for some firms, Davenport argued that the upheavals involved in ERP had been underestimated, and that it was not suitable for many companies. Yet large firms continued to order ERP systems without fully evaluating their suitability. The most extreme cases, such as that of WorldCom, seem to have been driven by nothing more than fashion. Only around 1999 did new orders for ERP really dry up, in part due to market saturation.[1116] While the Gartner Group tried to drum up interest for something to be

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[1115] These facts and figures are taken from Anonymous, Executive Guide: Enterprise Resource Planning (Darwin Magazine, August 08 2002 [cited November 6 2002]); available from http://guide.darwinmag.com/technology/enterprise/erp/index.html. The estimates are from an unnamed survey cited there and performed by the Meta group. For a case study of ERP problems see Ben Worthen, "Nestle's ERP Odyssey", CIO Magazine, May 15 2002.

[1116] Thomas H. Davenport, "Putting the enterprise into the enterprise system", Harvard Business Review 76, no. 4 (July-August 1998):121. On decline in the Fortune of ERP, see Josh McHugh, "Binge and Purge", Business 2.0 (June 2000).

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called ERP II, general attention shifted briefly to the construction of even more elaborate systems for Customer Relationship Management (CRM), intended to bring together all information and processes bearing on a firm's external relationships with its customers. The cycle of boom and bust has played out even more rapidly in this field – by 2001 reports of disillusion and failure were already spreading through the trade press.[1117]

A third major class of 1990s information system project was the data warehouse. This was essentially a revival of the 1970s dream of a single centralized database from which all information needed for managerial decision making could be retrieved. The twist was that proponents had given up on the idea of running all operational systems from a single, coherent and centralized data base. Instead, operational systems would maintain their separate data bases. Information would loaded periodically from these disparate sources, "cleaned," converted into a standard format, reconciled with related information from other systems, and placed into a huge centralized repository ready to be queried. Because information in a data warehouse would be read-only, it could be structured for efficiency in retrieval (duplicated, arranged "dimensionally," or together with pre-calculated totals) rather than efficiency in updating.[1118]

Armed with this comprehensive data repository, firms could then use specialized "decision support" tools to retrieve whatever information was needed. By the late 1990s, the idea of a "digital dashboard" was widely promoted. This intended to supply a single screen of easy to read gauges and dials to permit each manager to see at a glance how well his or her operations were performing. This idea, too, was less novel than generally believed. Back in 1957, officer

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[1117] B. Bond et al., ERP Is Dead — Long Live ERP II (Gartner Group, 2000). On the rapid loss of faith in CRM, see Susannah Patton, "The Truth About CRM", CIO Magazine, May 1 2001. For an attack on the whole concept of enterprise integration, see Chris Pickering, E-Comment: The Integration Chimera (internet.com, July 18 2001 [cited July 21 2001]).

[1118] A clear and influential introduction to data warehouse technology ware given in Ralph Kimball, The Data Warehouse Toolkit: Practical Techniques for Building Dimensional Data Warehouses (New York: John Wiley & Sons, 1996).

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management professor Alex Rathe had already used the dashboard metaphor to suggest that a computerized reporting system should present meaningful and simple signals, like the oil change light in a car. Even the classic, military-influenced 1960s idea of a computerized room full of huge screens, in which managers could sit together and monitor corporate progress, was dusted off and promoted by consulting firms as the key to effective decision making.[1119]

Data warehousing was another booming business for the consulting firms and software suppliers of the 1990s. Firms such as MicroStrategy gained huge publicity and massive stock market valuation on the promise that they could supply tools to sift through massive amounts of data and reveal hitherto unnoticed patterns of strategic importance. With data warehousing, too, many companies found that business benefits to be less impressive than anticipated, especially where the idea had been sold to a few executives by a consulting firm without building a consensus among managers about what tools might be needed or whether the system would be used. The difficulties involved in cleaning and reconciling data made the construction and maintenance of a data warehouse into a major and ongoing expense. (Given the difficulties in producing a true "enterprise" warehouse, many firms relied more on local "data marts" of more limited scope).[1120]

Properly used, all these technologies held great potential. Yet it is hard to escape the impression that businesses rushed, herd like, from fad to another. In this context, the fact that

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[1119] Walter B. Schaffir, "Developing a Management Control "Instrument Panel": A Practical Approach", in Men, Machines and Methods in the Modern Office (New York: American Management Association, 1958). On EIS, see Bartholomew, "When Will EIS Deliver?". On the digital dashboard idea, see T. Austin, Are Microsoft's Digital Dashboards Perpetual Demoware? (GartnerGroup, 2000).

[1120] For examples of the MicroStrategy hype, see Catherine Yang, "MicroStrategy Wants to be an Angel Whispering Data in Your Ear", Business Week (December 21 1999) and Chuck Salter, "People and Technology - Microstrategy Inc." Fast Company 2000. On the aftermath, see Anne Usher, "Still sinking: MicroStrategy retrenches, but recovery is for from assured", Washington Techway, May 28 2001. On the difficulties of data warehousing see Peggy King, "Decision Support Grows Up... and Out", CIO Magazine, November 15 1999 and David Pearson, "The Hidden Cost of Data Integration", CIO Magazine, May 1 1999. For a review of similar concepts in the 1960s, see Richard G. Canning, "The Corporate Data File", EDP Analyzer 4, no. 11 (November 1966).

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many of the ideas involved turn out not to have been so new at all takes on an additional weight. While technologies have progressed enormously, the problems faced in doing something like BPR did not change enormously from the 1950s to the 1990s, and neither did the pitfalls involved. One is tempted to conclude that the most important change has been in the names (electronic data processing, total systems, management information systems), to redeem these dreams from the taint of their past failure. As one embittered CIO Magazine columnist asked in 1995, "Is information technology making progress—or do we just repackage it periodically?"[1121]

While these various kind of large scale computer projects created opportunities for CIOs to broaden their organizational mandate, the influx of consulting firms into these fields represented a challenge to the authority of the CIO. A range of companies offered IT services – from one person operations through small practices to giant international partnerships. Many firms specialized by client industry, type of application or computer technology. The most successful firms of the 1990s (measured by size, growth rate and profile in the corporate world) fit a definite mould – they recruited non computer-specialists, charged a great deal of money and had a partnership structure. They sold themselves on their ability to understand and document corporate requirements, their competence in project management and their ability to put together a team with precisely the skills required for any given job. Most of them bore the major accounting firms from which they sprang – Andersen Consulting, Price Waterhouse, Coopers and Lybrand, and Deloitte Touche.[1122]

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[1121] W. F. Dyle, "The Name Game", CIO Magazine (January 15, 1995) – available at www.cio.com. On ERP see Davenport, "Putting the enterprise into the enterprise system". For Business Intelligence in MIS-like terms, see Michael Vizard, "Yahoo and IBM head for a collision on the road to business intelligence", InfoWorld.com, 16 February 2001.

[1122] By 1996, Andersen's gross revenues from consulting had overtaken the firm's traditional accounting business, and stood at $3,115 million. Melody Petersen, "Consultants at Andersen Take Action" New York Times, December 18 1997. Consulting revenues have grew so rapidly as to undermine relationships between the staid accounting half of the firm and the suddenly powerful consultants – resulting eventually in a painful divorce in which the consulting arm was renamed Accenture. Shorn of its consulting arm, the accounting business went from the largest of the major firms to the smallest -- indeed,

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Firms like Andersen specialized in operational consulting. Unlike the strategic consultants (of which McKinsey remained the best known), operational consultants had a more prosaic business, making corporate systems and practices more efficient (though by the end of the 1990s the differences seemed to be blurring). These firms hired large numbers of MBAs. Partners and senior managers, who typically devoted most of their attention to selling new projects, were likely to have gone to the same business schools and 'spoke the same language' as the corporate managers they dealt with.

These consulting firms succeeding in doing what systems men and others had only dreamed of – selling technical expertise as management work. The actual work of designing and producing custom IT systems remained stubbornly technical. The techniques used – structured design, systems analysis, functional requirement specification, data flow diagrams – were those previously associated with software engineering (as practiced) and systems analysis. This work was largely performed by people with only a few years of experience. More experienced workers spent more time performing management and customer liaison roles. Consultants worked on client sites, charged at high hourly rates, after a training program that typically lasted for no more than two months. Whatever the content of their work, these programmers were referred to as "management consultants".

The irony is, however, considerable. Systems men and chief information officers had spent decades promoting the idea of computers and information as a strategic asset, vital to corporate success. They had advanced the concept, in part at least, as part of an effort to free corporate computing from the domination of accounting managers. Yet in the 1990s, just as executives began to give credence to the idea, responsibility for the implementation of key

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the ethical lapses that triggered its destruction have been attributed to its attempts to rapidly rebuild a consulting capability of its own. Of the other top 5 worldwide consulting firms in 1997, only McKinsey & Company (which focused on strategic rather than operation consulting) was not linked with a major accounting firm.

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systems was increasingly moved out of the hands of internal specialists and entrusted to accounting firms. Executives felt more comfortable handing this task to peers whose firms have delivered crucial corporate services for generations, than to the members of their own organization's technological culture.

The major consulting firms promoted their ability to 'define a goal, figure out what technology is needed to achieve it and execute the project crisply.'[1123] Their most important achievement was probably the standardization and mass production of corporate computing expertise – selling a promise of reliable and dependable results coupled to a managerial mindset. Firms like Andersen attempted to mass produce thousand upon thousand of consultants, all with the same training, a shared culture (stressing hard work, competition and group identity) and a uniform approach to problem solving. Smaller and more technically create firms disparaged its employees as "Andersen Androids," but it is precisely this appearance of discipline and control which endeared them to corporate managers. Like McDonalds, their unique strength as seen as their ability to deliver a standardized product reliably, rapidly and in massive quantities anywhere in the world.

## Changes in the Corporate Computing Workforce

The technological shift to personal computers and a rash of inexpensive servers instead of the centralized mainframes of the data processing era had profound effects on the makeup of the corporate computing workforce. Millions of people held corporate jobs as hands-on computer specialists tinkering with the configuration hardware and software. For many, perhaps most, these jobs offered decent pay, take place in safe and comfortable working conditions, and provide some inherent rewards and satisfactions. They have not, as yet, faced the kind of wholesale deskilling

[1123] The IT chief of Merrill Lynch, a firm which then spent $1.5 billion on IT each year, quoted in the Seth Schiesel, "The No. 1 Customer: Sorry, It Isn't You" New York Times, November 23 1997.

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and loss of control over their own work inflicted on industrial workers with the coming of industrialization and mass production. But neither did they emerged as an elite within the corporation, or achieved any kind of professional status or control over entry into the field. Their pay and prospects lagged those of the true corporate professionals, such as lawyers and accountants.

The number of traditional computer operator jobs gradually declined. Mainframes did not vanish – around 14,000 mainframe installations remained at the millennium – though the need to keep them constantly fed with tapes, punched cards, and paper diminished as their operation became more automatic. The proliferation of desktop computers shifted the primary burden of operation to their users, who turned them on and off, started programs, and put paper into the printer. On the other hand, an enormous number of support jobs have been created by this shift. Millions of people are employed configuring and preparing desktop computers, answering telephones to deal with user problems, setting up network connections, coaching users on their application programs and so on. These "desktop" or "front line" support jobs occupy much the same niche as traditional operator positions: they are the worst paid main category of computer specialist positions, have the lowest entry requirements, and enjoy the worst prospects for advancement.[1124]

The other main kinds of job descended from traditional computer operation were system administration and network support. System administrators set up, tweaked and upgraded server computers of different kinds. Some of these tasks, such as making backups of data or adding user

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[1124] On the continued existence of the mainframe, see Derek Slater, "I.T.-Rex? Reports of the Mainframe's Extinction Have Been Greatly Exaggerated", CIO Magazine, November 15 2000, Stephanie Sandborn, Back From the Grave (Infoworld.com, December 8 2000); available from http://www2.infoworld.com/articles/hn/xml/00/12/11/001211hngrave.xml?Template=/storypages/printarticle.html and Paul Murphy, Weighing the Pros and Cons of IBM's Mainframe Linux (LinuxWorld.Com, April 16 2002 [cited October 26 2002]); available from http://www.linuxworld.com/site-stories/2002/0416.mainframelinux.html.

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accounts to the system, mirrored those of traditional operations work. System administration jobs became increasingly specialized, because of the profusion of different kinds of specialized software. Networking specialists set up the physical and logical connections between different kinds of servers and personal computers. The sudden importance of corporate connections to the Internet and the provision of public access to corporate resources has greatly increased the scope and complexity of corporate computer networks. As a result, employment networking specialists grew very rapidly during the 1990s.

System administration and networking jobs ranked considerably above desktop support, but usually below experienced programmers and analysts, in terms of pay and prestige within computer departments. Compared to programming, analysis or management jobs they involved more hands on, craft-oriented kinds of work – more closely parallel to that of earlier generations of technicians who configured electrical systems or specified boilers than to the work of managerial technicians such as the systems men. They became increasingly separate from programming and analysis work, and appeared to have less scope for movement into managerial positions. Having said that, during the late 1990s, job market conditions drove up pay in many of these areas, particularly for such specialisms as an Oracle data base administration. Systems administration and networking were also the only IT jobs in which technical certification programs had achieved much success by the end of the 1990s. These programs were designed and administered on behalf of companies such as Microsoft and Cisco, and were closely tied to competence in their particular products. [1125]

During earlier decades, the market for packaged system and utility software such as data base management systems had developed more rapidly and more widely than that for application

[1125] For a roundup of current technical certification programs, see Diane Chen, Certifications 101 (CIO.com, 7 September 2000 [cited July 4 2001]); available from http://www.cio.com/forums/futurecio/edit/certifications101.html.

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software. The trend continued during the 1980s and 1990s. By 2000, the production of system software was a highly specialized skill almost entirely separate from the production of application software. For the most part it was handled by firms such as Microsoft and Oracle, and by specialist contracting firms staffed by the graduates of theoretically oriented computer science programs.

Despite the early claims made for end user computing, application programming remains alive and well as a corporate specially. Indeed, the number of programmers continued to increase during the 1980s and 1990s, though their proportional share of what was once called the data processing workforce may have declined. Packaged application software became far more important during this period. Its rise was hastened by the rapidly increasing use made of personal computers during the 1980s, coupled with the rising complexity of application development. The costs of developing a fully featured application package such as a spreadsheet, accounting or word processing program could amount to millions of dollars. As a result, it was far more cost effective for a firm to purchase a standard package and use a small subset of its features than to develop from scratch a program to provide the required capabilities. By the early 1990s, the market for such standard application packages was consolidated in the hands of a few companies, and by the end of that decade Microsoft products had more than 90 percent market share in many major application categories.

A similar process took place in the market for large-scale software application, run on mainframes or powerful servers and shared between hundreds of users. A single firm, Computer Associates, absorbed most of the major providers of mainframe software packages. Firms such as Oracle and SAP enjoyed great success in persuading multinational corporations to abandon their existing, custom programmed mainframe systems for things like accounts, inventory management and personnel and replace them with suites of standardized, integrated applications. In the 1960s

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almost all large companies created their own administrative applications; today, no firm would develop its own payroll or accounting programs from scratch.

Yet despite these developments, which eliminated most of the systems and application development tasks traditionally performed by corporate programmers, the amount of programming labor performed within corporations is higher than ever before. Much of this work was explained by the simple mass of so-called "legacy" systems. Almost any existing system required the continuing ministrations of a team of programmers, and as applications accrete so to do the ranks of maintenance programmers. Integrating a new system (whether packaged or custom built) with the existing application, changing business procedures, assimilating a merged company or adding a web interface requires additional programming work on the old application. A 1996 study claimed that 35 to 40% of all corporate programmer time was occupied in the construction and maintenance of routines intended to reconcile duplicate data stored in separate databases.[1126]

Just as important was the continuing stream of new development activity. A package such as SAP demanded an enormous amount of customization work, and was liable to require considerable reprogramming of the new and existing applications it had to work alongside. Likewise, packages such as Microsoft Office (a bundle of Word, Excel, Access, PowerPoint and Outlook) actually supported work for far more programmers than they displaced. Each of these packaged applications included a fully featured programming language, allowing developers to build custom applications in which capabilities such as the mail-merge capability of Word and the graphing capabilities of Excel were put to work within a custom administrative application designed around the data manipulation capabilities Access. These approaches dramatically lowered the cost of producing custom applications, and so substantially increased the number of

[1126] Koch, "The Integration Nightmare: Sounding the Alarm".

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companies able to afford them. This shift was part of a general move toward "object orientation," in which programmers assembled systems through the integration and extension of standard components rather than coding them from scratch in a general purpose language such as COBOL.[1127]

In doing so they have blurred the lines between systems and application software. Microsoft Word is clearly an packaged application, perhaps the most widely used in the world, but it is also an important development platform for custom applications. Another result has been the blurring of lines between programmers and non-programmers. Many specialists in financial or statistical analysis spend most of their time constructing elaborate spreadsheets and models, yet would not identify themselves as programmers. In a system such as Excel, where many users are writing programming code using macro recording features, no hard and fast boundaries can be drawn.

During the late 1980s and early 1990s, the idea of "open systems" was aggressively promoted by many computer companies. Connected to the spread of networked minicomputers and microcomputers, the slogan suggested that it ought to be possible to freely mix hardware, software and peripherals from different suppliers. The idea appealed to every major corporate computer supplied except IBM, because it made would make it possible for a firm with strengths in one area (such as terminals, printers or minicomputers) to compete effectively in this area without having to supply every piece of equipment required for a computer center. On the technical level it was accompanied by efforts to standardize interfaces and standards, particularly for network communication. While this kind of competition certainly eroded the large profit

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[1127] Fred Brooks did a nice job of contextualizing this trend toward the use of packaged software as components in Fredererick P Brooks, "The Mythical Man Month After 20 Years", in The Mythical Man Month: Essays on Software Engineering (Reading, MA: Addison-Wesley, 1995).

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margins IBM had enjoyed in many areas. firms found themselves landed with a great deal of additional work to integrate and test products from different suppliers.

By the end of the 1990s, applications were increasingly being spread over a number of different components or "tiers" running on different computers, each working with a particular kind of specialized system software. Back in the 1960s, a firm might have aimed to write all its administrative programs using a particular version of COBOL, in conjunction with a particular IBM mainframe operating system. Things got more complicated during the 1970s, with the influx of data base management systems and on-line applications, but most companies could still aim to deal with a limited number of technical specialisms involving the hardware and software products of a single supplier. In contrast, consider a very simple application of the late 1990s to provide something like a web page on which customers could check the current status of their orders. This could well involve data (stored using the SQL language) and portions of code (written in PL/SQL) buried within a data base system such as Oracle running on a Unix server, general logic on corporate procedures written in the Java programming language, application specific code running on a so-called "middleware" system such as Cold Fusion, and web pages presented by a web server program such as Apache hosted by a computer running Microsoft Windows NT, for viewing on an Apple Macintosh using a Netscape web browser. Other common functions, like credit card processing, might involve the addition of further products and layers to the mix. A lot of additional work might be required to link the new system to additional data bases and applications. Each of these software layers might run on a separate server computer, and require elaborate configuration and the use of further standards, products and languages to communicate with the others.

The combination of the new "n-tier" architecture with object-oriented programming theoretically made it much easier to reuse code and data between different applications, reduced the amount of programming and maintenance required to handle complex jobs like linking web

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pages to databases, and let smaller teams produce more powerful applications in much less time. Yet it also created hundreds of sub-specialisms based around particular versions of particular tools. Rather than look for a COBOL programmer with payroll experience, corporate job descriptions and resumes both listed dozens of obscure acronyms indicating the knowledge of particular areas of particular tools. New versions of each product arrived every twelve to eighteen months, and the successful completion of any product demanded a team with collective knowledge of all of them, and the ways in which they could be fitted together. Resumes were scanned into huge databases, and matched automatically with the acronyms included in hiring requirements. New specialties rose and fell very rapidly, leaving programmers to chase projects that might provide them with experience in the month's hot technology. The idea, fundamental to professionalization and certification efforts, that one could identify a common core of skills and knowledge required of a Registered Business Programmer or Certified Data Processor came to seem absurd. Programmers continued to identify more closely with particular skills than with companies, industries or professions, but those skills grew narrower and more ephemeral than ever.[1128]

This was, in part, because it was much easier to demonstrate and document experience with a particular coding standard or product than to show the kind of personal qualities and transferable skills that advocates of professionalism have always claimed to be more fundamental to productivity and a long term career. By the end of the century, the conventional wisdom in corporate computing management suggested that the skills and mindset required for different kinds of programming job might be so dissimilar as to make even the retraining of current programmers an inefficient alternative to the hiring of new staff already experienced in the new

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[1128] The topic of certification is debated in Cliff Brozo and Kewal Dhariwal, "Should CIOs Value IT Certification", CIO Magazine, February 15 2000 and discussed further in Tom Kaneshige, "Paper Chase", CIO Magazine, March 1 2000.

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technology. The Gartner Group, a premier supplier of research reports for IT managers, went to far as to issue a report purporting to show that it would be more cost effective to fire experienced COBOL programmers working on an old application than attempt to train them to use the newer Java language to tackle the same job. Despite the perennial shortages that often drove up wages for the holders of particular programming skills, corporate America as a whole tended to lag in its programmer training programs, with the result that demand for programmers and analysts with particular training outstripped supply.[1129]

The idea that corporate IT staff should see themselves as internal consultants assisting clients with their needs, promoted in the early 1980s along with the CIO concept, became a truism. IT managers discussed things such as how to brand their operations to raise visibility among corporate users, using measures such as snappy slogans or coffee mugs emblazoned with attractive logos. Because of the increasing complexity of modern application systems and the new dominance of packaged software over custom development, the corporate computing staff of the 1990s were increasingly serving as mediators between internal users and external providers of products and services. New job titles, such as "business relationship manager" have become increasingly important as IT departments devote an increasing proportion of their efforts toward improving internal relations. On the other hand, the very fact that such efforts are still widely discussed suggests that the perennial tensions between the computer department and the rest of the company were far from buried.[1130]

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[1129] See Bob Lewis, "Gartner, take a closer look: Is recruiting really better than retraining your programmers", InfoWorld, November 3 2000. Although some suggested that this represented prevalent age discrimination against older (better paid and less gullible) programmers there was little hard data to support the idea of widespread unemployment among this group.

[1130] For discussion of the new job titles given as part of attempts to tie together business and technical skills see Thomas York, "Business Specialists Needed: The convergence of business and technology is transforming IT", InfoWorld (April 6 1998). On the internal branding of the computer department, see Stephanie Viscasillas, "Brand I.T." CIO Magazine, January 15 2002.

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Because its budgets were growing so rapidly, IT provided a particularly tempting target for outsourcing. An aggressive new management culture, born with the corporate raids and takeovers of the 1980s, stressed the primacy of return on investment to shareholders over other measures of corporate success (growth, service to community, responsibilities to employees). This management philosophy was reinforced by newly aggressive shareholders, primarily pension funds and other institutional investors.[1131] In this climate, companies were encouraged to focus on their "core areas of expertise" in which they enjoyed some kind of unique advantage in the creation of "economic value added". It was more important to be profitable than large. As well as the divestment of peripheral divisions, companies sought to contract out specific tasks to specialist firms – for example security services, building maintenance and catering. Whatever the strategic merits of a great information infrastructure, much day-to-day computer support work (fixing computers, helping and training users, administering networks, installing new software) seemed more of an expensive distraction than a core competence.

The most basic kinds of work, such as supporting and servicing desktop computers, were increasingly outsourced to specialist organizations. By the end of the 1990s, the consensus among industry analysts was that the proportion of information technology work carried out a firm's own computer staff was about to decline sharply, as outsourcing became the exception rather than the rule. They expected consulting firms to dominate application development, and to largely take over such tasks as network and server administration and technical support. This idea was not new – as we have seen, experts had been predicating the imminent death of the corporate application programmer for decades, and facilities management and timesharing were heavily promoted during the 1960s and 1970s. There was also an element of self-interest, whether

[1131] Michael Useem, Executive Defense: Shareholder Power and Corporate Reorganization (Cambridge, MA: Harvard University Press, 1993).

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conscious or not, when analysis and consulting firms such as Gartner produced reports estimating that demand for consulting services would boom.[1132]

The newly ubiquitous nature of corporate computing and the break-up of the physical centralization of programming, operations and analysis work fostered by the data processing technologies of the 1960s may have played a part in weakening the idea that the different data processing jobs might amount to a unified profession or offer a career ladder from operations to programming. Although the corporate computing press still talked about overall groups such as "IT workers" or "high-tech workers," these vaguely defined umbrella terms lumped together some highly disparate kinds of job. According to the Information Technology Association of America, there were around ten million IT workers in the US in early 2002, a drop of about 5 percent from its peak during the technology boom a year earlier. About two million of this total were programmers. 92 percent of all IT workers were employed by firms whose primary business was not IT – in other words, they worked for banks, manufacturers, retailers and the like, rather than hardware firms, software firms, technology consulting firms or Internet firms.[1133] This is an important point to remember – much historical and economic discussion of the employment of computer specialists uses terms such as the "software industry" as if they encompass all or most programmers.

The holders of different computer-related jobs often blurred together in the minds of external observers. The Internet boom of the late 1990s, reflected through an incessant blizzard of media coverage, left many with the idea that the "geeks" and "nerds" of the computer world

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[1132] According to material presented by a Gartner representative to 10,000 computer industry leadeaders at its 1998 IT Expo, the firm predicted that the proportion of all "IT work" done by "internal" IT staff members would fall from 42% in 1998 to 20% in 2003. Source of "external" IT staff included "contract IT employees, infrastructure outsourcers, systems integrators, and consultants, plus business process outsourcers." Sandy Reed, "New Environment Will Require New Skills for IT Professionals of the Future", InfoWorld (November 16 1998).

[1133] Information Technology Association of America, Bouncing Back: Jobs, Skills and the Continuing Demand for IT Workers (Washington, DC: Information Technology Association of America, 2002).

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formed a new kind of elite, and that any skilled IT worker stood a good chance of following in the footsteps of Bill Gates (then the world's richest man). To belabor the obvious, it was Gates's entrepreneurial abilities and family connections that put him on the road to serious wealth, rather than his skills as a programmer. The skills and personal qualities needed to rise within the IT operations of a non-IT firm remained quite different from those demanded of an elite systems programmer or an entrepreneurial visionary.

Although the size and visibility of the self-proclaimed computer nerd community grew along with the general expansion of the IT workforce, it remained a mere subculture within the broader world of corporate IT. These people were the successors to the obsessive computer hobbyists and hackers (before the term took on its criminal connotations) of the 1970s and early 1980s. As described in the pioneering work of Sherry Turkle and Steven Levy, this subculture values engineering elegance and technical virtuosity, while rejecting conventional standards of personal presentation.[1134] Its members shared a faith in the power of technology to change the world, and sense of their own superiority to others based on their superior ability to manipulate technology. While some members of this community held advanced degrees or great programming talents, others were drawn into it as hobbyists and merely dreamed of technical feats while working in more menial technological jobs such as computer support and service. The discussants at websites such as slashdot.org (motto "New for Nerds; Stuff that Matters") shared a love for cool devices, open-source software and inspired tinkering and a general disdain for corporate culture. The technology boom of the late 1990s saw many of these values leaking into business culture, as investors rushed to fund companies with appealing technological concepts regardless of their business prospects. Gifted nerds were famously courted by startup companies,

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[1134] Sherry Turkle, The Second Self: Computers and the Human Spirit (New York, NY: Simon and Schuster, 1984). Steven Levy, Hackers: The Heroes of the Digital Revolution (Garden City, NY: Anchor Press/Doubleday, 1984).

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and offered impressive titles and perks such as free soda and lax dress codes. Yet, even at the height of the .com boom, only a tiny proportion of IT workers held stock options or were employed by startup companies.

The most senior and best paid jobs remained those intended to bridge the gulf between information technology and business. From the earliest days of data processing, analysts had earned more money than programmers, and managers had earned more money than analysts. These principles remained as true as ever in the late 1990s, though divisions between programmers and analysts have blurred from the 1970s onward. Promotion for corporate application programmers involved either increasing responsibility for analysis and liaison with customers, or increased responsibility for project management and the supervision of other programmers. More senior and experienced analysts took on responsibility for the overall design, or "architecture" of systems. As with engineering, career success takes one ever further from the technical work for which one was hired. Many leading consulting firms, the most immediately and generally well paid kind of non-managerial IT job, even preferred to hire candidates with a major other than computer science. The ultimate goal of the upwardly mobile corporate IT worker is to run all or part of the corporate IT group as a CIO.

## The CIO and the Internet

In 1994 the Internet, hitherto beloved of computer science researchers everywhere and almost unknown by business men and the public, exploded into general awareness. For the first few years, both reporters and researchers focused their attention primarily on the cultural and technological novelties involved in this new medium: virtual communities, newsgroups, downloads, and – more intriguingly of all – cybersex. As the newly-invented world wide web emerged as the key driving force behind the connection of the general and business publics to the

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Internet, a host of small startup companies emerged to provide a variety of tools to access and extend its capabilities.

This was the start of a new wave of business enthusiasm for the revolutionary power of the computer. The best known and most successful of the Internet firms was Netscape, creator of the first commercially successful web browser. Marc Andreessen, Netscape's co-founder and chief technologist, was twenty-two years old when the company was incorporated. Eighteen months later the massively unprofitable company offered its shares to the public. Netscape's shares doubled on the first day of trading, and three months later they had increased twelve-fold from the offering price. Andreessen was the new pin-up of high-tech business. He, his backers, and many of the programmers he hired were multi-millionaires.[1135]

During the next five years, hundreds of Internet firms were founded, funded generously by venture capitalists and encouraged to spend money freely in order to provide their services to as many people as possible. Their goal was to follow Netscape and offer themselves to the investing public as rapidly as possible, something that had never been easier to achieve since investors were happy to pay two, three or in one case six times the offering price for companies without profits or appreciable revenues. From 1997 onward, companies planning to sell goods or services over the Internet were attracting most of the attention, and were being valued by investors on the assumption that somehow the Internet would allow retailing (a notoriously competitive, low-margin sector of the economy) to achieve the massive gross profit margins and growth rates associated with successful software firms such as Microsoft. Billions of dollars were supplied to companies planning to sell groceries, pet food, furniture, garden supplies and even

[1135] The story of Netscape has been told many times, but the snappiest account is Michael Lewis, The New New Thing (New York: W. W. Norton, 2000), 80-86.

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hand-delivered ice-cream over the Internet – almost all of which vanished within two or three years.[1136]

No comprehensive analysis of this collective madness has yet been published, and it will take years for the long term effects to become clear. But it is clear that the ideas behind firms such as Webvan (an exemplar of hubris headed, let us not forget, by the former CEO of Accenture, then the world's largest consulting firm) spread far beyond the world of startups and into the heart of established and profitable corporations. Dozens of best selling business books promised manifestos, "rules for revolutionaries," and the advent of a new economy in which the Internet had changed everything. As so often before, consultants and academics jumped on the juggernaut. In one of the most influential articles of the era, expanded into a bestselling book, consultants Philip Evans and Thomas S. Wurster suggested that the power of the Internet was poised to "blow to bits" all established companies, "deconstructing" their "value chains" and turning their physical assets and experience into handicaps. Only by rapid and wholesale transformation could an already successful company hope to survive the onslaught of new competitors in all directions.[1137]

This argument prompted firms such as General Motors to survey their businesses with the assumption that they would have to "concede, co-opt or collaborate" with Internet startup firms in every facet of their operations. Jack Welch of General Electric, then universally lauded by the business press as the greatest manager of the late twentieth century, viewed the Internet as the key challenge facing his empire and used his trademark methods of inspirational speaking and personal intimidation to push his subordinates into launching hundreds of projects. The

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[1136] A well-received recent account of the rise and fall of the e-business startup firms is John Cassidy, Con: The Greatest Story Ever Sold (New York: HarperCollins, 2002).

[1137] Evans and Wurster presented their ideas in the widely influential Philip B Evans and Thomas S Wurster, "Strategy and the New Economics of Information", Harvard Business Review, no. 5 (September-October 1997). Expanded into book form, Evans and Wurster, Blown to Bits: How the New Economics of Information Transforms Strategy was one of the business best sellers of 2000.

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announcement of an Internet initiative by a huge corporation could instantly add hundreds of millions of dollars to its stock valuation, and many rushed to set up Internet-focused subsidiaries intended for sale to the public at inflated prices. At a time when stock immediately following its initial public offering valued niche on-line travel agent Priceline.com more highly than United Airlines, Continental Airlines and Northwest Airlines combined, this was an understandable reaction.[1138]

The rush to make all internal and external corporate activities available over the Internet was something of a mixed blessing for corporate computing managers. The idea that the Internet itself somehow dictated a time-scale so compressed as to make irrelevant the methodologies and approaches developed during forty-five years of corporate computing led to a proliferation of incomplete and overlapping systems. Web systems were often produced at divisional and departmental levels, and many firms placed control of web strategies in the hands of consultants or new "Chief Technology Officers" rather than firmly within the domain of the CIO. The technologies on which web-based application systems ran (such as web servers, programming systems and specialist tools to link web pages to data bases) evolved very rapidly – forcing those companies seeking to become "early adopters" to constantly alter their plans, retrain staff and recreate systems. Many web-based systems for things like order processing did not integrate closely with the existing software used to perform the same tasks – even companies that had spent millions to shift to the latest integrated software from firms such as SAP found themselves forced to create complex and hard to maintain workarounds to copy data between different systems. As a result, the immediate effect of the web for many companies was to retard and even reverse

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[1138] On General Electric's reaction to the Internet, see Marianne Kolbasuk McGee, "Wake-up Call: GE and GM Pumped Up E-business Efforts and Overhauled Their Old-line Businesses to Aggressively Counter Competitors."", Information Week, September 18 2000. On Priceline, see Saul Hansell, "Priceline.com Stock Zooms in Offering" New York Times 1999.

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attempts to plan and control the development of information systems and to integrate the information scattered across the firm in separate and incompatible databases.[1139]

Talk of revolution and rupture marked the late 1990s even more strongly than earlier periods. As a result, the CIO risked being seen as old-fashioned, dull and out of touch – focused on the boring tasks of technology support and operational systems rather than the exciting new world of Internet technologies and the creative destruction of the existing capitalist order.[1140] In 1997, as Internet hysteria blossomed, the annual CIO Magazine poll showed that the relatively unglamorous "aligning IS and corporate goals" and "organizing and utilizing data" remained the number one and two priorities of corporate CIOs.[1141] One report warned that "companies are leaving CIOs and the IS department out of the loop altogether and choosing to outsource e-business initiatives because of the perception that IT is too slow."[1142]

CIOs had spent many years working assiduously to present themselves as serious, mature, financially responsible business managers who viewed technology as a means to an end rather than a romantic adventure into uncharted territory. Suddenly, saturation coverage of startup firms in the mainstream press and in a rash of fat and glossy new publications such as Fast

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[1139] For SAP's problems with the web, see Christopher Koch, "Can You Do the WWW? Your ERP System is Up and Running. Your Business has been Reengineered. But Do You Have E-Commerce? Not Yet If Your Vendor is SAP." CIO Magazine, October 15 1999. On the implication of e-business for the CIO see Tom Davenport, "The Other Digital Divide: Battle Lines are Drawn as IT Managers and E-Managers Face Off", CIO Magazine, July 1 2000, Mindy Blodgett, "The Wolf at the Door: Worried About the Rise of the CTO? Well, Maybe You Should Be. The Trend Represents Both Threat and Opportunity for Sitting IT Executives", CIO Magazine 2000, Susannah Patton, "Amicable Split: Companies are Dividing IS Staffs to Better Compete in the Internet Race", CIO Magazine, September 15 2000, Ephraim Schwartz, Raft of CEOs Critical of IT's Contribution to Business Results (InfoWorld Electric, 6:22 AM PT, Apr 30, 1999 1999); available from www.infoworld.com and Tom Field, "IS at the Crossroads: Free to Lead", CIO Magazine, June 15 2000.

[1140] Blodgett, "The Wolf at the Door: Worried About the Rise of the CTO? Well, Maybe You Should Be. The Trend Represents Both Threat and Opportunity for Sitting IT Executives".

[1141] For CIO priorities, see James P. Saviano, "Are We There Yet?" CIO Magazine, 1 June 1997. The idea of e-business had not, however, escaped the notice of the CIOs – the report also mentioned that, "'Capitalizing on advances in IT' and 'using IT for competitive breakthroughs' -- numbers 15 and 13, respectively, just two years ago, are tied for third in 1997."

[1142] Eric Berkman, "Why We're Still Talking about Alignment", CIO Magazine, January 1 2001.

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Company and Business 2.0 suggested that the fame and money CIOs had longed for were being lavished on firms made up of strangely dressed twenty-somethings with no real business experience, erratic work habits and a deep-seated faith that youth and technology made conventional managerial training a handicap. Everyone involved with the application of computers to business was expected to possess vision, passion, and ability to speak a strange new jargon full of value propositions, clickstreams, business models, and disintermediation. Still, the fads and fantasies of the new economy years did at least convey to top executives the idea that computer technology could change the very shape of their businesses, something CIOs had been pushing for years with limited success.

The Internet boom also pushed companies to update their data base systems, to computerize new areas of the business, and to take seriously the old-dream of providing customers and suppliers with constantly updated electronic information. As we saw, the idea was current back in the 1960s, and under the name EDI (Electronic Data Interchange) it become a reality during the 1980s for many firms producing things like auto parts. Only in the late-1990s, however, did the idea really obtain critical mass. By the start of the new century, firms such as SAP were providing web-based interfaces to their products and redesigning them in a more modular fashion for easier interconnection with other systems. Today, managerial and professional employees now have access to corporate "intranets" designed to place information, forms and interactive access to computer systems using standard Internet tools. By standardizing the hardware, software and network connections required to access systems, the web made it far easier to share computer systems with a broad range of users in different parts of the same company, or in different companies.

Despite the failure of so many Internet firms whose existence was premised on the instant and wholesale transformation of business, corporations continue to use the evolving technologies of the Internet to move toward a future in which standard software tools are used to conduct the

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vast majority of routine business transactions and communication on-line. The same technologies are making it ever easier to connect spreadsheet and analysis software to corporate databases, and to provide management with the on-line access to information about the current status of the company. Many of the predictions made forty years ago for the capabilities of MIS systems are finally coming true on the technical level, though the relationship of this to a possible managerial revolution remain rather unclear.

In most firms, the CIO remained a manager of computer technology rather than a strategic visionary or board member. Critics continued to fault CIOs for their technical mindset, and point to widespread problems in controlling computer costs and delivering promised systems. Few had a realistic chance of rising to head their companies.[1143] Even during the Internet boom, CIO Magazine warned its readers that "users root for their IS departments to get outsourced" and that "CEOs don't see the [IT] organization adding any value." A survey of chief executives claimed to show that only a quarter of them felt their CIOs were doing an average or better job in contributing to business results.[1144] By 2002, many CIOs complained that Internet hype had made executives more skeptical about the claims to technology to transform, or even provide benefits to, their businesses.[1145]

## The Two Cultures of Corporate Computing

When the first administrative computers were installed back in the 1950s, few outside the rapidly growing community of corporate data processing specialists had any real understanding of

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[1143] David Pearson, "Trail to the Chief: A Question For Those Whose Careers Have Plateaued at CIO: Could You Run the Business?" CIO Magazine, August 1 1999. Davenport, "The Other Digital Divide: Battle Lines are Drawn as IT Managers and E-Managers Face Off".

[1144] Tom Field, "IS at the Crossroads: Back from the Brink", CIO Magazine, 15 June 2000.

[1145] Abbie Lundberg, "Courage", CIO Magazine, March 15 2002. With the recession of 2002, CIOs faced particular problems as they attempted to reduce costs and deal with the disappointments incurred by many Internet, ERP and CRP initiatives. See Alison Bass, CIOs Between a Rock and a Hard Place (CIO Magazine, October 17 2002 [cited October 25 2002]); available from http://comment.cio.com/crm/101702.html.

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how the machines worked, what their capabilities were, or what opportunities they opened up. Keeping current with changing answers to these questions was something close to a full time job. As a result, the execution of ever larger swathes of business administration, such as stock control, order processing or payroll processing, vanished inside a black box. All that general managers knew was that computer systems were very hard to change, were usually delivered late, and gobbled up ever increasing amounts of money. This created something akin to C.P. Snow's famous description of two cultures, each seeming alien to the other.[1146]

In the late 1990s, as in the early days of data processing, it was universally agreed by those writing from a managerial viewpoint that technical skills have little relevance to success in computer management. A recent survey conducted by CIO Magazine reiterated this message, with the opening suggestion that, "If you want to succeed as a CIO, shut off the computer, toss aside the code and bone up on your corporate-executive skills." The CIOs polled picked communication, an understanding of business processes and strategic thinking as the top three skills for those hoping to rise to assume senior positions with computer departments. Technical proficiency came in last place (chosen by just 10% as one of the most important three of the seven skills specified), behind negotiation skills and salesmanship.[1147]

Indeed, even in organizations specializing in the application of computers to business the "technical" can carry a kind of stigma. An insightful piece of ethnography by Janet Rachel and Steve Woolgar explored this issue within a major computer services firm. Interviewing specialists working in different parts of the firm, they found that each interviewee located "technical work" elsewhere. To a change management specialist (working with users to adapt work practices to the new system) all programming and development work was technical, but members of the

[1146] C P Snow, The Two Cultures and the Scientific Revolution (New York: Cambridge University Press, 1959).
[1147] Eric Berkman, "The State of the CIO: Skills", CIO Magazine, 15 March 2002.

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application programming teams saw only the complex database parts of the project as technical. The data base designers themselves did not consider their own work technical, though they did view the work of the programmers who created the system tools they used as technical. In this firm, at least, the "technical" served its members as a black box in which to encapsulate the work of others, work that they did not themselves understand or really wish to understand. While others, such as Gideon Kunda, have explored the corporate cultures of IT firms in which the claim to be technical served as a badge of pride for managers, the experience of Rachel and Woolgar is almost certainly more deeply representative of that found in most corporate computing installations.[1148]

The most rewarding first-hand account of life as an application developer during the mid-1990s came in Ellen Ullman's book, Close to the Machine. Its title evoked the mindset of many talented programmers, for whom the production of quality work required a kind of mental bonding with the computer system being produced, an internalization of its quirks and embedded assumptions. As Ullman described it, effective programming work required the programmer to enter a trance-like state in which awareness of the broader world was temporarily excluded. To the disappointment of those who advocated a more systematic, more repeatable and orderly approach to application development work, many of those working as application developers continued to believe that successful projects must rely on the efforts of a few exceptionally gifted programmers. The idea was captured in the title of another recent book intended to prepare

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[1148] Janet Rachel and Steve Woolgar, "The Discursive Structure of the Social-Technical Divide: The Example of Information Systems Development", The Sociological Review 43, no. 2 (May 1995):251-73. Gideon Kunda, Engineering Culture: Control and Commitment in a High-Tech Corporation (Philadelphia, PA: Temple University Press, 1992).

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supervisors without programming background for the experience of motivating and dealing with programmers: Managing Einsteins.[1149]

The cultural chasm between technical workers and their managers was the unlikely central theme of the enormously popular late-1990s comic strip Dilbert. Much of its humor stemmed from the mutual incomprehension between the eponymous long-suffering engineer and his manager, who had not idea of what his team was supposed to be doing or how they might go about doing it. Most of the team's problems were invariably inflicted by the blundering and incompetence of their own managers, rather than any inherent technological challenges. The boss was drawn with two small tufts of hair which, as the character evolved, became ever satanic in their overtones. In one 1994 strip, the boss announced to Dilbert that, "I saw the code for your computer program yesterday. It looked easy. It's just a bunch of typing and half the words were spelt wrong. And don't get me started about your overuse of colons." Indeed, the term "PHB" for Pointy Haired Boss entered the discourse of nerds as a generic description of supervisors who, despite a complete lack of understanding of the technical issues involved, refused to defer to the wisdom of their underlings and instead forced them to undertake pointless projects or use perverse methods.[1150]

These modern folk tales pointed toward the central dilemma of the corporate IT worker. On the one hand, computer technology remained extraordinarily complex and changed extremely rapidly. To retain technical competence, one had to learn new ways of thinking and new tools on a regular basis. In addition, to excel as an IT worker, and in particular as a programmer, demanded the development of particular ways of thinking, developing an ever closer rapport with the inhuman and inflexible world of the computer. But, on the other hand, managers of corporate

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[1149] Ellen Ullman, Close to the Machine : Technophilia and its Discontents (San Francisco: City Lights Books, 1997). Tom Duening and Jack Ivanevich, Managing Einsteins: Leading High Tech Workers in the Digital Age (New York: McGraw-Hill, 2002).

[1150] Scott Adams, The Dilbert Principle (New York: Harper Collins, 1996), 15.

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computing efforts had from the very beginning downplayed the importance of technical skills, stressing instead the need for careful analysis of business problems, an ability to deal with customers and basic skills of teamwork and disciplined, methodical progress. The IT worker was forced to navigate between these two cultures.

An junior or mid-level computer department manager was thus caught in the middle. Furthermore, technical skills became obsolete so rapidly that it was almost impossible to adopt a managerial or supervisory role and retain hands-on ability. To her subordinates within the IT world, she appeared to be a "suit," someone thoroughly assimilated into the alien culture of management and without any core of true technical competence. To executive peers, on the other hand, the same manager might appear an introverted technician concerned more with machines than with people, unable to keep promises, and without a real feel for the operational and financial management concerns that dominated managerial culture. Indeed, all the discussion of the CIO as a manager first and a technologist second seems to have had an unexpected effect. While few non-technical managers shifted into CIO careers, ambitious computer managers did learn to disparage the importance of technical knowledge.

## Beyond Information

The concepts of the CIO and of information management served to justify a rather odd combination of duties. The CIO as someone responsible for "managing information" implied a broad authority over the firm's entire stockpile of facts. How authority over information could be separated from general management authority was never entirely clear, but this was an attractive dream. In practice, this translated to the idea the CIO should make sure that data base systems were full of the right kind of information. Then there was the MIS sense, implicit in talk of the CIO as someone responsible for information systems, of the CIO as the person responsible for informing management. This justified the CIO's authority over the construction of new computer

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applications. Many of these had little to do with information in the grand sense, but instead automated simple but crucial business operations. Walmart, for example, used computerized inventory management systems as part of a much broader strategy to boost its efficiency. While computer executives had a part to play here, it was hard for them to take the initiative in such far reaching and integrated changes.[1151]

In practice, however, much of the CIO's energy went on a third topic: managing information technology. This meant negotiating with suppliers of hardware and software, setting technical standards for internal application development, and so on. The CIO was also responsible for the technical support teams, training efforts, and other services arranged for the firm's computer users. Then there were the duties common to any manager with direct responsibility for the running of a large department, such as hiring and supervising employees, managing a substantial budget, making financial projections and so on. While the strategic, visionary elements of the CIO's job received most of the hype (and were always predicted to increase in importance in the near future), these routine tasks of managing computer technology and providing basic services requested by users continued to dominate the actual work of most CIOs.

By blurring these three activities together, the designation of computer as information technology and of data processing managers as information managers addressed the fundamental problem of the managerial technician: how to make a claim to managerial authority on the basis of technical expertise. Any computer specialist eager to rise into the higher levels of corporate management faced this stigma, and would struggle against the perception that his or her expertise

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[1151] See Sandra Stringer Vance and Roy V Scott, Wal-Mart: A History of Sam Walton's Retail Phenomenon (New York: Simon & Schuster, 1997). Because the overall strategy had shaped the whole company, including its design of stores, placement of warehouses and methods of transporting goods, competitors such as K-Mart found it impossible to replicate by installing computer systems. Michael Schrage, "Wal-Mart Trumps Moore's Law", Technology Review (March 2002). Christopher Koch, "It All Began With Drayer", CIO Magazine, August 1 2002.

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lay in an area that was technical rather than truly managerial. The same problem applied to consultants trying to gain the interest of top management in broader applications of computer technology, to academics looking to establish the study of business computing as a legitimate sub-discipline, and to computer vendors eager to sell more and more elaborate systems.

Whereas expertise in data processing or in computing appeared purely technical, expertise in information appeared to bridge the chasm separating these two worlds. Information blurred all kinds of boundaries. Technical expertise in information systems or information technology appeared to be, in itself, a claim to managerial authority. (Remember Synnott's claim that "issuance of corporate policy and instructions is, in fact, an information service.") As we have seen, from many viewpoints it was a spectacular success. Computer-related work supported a massive increase in the size of the consulting industry during the late 1980s and 1990s. MIS achieved respectability within business schools. Computer managers received their new title of CIO, and rose up the organization chart.

In some ways, information remains a technological fix so powerful that the exact problem it fixes need never be defined. Promises to pipe better information to more decision makers, current to the millisecond, seem as compelling today as they did around 1960, when MIS and total systems concepts first enthused the systems men. In 2002 Vinod Kholsa, venture capitalist, and co-founder of Sun Micro Systems, addressed an industry forum. His Silicon Valley successes had made Kholsa one of the celebrities of the new economy, earning him a reputation as a technological visionary and business genius. His speech was full of references to the latest and greatest software technologies: "componentized" applications, web services, and a new "meta architecture" to couple business processes to computer logic. Yet all these hot new buzzwords were applied in service of a concept that would have seemed familiar to any attendee at the 1962 meeting of the Systems and Procedures association. This new concept was "the real time enterprise" (enterprise being a fashionable term for a large company). According to Kholsa, "[i]n

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the real-time corporation, as you remove costs you migrate quality because information becomes more current and because you are eliminating steps of inefficiency in the way the company works." His assertion that, "[b]ecause information comes in real time, senior people get to make more decisions" suggests little intellectual evolution had taken place over the intervening decades.[1152]

There have also been some problems. Systems and approaches aimed, in non-specific terms, at building stockpiles of information or improving managerial decision making have not as a whole been particularly successful. While a spirited debate continues, it is by no means clear that computers have boosted overall economic productivity, or that firms spending more on computers have been more successful than those spending less. Though some computer systems have undoubtedly paid for themselves many times over, these may have been cancelled out by the large numbers of failed or misconceived applications of computer technology. The language of information, which appears to imply a clear link between "information technology investments", "information resources" and improved decision making, has undoubtedly played a role in legitimizing some of these more dubious applications.[1153]

As a bridging device, information's success has been limited. It has tended to crumble when computer managers have tried to cross it, and enter the world of executive management beyond. The information executive was supposed, after all, to be a centaur, "part IS horse, galloping beside the fast-paced changes in technology, but from the waist up a savvy general

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[1152] Jack McCarthy, Sun Founder Touts 'Real-Time Enterprise' (InfoWorld.com, April 9 2002 [cited April 10 2002]).

[1153] On the so-called productivity paradox, see Jenny C. McCune, "The productivity paradox: do computers boost corporate productivity", Management Review 87, no. 3 (March 1998):38(3) and Pam Woodall, "Survey: The New Economy -- Solving the Paradox", The Economist, 23rd September 2000. Strassmann, The Squandered Computer, written by a former computer manager with extensive corporate and government experience, includes some excellent discussion of the techniques used to justify computer spending. A rather mild critique of information hype, notable for its co-authorship by a technology celebrity and head of Xerox's famous PARC laboratory, was delivered at the height of Internet mania as John Seely Brown and Paul Duguid, The Social Life of Information (Boston: Harvard Business School Press, 2000).

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manager." To revise a question attributed to Churchill when faced with a similar proposition, "what if it got my brains and your body?" Too often the CIO, intended to blend in with technical staff and general managers alike, seemed like an outsider to both camps: the intellectually challenged head of a horse on the panting body of a manager.

By the end of the twentieth century, the increasingly tight association of information with the routine use of computer technology led many of those arguing for novel and managerially oriented applications of technology to seek new terms. Its very ubiquity had robbed it of its power to differentiate an idea as futuristic. Its intimate association with information technology and information systems had begun to stigmatize it as too low level, too technical. In other words, it had become a victim of its own success. When it comes to business jargon, we may be entering the post-information age. In twenty years, the CIO will probably as out of date as the data processing manager would today.

"Business Intelligence" emerged as a new term for the provision of improved information to boost business performance. This concept of intelligence was frequently associated with the output of data warehouse systems – indeed, when the magazines DBMS (standing for Data Base Management System) and Database Programming & Design were merged they were renamed Intelligent Enterprise. As always, the new buzzword was promoted as the response to a sudden change in the business environment. According to the computer industry newspaper InfoWorld, "[w]hat's driving interest in BI services is the pace of Internet business. Companies no longer have the luxury of figuring out what went wrong or right with the business three months to nine months after the fact."[1154] By an interesting irony, this term had actually been popular during the 1950s. In 1961, James D. Gallagher, the McKinsey consultant and key promoter of the MIS concept within the American Management Association, wrote that, "[s]uch business intelligence

[1154] Vizard, "Yahoo and IBM head for a collision on the road to business intelligence".

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systems will go far beyond the limits of classical accounting information to process and analyze a broad range of data--non-financial and financial--that are needed by top management to run the business."[1155] The spread of information as the preferred designation of managerially relevant computer use appears to have edged out discussion of "intelligence" for most of the next forty years. Its sudden return seems to signal that information had become too closely associated with the routine use of computer technology to convey and appropriate weight.

"Knowledge" has likewise made a comeback. By the mid-1960s information had largely edged knowledge out of business discourse. Nobody much talked about knowledge processing, or the knowledge industry, or knowledge processing, or business knowledge systems, or the knowledge revolution. In the 1990s, however, knowledge management became a hot new topic. Whereas information now seemed to designate the use of computers for routine administrative tasks and highly structured quantitative and numerical data, knowledge was the new term for less structured material such as the best ways to tackle a particular design job, or consulting project. Knowledge management was soon the subject of many articles, books, lavish conferences, trade shows, and consulting assignments. The term was used increasingly broadly, and applied to database systems and other software tools intended to build "knowledge repositories" where knowledge workers could deposit their knowledge for others to tap into. Salesmen promoted their packages as instant solutions to knowledge problems. As they had done earlier, when discussing information management, the more thoughtful experts decried this rush for the technological fix,

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[1155] James D. Gallagher and Douglas J. Axsmith, "Data Processing in Transition: Can Management Manage EDP of the Future?" in EDP: The First Ten Years. Highlights of Management Experience and a Look Ahead, ed. McKinsey & Company (Chicago: American Society for Public Administration, 1961). See also Ray Eppert, "A Central Intelligence Program for Management" (paper presented at the Systems and Procedures Association of America, 1956) and Bello, "How to Cope with Information".. On the more recent use of business intelligence, see Vizard, "Yahoo and IBM head for a collision on the road to business intelligence".

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and instead focused on the need for cultural change, executive support and the careful identification of business needs to create an atmosphere of knowledge sharing.[1156]

In practice, however, the term knowledge management was attached so indiscriminately to software products, consulting services and internal corporate products that its peak of hype came and went without a coherent definition ever actually emerging.[1157] While some of the activities conducted under the knowledge management banner were new, many were not. In 2000, Peter Senge, a leading proponent of the 'learning organization' quoted an acquaintance "responsible for the IT business in a big part of [a large] company" as musing that "15 years ago, I was an EDP expert, then I became a MIS expert, then I became an IT expert, now I am a knowledge management expert. But, all this time I have been doing pretty much the same stuff."[1158]

Along with knowledge management came the Chief Knowledge Officer (CKO). Despite early hopes that the data base administrator could be responsible for data of all kinds, and that the chief information officer would hold a mandate over all corporate information, both positions had soon developed an exclusive focus on computer technology and highly structured computerized records. The CKO, therefore, was a new attempt to succeed where these had failed and create an executive responsible for the kinds of hard to formalize information vital to effective management. A 1999 article by Michael Earl, formerly one of the MIT promoters of "decision support systems," suggested that the CKO was concerned with "20 percent technology and 80

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[1156] For discussion of knowledge management, see Thomas H. Davenport and with Laurence Pursak, Information Ecology: Mastering the Information and Knowledge Environment (New York: Oxford University Press, 1997) and Erick Berkan, "When Bad Things Happen To Good Ideas", Darwin Magazine, April 2001.

[1157] As early as 2000, Davenport noted that "knowledge management is no longer the next big thing. It had its day in the PR sun but now has been eclipsed on the hype-o-meter by electronic commerce. You'd be nuts to try to market a new conference or a new book on plain-Jane knowledge management." Tom Davenport, "The Last Big Thing", CIO Magazine, November 1 2000.

[1158] Peter Senge, "Reflection on 'A Leader's New Work: Building Learning Organizations'", in Knowledge Management: Classic and Contemporary Works, ed. Danyl Morey, Mark Maybury, and Bhavani Thurasingham (Cambridge, MA: MIT Press, 2000).

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percent cultural change" and included quotes from CKOs such as the enigmatic, yet defiantly non-technical, "I spend 90 percent of my time creating markets for conversations." He glorified his small sample as entrepreneurs, environmentalists, self-starters, risk-takers, strategists, "eclectic change agents" and "unusual and arresting people." "The qualities required of the CKO," he concluded, "are an unusual and perhaps rare mix...." The CKO must combine the "technological, systems, and informational perspective of the CIO" with the "softer, organizational, and process-oriented perspective of the human resources specialist" and the "strategic, integrationist, and enterprisewide (sic) qualities of the CEO."[1159]

It is as yet unclear whether the CKO will prove a passing fad or a permanent feature of the corporate landscape. It is, however, clear that its popularity reflects the idea that information is too closely associated computer technology and the CIO to continue to serve as a more general description of organization knowledge. Advocates of knowledge management cast information management as narrow and technical, just as advocates of information management and management information systems had cast data processing as narrow and technical. As one article put it, "information management is a subset of knowledge management," concerned only with finding information and moving it around, rather than the broader questions of creating and using it.[1160]

The Internet gave rise to a proliferation of ugly neologisms in which e- (standing for electronic) and cyber- were appended to words such as commerce, marketplace, university, and management. Whereas information had been prominent in the new terms of the 1980s, in the 1990s the information superhighway was the only main new piece of information jargon. Interestingly, both electronic (as in electronic data processing) and cyber (as in cybernetics) had

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[1159] Michael J. Earl and Ian A. Scott, "What Is a Chief Knowledge Officer?" Sloan Management Review 40, no. 2 (1999):29(1).

[1160] Wendi Bukowitz and Ruth Williams, "Knowledge Pool", CIO Magazine, July 15 2000.

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been widely used in the neologisms of the 1950s. While their allure of modernity had quickly worn off, by the 1990s it had evidently regenerated itself.[1161]

Academic theorists, and consultants keen to appear insightful, tried to formalize the distinctions between knowledge, information, and data. These definitions generally used data to refer to the bits and bytes stored within computer systems. Data was then turned into information when extracted from a database and summarized to give averages, totals and so on. Most models added additional levels. One consultant, for example, proposed that data was turned into "analytic" by discovering trends and relationships, that knowledge was "the next level of elevated understanding," and that "wisdom is the utilization of accumulated knowledge." The same author paired each of these "levels of understanding" with a particular technology. Information, for example, corresponded to "ad hoc query and reporting applications," whereas knowledge was the province of "data mining applications," and wisdom the sole domain of the human mind. Other models omitted analytic and included alternatives, such as the insertion of intelligence between knowledge and wisdom. As with the process of advertising one-upmanship that made the 14-speed kitchen blender a standard, there would seem no inherent limit to the number of different levels one might propose.[1162]

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[1161] The revival of all things cyber can be traced to the adoption of this piece of dated futurism to describe the work of a school of early 1980s science fiction writers, the cyberpunks. William Gibson, the most prominent of these authors, used to prefix to coin the term cyberspace. The revival of electronic took place as a generalization of the term email, a contraction of electronic mail.

[1162] Jonathan Wu, Business Intelligence: The Transition of Data into Wisdom (DM Direct, November 2000 [cited 26 June 2002]); available from http://www.dmreview.com/portal_ros.cfm?NavID=91&EdID=2524&PortalID=17.

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**Figure 45: A typical representation of the "knowledge hierarchy" in pyramidal form. This was a cliché of the late 1990s.**[1163]

These particular definitions made remarkably little sense, and indeed any attempt to draw coherent distinctions between, say, knowledge and information is unlikely to succeed. One must contend not only with the slipperiness of these concepts, but also the long history of overlapping and contradictory usage. For an example of this, it is hard to beat the definition given in a 1957 report produced by accounting firm Haskins & Sells: "Data originated in the human mind. Data is information -- a piece of intelligence."[1164] They suffer particularly from the problem that information theory describes data, and that the word information is used to describe both a single level and the entire pyramid. Such schemes do, at least, have the virtue of suggesting that information is something produced when computerized data is processed in some way, rather than using the term for the raw data itself. On the other hand, they reserve a term such as wisdom for what we used to call information, the useful facts communicated to a human mind.[1165]

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1163 Ibid.

1164 Haskins & Sells, Introduction to Data Processing: An Outline of Basic Data-Processing

1165 Ibid.

1164 Haskins & Sells, Introduction to Data Processing: An Outline of Basic Data-Processing Operations and Methods.

1165 One is also faced with the problem that data cannot be gathered or stored without the guidance of human wisdom in the first place, and hence is not as neutral as the model suggests, a point made recently by Iikka Tuomi. Ilkka Tuomi, "Data Is More Than Knowledge: Implications of the Reversed Knowledge

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# 15. CONCLUSIONS AND FURTHER RESEARCH

The extended introduction includes an extended discussion of the methodological and conceptual relevance of the perspectives adopted in this dissertation to major themes in the history of technology, business, and labor. My comments here are intended to recapitulate the central theme of the dissertation, and to address its relationship to more specialized current and future work.

## Continuity and Change for the Managerial Technician

The dilemma of the managerial technician remained essentially the same from the 1910s through to the 1990s: how to assert unequivocal technical authority over the machines and minutiae of administrative systems while at the same time establishing sufficient managerial legitimacy to claim a decisive role in the reshaping of corporate structures and the transformation of managerial practices in ways made possible by the new technologies. How to reconcile the managerial and the technical; the why and the how.

The continuing status anxiety of the chief information officers of the 1990s demonstrates that this issue was never resolved. Despite the efforts of many different groups to redefine managerial authority and to inculcate managerial class consciousness within the rank-and-file of corporate computing, the computer executive was in constant danger of becoming an oxymoron. While the contradictions facing the managerial technician have yet to be resolved, this does not mean that nothing of importance altered during the period. Indeed, technological and institutional changes led to a massive increase in the numbers, prominence and importance of managerial technicians. Change took place on many different timescales. However, the areas to which

Hierarchy for Knowledge Management and Organizational Memory" (paper presented at the Proceedings of the 32nd Hawaii International Conference on System Sciences, Maui, HI, January 5-8 1999).

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administrative technologies were applied, and the ways in which they were used, changed much less rapidly than the technologies themselves. Occupational identities and corporate institutions changed still more slowly. Human nature did not change at all.

In the 1910s, Leffingwell and Galloway had already most of the key rhetorical ingredients used by later pamphleteers. They called for the centralization of functional authority over all administrative processes. They suggested that new technology could dramatically boost productivity, but only if introduced as part of a fundamental reorganization. Benefits, they insisted, would stem from systematization and specialization, not from the mere presence of machines. They argued that design of inter-departmental administrative processes was a specialist task, and that it should therefore be placed in the hands of those who best understood the means by which these systems could be efficiently implemented. They used flowcharts to diagram the flow of these processes. They even produced organizational charts showing that administration deserved recognition as a primary corporate function alongside sales and production.

Yet these ideas proved very much less powerful during the 1920s than they were to become by the 1950s. The much improved reception given to them during the 1950s and 1960s can be explained by three key shifts, two intellectual and one technological. The technological shift is the most obvious: the introduction, during the mid-1950s, of the first electronic computers designed for administrative use. Whereas attempts to centralize authority over files, forms and typewriters had been easy to resist, computerization created a well-funded and high profile electronic data processing center in which increasingly large volumes of administrative activity took place. Likewise, while bookkeeping machines worked with traditional paper records, and even punched cards could be read with the naked eye, the invisible magnetic signals encoded on drums, tapes and disks could be interpreted only with the aid of specialists and expensive machines. Managers who might have seen no reason to engage specialists to document and improve administrative procedures, or to advise on the use of dictating machines, now had no

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choice but to rely on computer programmers to encode and formalize the smallest details of these operations. Technology did not dictate the corresponding centralization of control over the analysis and design of these administrative systems, indeed this remained a question of heated debate, but there can be no doubt that computerization greatly aided in this process and created a formidable platform on which expert authority could be constructed.

The second key innovation was the acceptance and expansion of the concept of staff (as opposed to line) management authority for managerial technicians. Many firms of the 1950s created staff groups in a number of areas and provided them with a mixture of advisory and functional authority over specific areas. The systems men, heir to many of the techniques and ideas pioneered by the office managers and office machine salesmen of the 1910s, distinguished themselves by their strong preference for corporate-level staff appointments and their phobia for the actual supervision of clerical workers. They tried to separate responsibility for the design and specification of new systems from the continuing oversight of their execution. The expansion and diversification of corporations during the post-war era helped them to achieve some success in this, though their attempts to gain autonomy and recognition as generalist managerial experts enjoyed only limited success.

These two innovations were hard to reconcile. Systems work was best conducted on a staff basis, whereas data processing involved the assumption of direct responsibility for the routine operation of administrative processing. This was, admittedly, the supervision of computers, operators, programmers, and keypunch operators rather than that of clerks, typists and bookkeeping machines – but it still dragged one into the mire of direct responsibility for clerical production (most commonly somewhere within the empire of the corporate or divisional comptroller). Punched card installations, the less glamorous ancestors of most electronic data processing departments, had exercised little control over the design of the systems they processed.

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The third innovation, adopted largely in order to reconcile aspirations to staff authority over administrative systems with the emergence of computer departments as important corporate institutions, was the concept of the information system. From the late-1950s onward, those seeking to turn the computer department into a seat of true managerial power laid claim to functional, technocratic authority over the manipulation of information. Information was, in this sense of a quantity that could be stored and even created by machines, a new category in managerial thought. Its acceptance was inseparably tied to the new enthusiasm for electronic computers. It provided ambitious computer staff of the 1960s with something that earlier managerial technicians had sought for in vain: a single intellectual category in which the technology of clerical production and the managerial tasks of creating administrative systems were seamlessly joined. Over time, linguistic usage shifted until "information" no longer implied that anyone was necessarily informed of anything. Instead was born the idea of information as the content of an information system, something processed with information technology that could be stockpiled as a resource, stored in an information bank or data base, and drawn upon as a strategic resource. Information was, in the rhetoric of the 1970s and 1980s, something as real and as vital to corporate success as money. The chief information officer was born as an attempt to appropriate the legitimacy of the chief financial officer.

This points toward the continuing gulf between technical expertise and managerial expertise – categories that, "information," as an area of professional expertise, promised to blur. Viewed as a tool for granting managerial status to the application of computers and other administrative technologies, information has enjoyed only a qualified success. The spread of information as a concept rests on its ability to absorb contradictions and bridge technical and managerial discourse; however this bridge is something of an illusion, and has often crumbled when people have tried to walk over it. In recent years, its close association with computers has

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even begun to shake the popularity of "information" expertise as a claim to true managerial relevance – hence to rise of "knowledge management" and the "chief knowledge officer".

The concept of system runs right through this story. It has evolved from the early days of systematic management, System magazine, and visible card filing systems, through the total system (and many variations thereof) and the management information system, to widespread discussion of information systems in the more recent past. Its appeal perhaps peaked in the early 1960s, at which point expertise in the universal characteristics of systems appeared to many as the basis for a truly scientific approach to the problems of management. During the 1970s, the "information" part of (management) information system gradually overshadowed the "system" part, so that today the term system is still ubiquitous but has lost much of its allure. It seems something more technical, used to describe a computer system or an operating system, or what would previously have been called a computer application.

Behind all the verbiage devoted to systems lay a kernel of common sense. In one way or another a single point has been made by systems thinkers from Leffingwell onward, through data processing experts such as Richard G. Canning and Robert V. Head, to more recent thinkers on supply chain management or business process reengineering. Peter Drucker, the original management guru, famously observed that it was much more important to spend time working out the best thing to spend the same amount of time in efficiently implementing the wrong idea.[1166] Thinking along similar lines, each generation of concluded that it is pointless to apply technology to the automation of a bad system. First, the system must be studied and improved. Rather than improving efficiency in each step of the existing system, the aim must be the production of a new system, using technology to achieve an optimal solution to the problem as a

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[1166] Peter Ferdinand Drucker, The Effective Executive (New York: Harper & Row, 1967).

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whole. This has proved to be much easier said than done. It is unclear whether the structural divides separating the computer technician from the manager will ever be entirely removed, or if the chaotic process of continual organizational redesign can be blended with the technocratic authority of the computer systems specialist.

A historical perspective makes clear that recent and apparently novel attempts to combine organizational redesign and technology, such as business process reengineering, have merely served to reenact earlier cycles of raised expectations and dashed hopes. How can ideas so tarnished have appeared so novel? One answer is that a persistent strain of technological utopianism has served to make old ideas seem new. Computer hardware increases in power fast enough to sustain a faith that the newest hardware, the latest methodology, or the most powerful software tool will solve enduring structural and cultural problems. Another answer is institutional. The continuing computerization of management systems has caused a real, if often unintended, transfer of control over many aspects of administration from line managers to staff specialists. Computer departments develop their own priorities and assumptions. The cultures of corporate computing and corporate management remain mutually distrustful, although hope springs eternal that a new breed of manager is about to finally bridge the gulf separating the stubbornly disconnected worlds of the executive suite and the server room. A final answer lies in an uncritical acceptance of the particular concepts of information and information systems shaped by the systems men. In this "information age," it remains easy for consultants, computer staff, and computer salesmen to justify investments in information technology for the provision of better management information through improved information systems.[1167]

As consultant and former reengineering advocate Thomas Davenport wrote recently, "Our fascination with technology has made us forget the key purpose of information: to inform

[1167] For a manager's wide-ranging and historically informed discussion of structural issues in corporate IT management as "politics" see Strassmann, The Politics of Information Management.

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people." Davenport suggests the adoption of a broader, more "ecological" approach to corporate information, grounded in a realistic understanding of organizational politics and an acknowledgement of the continued reliance of managers on informal and unstructured information. He faults continued reliance on a "machine engineering" idea of information systems. Sensible as his advice is, the idea of information systems was defined within business only through the seemingly all-powerful computer technology and systems ideology of the early cold war era. It seems unlikely that the idea of information can ever truly be separated from these roots – it is just too historically and culturally charged. For better or worse, to speak of something as an information system continues to imply that it should be engineered by an information specialist and built using information technology.[1168]

Generation after generation of slick theorists has called for the creation of a new breed of giants, able to stand with one foot on each side of the chasm separating managerial authority and technical expertise in the technologies of administration. This plea has invariably been supported by a denunciation of the current state of affairs, lambasting both the narrow focus and dull nature of the "technicians" in whose hands the newest technologies had been placed and the unwillingness of general managers to admit that new technologies demanded fundamental organizational change.

The enduring appeal of this message tells us that the chasm between technical and managerial authority did not, in all this time, narrow significantly. Had this gulf not loomed large in the minds of corporate staff, and particularly in those who feared themselves stranded forever on the technical side, then it would not have been invoked with such consistency and frequency. They believed the chasm to be real, and they believed it to be important.

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[1168] Davenport and Pursak, Information Ecology: Mastering the Information and Knowledge Environment, 3.

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Almost everyone involved in the promotion and conceptualization of this approach to corporate computing over the past half century appears to have been ignorant of its history. They had no idea that others had preached the same message. Neither did they appreciate that the approaches they criticized as narrowly technical had themselves originally been promoted as managerial panaceas. This is seen most clearly in the changing vocabulary of administrative computing. After the initial disappointments of electronic data processing in the 1950s, enthusiasts turned to total systems, and then to management information systems, for salvation. By the 1980s, MIS had itself become a stigmatized term and every self respecting computing manager wished to be called a chief information officer. Unknown to all, the office managers of the 1920s had faced the same challenges in their attempts to assert functional authority over office machine salesmen and general managers. It is as if party after party of colonial missionaries had been dispatched to a remote area, never realizing that the tribes they fought with and strove to convert were the descendents of previous expeditions.

This amnesia is apparent in other areas too. The debate on the certification of corporate computing staff has progressed very little since its emergence in the late 1950s. The same arguments for and against are endlessly rediscovered. The relationship of computer science, and more recently software engineering, to the work of administratively oriented computer staff has been the subject of an equally interminable and repetitive discussion.

The first electronic computers appeared to mark a fundamental departure from earlier technologies, and their purchasers were initially willing to credit the idea that this made it impossible to evaluate them in conventional terms. Dozens of new technologies, from random-access storage to the Internet, have been promoted constantly since then, each predicted to revolutionize the practice of corporate computing and redeem its promise. Managers have grown used to the idea that any given piece of computer hardware will be obsolete within a few years. In addition, the continuing growth of the corporate computing field (and the problematic nature of a

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professional career within it) has ensured that most of those working within it have no more than a few years experience. Management consultants, responsible for so many widely reported predictions for the future of computing, also have notoriously fickle imaginations and short careers. Amidst a constant struggle to stay current with this year's technologies and make the transition to the latest approaches and technological platforms, few connected with administrative computing have had time to ponder history. Neither, given the rate of technological obsolescence, have many believed that the problems faced by the punched card supervisors of the 1950s could have much to do with their successors of the 1970s or 1980s. Callowness is perhaps inevitable in a field where specifications are upgraded weekly and a seven year old machine is hard to give away.

Administrative computing is far from unique in this respect. Only historians and the old habitually see the present as a product and an extension of what has gone before. It is the nature of humans, Americans particularly, to believe themselves to live in a time without historical precedent, and to face challenges and glimpse opportunities entirely different from those of the past. Yet the scale of historical ignorance in this field, and the speed with which memory lapses, is more indicative of Alzheimer's than of mere forgetfulness. Organizational continuities have been submerged beneath a churning froth of technological change, and the ideology of electronic novelty that has marked discussion of corporate computer technology for more than fifty years.

Within the corporate world, it is often assumed that the challenges faced by businesses in their attempts to "align" enormously complex administrative technologies and vast numbers of specialists with their overall structure and corporate objectives are a product of very recent technological change. Proposed reforms and new directions are invariably premised on the assumption of an unprecedented technological rupture separating the present and the future from all that has gone before. Because new generations of corporate information technology come along every five years or so, business is invariably advised to look ahead to an expensive

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transition to a new technology in order to address enduring problems with the current situation. As a result, corporate computing is strongly reminiscent of the proverbial job candidate who does not have seven years of experience, but merely one year of experience seven times. It has accumulated five years experience, ten times over.

## Further Research

My aim here has been to tell the story of the different groups involved in the development of administrative computing and its ancestors in the world of office management, punched card work and systems and procedures departments. Because of the underdeveloped (and in many cases nonexistent) nature of many adjacent historical areas, my account has also included a great deal of supporting material on the development of administrative computing technology and the ways in which it was most commonly used. Despite the conspicuous bulk of this dissertation, I neither hope nor expect that it will provide a definitive statement on any of these areas. Indeed, by attempting to provide a panoramic view without waiting for the emergence of more specialized studies on which to draw, I have guaranteed that many of the claims presented here will be modified, or even rejected, as the field matures.

My work makes no pretense to evaluate the actual impact of computer technology upon the effectiveness of business. This topic has been the subject of a great deal of recent discussion of the so-called productivity paradox, which in essence was that aggregate business spending on information technology had risen just as improvements in white-collar productivity (and indeed in American total factor productivity as a whole) reached their lowest level since the industrial revolution. In addition, studies of information technology expenditure by individual firms have failed to show any link between levels of expenditure and performance. Given the failure of relatively large numbers of economists, with access to relatively good data, to reach consensus on patterns in recent years it would be foolish of me to speculate as on the actual relationship. My

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focus has been instead on managerial perceptions of the effectiveness of certain kinds of information technology investment. These have generally followed a pattern in which rampant hype and enormous expectation have given way to cynicism and hostility. It is at least clear that few firms were able, or even attempted, to measure their actual returns on investment, and that as a result, a predisposition to approve future computer expenditure cannot be entirely explained by returns on earlier investment.[1169]

The biggest limitation of this study is undoubtedly its lack of detailed studies of particular firms and industries. Only the ambitions of experts and professional organizations to hold answers applicable to all firms and industries prevent this from being a fatal flaw. From office managers to chief information officers, those setting forward prescriptions for the proper organization of administrative technology have rarely acknowledged that one model might not be universally appropriate. Those such as Richard L. Nolan who have proposed models for the development of computing within an organization have sometimes suggested that some industries might be farther forward on the path to nirvana than others, but they have never suggested that different paths might lead to different destinations. To admit this would be to voluntarily limit the scope of their own expertise. Likewise, groups such as the Data Processing Management Association (DPMA) and the Systems and Procedures Association (SPA) did not confine their attention to particular industries, or even set up permanent interest groups for those working on the problems of areas such as insurance or manufacturing.

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[1169] For a recent summary of the productivity paradox debate see Jeff Madrick, "Computers: Waiting for the Revolution", New York Review of Books, March 26 1998. See also McCune, "The productivity paradox: do computers boost corporate productivity" and Woodall, "Survey: The New Economy -- Solving the Paradox". On the firm-level relationship of IT spending to profitability, see Strassmann, 1997 #2989]. Following the discrediting of new economy thinking, this idea has recently been penetrating computer consulting firms, and hence appearing more prominently in the computer trade press, as in John G Spooner, Report: Don't Overspend on Technology (News.com, November 1 2002 [cited November 2 2002]); available from http://news.com.com/2100-1001-964213.html?tag=fd_top.

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My diffuse focus is therefore appropriate for the study of ideas, individuals and organizations claiming to hold universally applicable expertise. But for work aimed primarily at the documentation of the ways in which computers were actually used, and of their influence on the fortunes of the firms adopting them, a more specific focus will be necessary. In reality, insurance companies and logging companies used computers in very different ways. As focus gradually shifted away from simple clerical activities such as payroll, and toward the automation of operational processes, these gaps became still more pronounced. It is no coincidence that the 1980s, during which computers finally became an integral part of the operations of many companies, also saw a shifting of gravity away from groups such as the DPMA and publications such as Datamation and toward the coverage of technology within industry-specific groups and publications. Accounts in which the issues covered here are integrated with the history of specific industries will form a vital counterbalance to the perspective I adopted.

Studies of specific companies, the bread and butter of business history, will be just as important. I have been conscious here of dealing with perceptions more than realities – with survey data providing the only good source of information on prevalent practices. While case studies carry their own risk of exceptionalism (the handful of firms committed to preserved and accessible archives are by definition far from representative), they also provide a richness and specificity of historical experience. Case studies of the kind performed by JoAnne Yates and Martin Campbell-Kelly for the late nineteenth century would likely reveal that even firms within the same industries differed greatly in their use of computer technology. The importance of individual personality and corporate culture in the development of administrative computing in

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particular firms may be as importance to the reality of corporate computing as the waves of hype and cycles of disillusion that characterized its public discussion.[1170]

Quantitative research to establish firm figures on the growth and development of a sample of office management, systems or data processing departments over time would be of enormous value. Historians are likely, however, to find that the reality of corporate computing is rather harder to document than its rhetoric. Recent attempts to document current conditions, such as measuring returns on IT spending or determining the size of the IT workforce, have made it clear that no consensus exists on these matters. Historians are unlikely to achieve more definitive results when studying previous decades.[1171] Work by scholars interested in the historical evolution of corporate institutions may prove of particular value here. While the most obvious lack here is of studies of data processing, office management and MIS departments, the absence of any overall history of the changing role, status and identity of accounting and finance within the American corporation deprives us of vital information about the context of administrative computing.[1172]

Plenty of work remains to be done on the issues of identity and aspiration at the heart of this dissertation. Detailed histories of the main groups and occupations considered here would provide a sense of how those elements of their histories considered here fit into their broader

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[1170] Yates includes a number of detailed case studies in Yates, Control Through Communication: The Rise of System in American Management, along the pattern used to great effect in the classic Chandler, Strategy and Structure. While firms are in general hesitant or unwilling to grant historical access to records concerning controversial matters in their more recent history, some historians have nevertheless been able to piece together comparative studies of mid and late twentieth century firms. For a notable recent example see Jacoby, Modern Manors: Welfare Capitalism Since the New Deal.

[1171] This point is made persuasively in Nathan Ensmenger and William Aspray, "A Commentary on David A. Hounshell's Commentary on 'Software as Labor Process'", in Mapping the History of Computing: Software Issues, ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur L. Norberg (New York: Springer-Verlag, 2002).

[1172] Initial work on the spread of the MIS department has been conducted by a group at Princeton University and presented as Dirk Zorn, "Room at the Top? The Failed Institutionalization of Management Information Systems" (paper presented at the Academy of Management Conference, Washington, D.C., 2001).

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stories. No comprehensive academic history has yet been produced of any of the major groups discussed here, including the DPMA, the SPA, the ACM and the IEEE Computer Society. While I have included considerable information on the former, the bulk of its archival material remains untapped. Material relating to the others is less accessible, though a determined investigator would likely use oral history and privately held sources to supplement published documents. No history of the corporate use of operations research, or of the operations research societies, has been written. Published sources give almost no information about the short-lived but intriguing Association of Computer Programmers and Analysts.

Neither, still more surprisingly, has much been written about the actual tasks undertaken by analysts, programmers or operators. Almost all work on the history of software or programming has, as discussed earlier, focused entirely on the development of computer science, programming languages, the emergence of software engineering, and the pronouncement of elite academic and industrial researchers. Discussion of these topics has largely displaced discussion of actual programming work – an elision not entirely avoided in my own work. This is in part because it is very much harder to find printed sources or interview transcripts on more representative experiences and practices. The memoir of John J. McCaffrey proved invaluable in my discussion of punched card work, but as an extended record of a typical data processing career it is unique. Had a similar source existed to, for example, describe work on an ambitious 1960s MIS project then this account would have been much richer. Action to discover, publicize and collect such material is vital. While many of those who worked on the first data processing installations are still alive, if action is not taken soon to record their histories then this resource may be lost for ever.

This dissertation focuses primarily on the pre-1975 period, and provides little information on professional identity or on the practice of programming, analysis and operations for the later period. Further work on this era is clearly required. Entire books could usefully be written about

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each of following: office automation, the data base management system, the role of the minicomputer in administrative computing, the rise of open systems and the client-server model, the concept of end-user programming, the spread of new software tools, the corporate use of personal computers, the spread of networking and, of course, the influence of the Internet on corporate computing. While most of the key associations for administrative computing (in particular the DPMA and the renamed SPA), went into eclipse after the 1970s, more research is necessary to explore the extent to which this represented a shift in the loyalties and aspirations of computing staff. In contrast to the excellent technical histories produced on earlier computers, even mainframe and minicomputer hardware of the era is yet to receive clear historical explanation. Studies in these areas will also clarify the extent to which the information technology department of the 1990s truly represented a break with the practices and culture of the data processing departments of the 1970s.

## Information and the Historian

During the 1990s, the term information technology became so ubiquitous, and so closely associated with the computer, that even the unmodified "technology" came to mean much the same thing. Taking part in a "reengineering" project made historian of technology Rosalind Williams discover that her fellow MIT administrators had joined corporate managers in redefining technology so that "instead of embracing the totality of the human-built world, it just means 'computers'."[1173]

The social and cultural history of the concept of information is, as yet, an almost entirely undeveloped field. American historians of future centuries are likely to associate the last quarter of the twentieth century with information ideology just as closely as they associate progressive

[1173] Rosalind Williams, "'All that Is Solid Melts Into Air:' Historians of Technology in the Information Revolution", Technology and Culture 41, no. 4 (October 2000):641-68.

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ideology with its first decade, and republican ideology with much of the century before. Yet study of information as a humanly constructed and ideologically charged concept has so far been the province of sociologists and linguists rather than historians. This dissertation has documented the emergence of one strand of this ideology, from the world of the corporate systems men and data processing workers of the 1950s. The concepts of information as a collection of facts, information technology and information systems have spread far beyond the corporate and managerial settings in which they gestated. Exactly how this transfer from corporate discourse to more general social awareness took place, or indeed what part information ideology will ultimately seem to have played in American history, will not become clear until a great deal more work has taken place and a great deal more time has passed.

The ubiquity of information talk in recent decades can be attributed, more than anything else, to this conceptual ambiguity of information. The sense of information as that which informs, as the communication of useful facts, co-exists with the sense of information as the bits and bytes manipulated by a computer. One does not have to say which sense one is using. Thus when Al Gore and his allies in the computer industry spoke of the information superhighway in the mid-1990s, they appealed to our sense that information was power, that freedom of information was a virtue, and that, in the words of James Madison, "a popular Government, without popular information, or the means of acquiring it, is but a Prologue to a Farce or a Tragedy."[1174] President Clinton called for action to address the so-called digital divide in access to "computer and the Internet" because "access to these Information Age tools is becoming critical to full participation in America's economic, political, and social life." What this meant in practice was that computers and computer networks must be spread throughout America as evenly as possible and in the

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[1174] James Madison, "Madison to W.T. Barry, August 4, 1822", in The Mind of the Founder: Sources of the Political Thought of James Madison, ed. Marvin Meyers (Indianapolis: Bobbs-Merrill, 1973).

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greatest possible number. At around the same time, business leaders received a similar message that only by raising computer spending to unprecedented levels could they reap the benefits of the e-business revolution. Support for the public provision of computer hardware and training seemed more broadly based than that for other entitlements such as food, shelter or healthcare. At this particular moment in history, the connection of information to computers and networks appeared obvious. Computers were, after all, information technology. Information was their essence.

The word information, when not conjoined with technology or system, is today most commonly used as a synonym for fact. Information is the factual material held in books, encyclopedias and scientific publications. While this sense of information does not always imply that anyone is being informed (we find it natural, for example, to speak of information storage), it is nevertheless frequently associated with the communication of knowledge. The putatively revolutionary power of information technology thus lies in its ability to store vast bodies of facts, to sort and process them automatically, and to disseminate them as required.

The word information is also applied, in a different but overlapping meaning, to anything stored digitally within a computer system. This linguistic usage of information has departed altogether from the implication that somebody is informed of something, or from the sense that information consists of organized facts. The computer is an information machine because it is a generalized processor of digitally encoded symbols. Once something has been encoded digitally it is stored and manipulated in exactly the same way whether it forms part of a videogame program, the complete works of Shakespeare, or a pornographic film. While we would not usually speak of a live musical performance as a stream of information, it is more common to speak of a digital audio recording of the same concert as information when stored within a computer system. This kind of thinking reached its apotheosis in 2000 when Hal Varian, Dean of the School of Information Systems and Management at Berkeley, tried to quantify the volume of information in

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the world by estimating how many megabytes of computer disk space would be needed to store all of it.[1175]

One cannot but help notice an unfortunate circularity in these implicit definitions of information and information technology. The computer is an information technology because it stores, processes, and communicates information of all kinds. Information is that which is stored, processed, and communicated with information technology.

As we have seen, neither the implicit definition of information as they quantity stored within a computer nor the less obviously computer-related sense of information as a collection of facts was widely used before the coming of the digital computer. Yet historians have so far shown little awareness of the recent genesis of these concepts. Scholarly work exploring the history information technologies or information revolutions, the subject of many recent books, has shown little interest in where the concepts of information, information technology, or information system came from.[1176] Instead, these information-based concepts been taken as neutral and timeless

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[1175] Peter Lyman and Hal Varian, "How Much Information?" The Journal of Electronic Publishing 6, no. 2 (December 2000).

[1176] Scholars approaching the pre-history of the information age from the viewpoint of books and reading include James Joseph O'Donnell, Avatars of the Word: From Papyrus to Cyberspace (Cambridge, MA: Harvard University Press, 1998) and Michael E Hobart and Zachary S Schiffman, Information Ages: Literacy, Numeracy, and the Computer Revolution (Baltimore: Johns Hopkins Press, 1998). Historians of business and economics have shown an increasing interest in using information to explain historical behavior (motivated in part by a renewed theoretical concern with the internal structures of firms and work on transaction cost economics and information costs). See Levenstein, Accounting For Growth: Information Systems and the Creation of the Large Corporation and the collections Temin, Inside the Business Enterprise: Historical Perspectives on the Use of Information, Bud-Frierman, ed., Information Acumen: The Understanding and Use of Knowledge in Modern Business, Lamoreaux and Raff, eds., Coordination and Information: Historical Perspectives on the Organization of Enterprise. Historians exploring topics such as telegraphy and the postal system have framed their work in terms of information – as in Richard R John, "Recasting the Information Infrastructure for the Industrial Age", in A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present, ed. Alfred D. Chandler and James W. Cortada (New York: Oxford University Press, 2000) and, in the journalistic sphere, Tom Standage, The Victorian Internet (New York: Berkley Books, 1999). With the exception of Bowker, "Information Mythology: The World Of/As Information", none of these works includes any critical examination of the concept of information or information technology, or of the historical development of these concepts. Correspondingly, analysis of information as a concept, such as Albert Borgmann, Holding on to Reality : The Nature of Information at the Turn of the Millennium (Chicago: University of Chicago Press, 1999), has not been performed within the disciplinary framework of

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categories. Consider a recent, well-received work by a respected historian: Daniel Headrick's When Information Came of Age.[1177] Headrick's thesis is that the information revolution should properly be dated to the eighteenth-century, and that historians have unfairly privileged the printing press, telegraph and computer over other information systems and technologies such as maps, taxonomies, statistics and postal services. In his introductory chapter, "Information and Its History," he defines information as "data organized in a systematic fashion" and suggests a taxonomy of information gathering systems (such as censuses), information classification systems (such as taxonomies), information transformation systems (such as statistics and cartography), information storage and retrieval systems (such as dictionaries or museums), and information communication systems (such as messengers).

Neither here, nor in the body of the book, does he devote the slightest attention to what the idea of information itself might have meant to his historical actors, or how it might have changed over time. This is not to imply that Headrick fails to prove that the things we would now call information systems have a long history. We should, indeed, welcome this challenge to the techno-libertarianism and millennial utopianism of much popular writing on the subject. Headrick implicitly rejects the attempts of radical information enthusiasts such as James R. Beniger to blur the lines separating human's conscious use of information from cellular processes or cybernetic feedback loops.[1178] It is, however, startling that an author intent on challenging the blinkered perspectives and short historical memories of computer enthusiasts should adopt so unreflexively the historically specific conceptions of information and information systems recently created by

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history. The promisingly titled Ronald E Day, The Modern Invention of Information: Discourse, History, and Power (Carbondale: Southern Illinois University Press, 2001) is a work of critical theory, exploring the texts of Paul Otlet, Suzanne Briet, Claude Shannon, Pierre Levy, Walter Benjamin and Martin Heidegger. It has little to say about broader changes in the use of information concepts.

[1177] Daniel Headrick, The Tools of Empire: Technology and European Imperialism in the Nineteenth Century (Oxford, UK: Oxford University Press, 1981).

[1178] James R. Beniger, The Control Revolution: Technological and Economic Origins of the Information Society (Cambridge, MA: Harvard University Press, 1986).

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those self-same enthusiasts. By naturalizing these concepts, historians risk obscuring their actual origins. We have, as yet, nothing approaching a social history of information.

Computer enthusiasts have been quick to proclaim the final decades of the twentieth century as the Information Age. When future generations of historians have assimilated this era into their broader understanding of America's history they may choose to retain the term, at least for the period from the end of the Cold War to the start of whatever they call our war on terrorism. In a mature historiography, however, their understanding of what information has meant over the last twenty years will be just as removed from that of the typical information enthusiast of today as our present understanding of the discourse of progress is from that of a Progressive Era reformer. After we are all dead, and historical distance is thereby established, information may emerge as the defining ideology of a society that briefly thought itself to have passed beyond the grip of both history and ideology.

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## APPENDIX: TIMELINE

The timeline below is intended to give a summary of the main events discussed in this dissertation, to give a sense of how its parallel threads are unfolding over time. In addition, some prominent events in the history of computing not directly discussed elsewhere have been added here to give the interested reader a sense of perspective.

Some of these dates are taken from third party sources (including web pages, association publications, and popular histories). For reasons of concision, sources are not given. Not all of them have been verified to the same standards as those in the body of the text. In some cases, the literature includes two different years for the same event. In most cases these refer to the design, public announcement or first shipment of a product. Care should be taken to independently verify the facts given here before relying on exact dates.

| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1911 | Taylor publishes "Principles of Scientific Management." | | | |
| 1914 | | Thomas Watson Sr. hired as president of CTR | | |
| | | Powers Accounting Machine Company becomes first to offer tabulating machines able to print out results. (Existing models could only display results on dials). | | |
| 1915 | | James H. Rand, Jr. creates Kardex system of visible records | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1917 | Leffingwell publishes Scientific Office Management. | Electric Keypunch introduced. | | |
| 1919 | National Office Management Association founded. | | | |
| 1924 | Publication of NOMA Bulletin begins. | CTR changes name to IBM. | | |
| 1925 | Leffingwell publishes "Office Management -- Principles and Practice." | | | |
| 1926 | The Office Appliance Manual, edited by Leffingwell, documents richness of office equipment field. | | | |
| 1927 | | Remington Rand formed by series of mergers. Produces offices equipment of all kinds. | | |
| 1928 | | IBM introduces the 80 column punch card, allowing more information to be encoded on each card than on existing 34, 38 or 45 column cards. It becomes the dominant standard for future punch card machines (and eventually computer displays and printers). | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1930 | | | The Women's Bureau performs field work for its exhaustive survey of female clerical workers and office technology in the service sector. | |
| 1931 | Controllers Institute of America is founded -- membership made up of senior financial and accounting officers. | | | |
| 1932 | | First IBM tabulating machine capable of printing letters as well as numbers is marketed. (approx) | | |
| 1933 | | IBM introduces the 601 Multiplying punch. This relay-based punch card machine is widely used for scientific and commercial calculations. About 1,500 are produced. | | Harvard researcher Elton Mayo publishes "Human Problems of an Industrial Civilization" -- a founding text of the Human Relations school of managerial theory. |
| 1934 | | IBM introduces the 405 Electric Accounting Machine. It remains a mainstay of punch card installations into the 1960s, including 55,000 parts and 75 miles of wire. (approx date) | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1935 | | IBM introduces its first electric typewriter. Though not the earliest,' it is the first to achieve general use. | | Alan Turing writes seminal paper "On Computable Numbers...", which introduces the concept of Turing Machine. In retrospect, this is seen as the founding statement of theoretical computer science. |
| 1936 | | | The newly created Social Security Administration takes delivery of its first punched card machines. The SSA punched card technology its largest use to date for general administration. | |
| 1938 | | | | Claude Shannon publishes "A Symbolic Analysis of Relay and Switching Circuits" -- an important step towards his mathematical theory of information. |
| 1939 | | | | First Ph.D. in accounting is conferred (University of Illinois, Urbana). |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1943 | Urwick publishes "Elements of Administration." | British "Colossus" codebreaking machine becomes the first all-electronic calculating device. It is not programmable. | | ENIAC project begun. |
| 1944 | First informal meeting held in Philadelphia to discuss the formation of what will become the SPA. | | | The Harvard Mark I, programmable mechanical calculator, is completed. |
| 1945 | | | | John von Neuman circulates "First Draft of a Report on the EDVAC" -- codifying computer design principles now referred to as the "von Neuman architecture." |
| 1946 | | UNIVAC forerunner (Electronic Control Company) founded by ENIAC creators Eckert and Mauchly to produce computers for civilian purposes | | ENIAC, the first electronic, general purpose computer, is dedicated at the University of Pennsylvania. |
| | | IBM introduces its specialized 603 Electronic Multiplier -- a specialized piece of auxiliary punched card equipment. This is its first electronic product. (Approx -- sources differ on this date) | | Term bit for binary digit is used for first time by John Tukey. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1947 | Formation of ACM (Association for Computing Machinery), by Edmund Berkeley in a public meeting held on the Columbia University campus. | | | William Shockley invents the transistor. Earliest civilian uses are in hearing aids and radios -- not computers. |
| | SPA, the Systems and Procedures Association, is formally chartered. | | | Moore School lectures (University of Pennsylvania) disseminate technical information on computer design from the ENIAC design team. |
| 1948 | | IBM dedicates the SSEC -- its first electronic computer. One of a kind design, used for public relations and as the basis of a public service bureau for technical calculations | | Manchester Mark I, the first electronic stored program digital computer, is developed. Uses electrostatic tube as memory. |
| | | IBM 604 "Electronic Calculating Punch" tabulator is introduced -- first general purpose electronic punched card machine. Short programs can be entered by wiring the control board. More than 4,250 are eventually in use. | | EDSAC, at Cambridge, becomes first full-scale stored-program computer in regular use. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| 1949 | Edmund Berkeley published "Giant Brains: or Machines That Think" -- the first book on electronic computers intended for a general audience. | | | |
| 1950 | Neuschel publishes "Streamlining Business Procedures." | | British computer LEO runs first routine office job. | |
| | Final edition of Leffingwell textbook is published posthumously. | | Time Magazine puts a self-programming military computer on its cover (Jan 23), asks "Can man build a superman?" | |
| | SPA begins regular publication of its journal, originally called Systems and Procedures Quarterly. | | | |
| 1951 | First Joint Computer Conference (JCC) is held. | A UNIVAC I, the first commercial electronic computer, comes on-line at the US Census Bureau. 48 of these computers are eventually installed. | Maurice Wilkes and colleagues from Cambridge publish first textbook on computer programming. | The Whirlwind computer (SAGE precursor) becomes operational at MIT. |
| | NMAA chartered (Illinois) | | | |
| | The first Fortune article on Operations Research is published, providing civilian managers with an introduction to the concept. | | Morse and Kimball publish "Methods of Operations Research" -- first textbook on subject. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| | Four years after its introduction, the ACM has attracted just 113 members world wide. | | | |
| 1952 | Operations Research Society of America (ORSA) founded. | RCA Bizmac computer uses magnetic drum for rapid access to data. | Fred Gruenberger writes first American computer manual | Whirlwind becomes first system to use magnetic core memory -- leading memory technology of 1950s. |
| | The Institute of Management Science (TIMS) founded. | | Grace Hopper builds first compiler (A-O Compiler). | John Diebold published "Automation, The Advent of the Automatic Factory" -- first book-length treatment of automation. |
| | Society for Industrial and Applied Mathematics (SIAM) founded. | | CBS television uses a Univac to deliver on-air forecasts of the Presidential Election during its broadcast -- exposing the computer to a national audience. | |
| 1953 | Fortune magazine publishes its first article on "information", introducing the concept to a broad executive audience. | Univac 1103 introduced -- thanks largely to improved memory it is fifty times faster than UNIVAC 1. | Nathanial Rochester, of IBM, develops symbolic assembly program. | Herb Grosch publishes his "law" -- the observation that the power of a computer is proportional to the square of its price, meaning that the largest computers offer the most power per dollar. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| | | Initial installation of IBM 701 -- its first large electronic computer. Formerly known as "Defense Calculator". Optimized for scientific calculations. Nineteen are built. | | |
| 1954 | Drucker published "The Practice of Management". | First IBM 650 delivered -- inexpensive, punch-card oriented computer. "Model-T of computing". 2,000 are eventually produced. | A Univac I installed at General Electric begins its regular payroll runs -- first routine office job performed in the US by a computer. | |
| | NMAA charters its 77th chapter. | | U.S. Steel introduce term "Integrated Data Processing" to describe system using paper tape to transmit data and link different office machines together. AMA hosts public meeting, produces special report. | |
| 1955 | SHARE user group for IBM 701 & 704 (large, scientific) customers is formed. | IBM 702 shipped -- the first large IBM computer designed for business data processing. 15 are eventually installed. | Computer Usage Corporation -- independent scientific programming firm -- founded in New York City. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
|---|---|---|---|---|
| | Harvard hosts conference on "Automatic Data Processing" -- includes contributions on automation of management, relationship of computer to operations research. | First IBM 704 installed -- faster and more reliable version of scientifically oriented 701. About 100 of these computes are eventually installed. | Time Magazine cover shows IBM head Thomas Watson, Jr. (together with a cartoon computer) on its cover. (March 28) | |
| | NMAA appoints Executive Secretary Dick Irwin as its first full time staff member. | DEC founded -- later to become the leading supplier of minicomputers. Initial products are intended for laboratories. | The RAND Corporation wins contract to produce software for SAGE system. | |
| | Research and Engineering magazine founded. Includes coverage of early computer hardware and electronic engineering. Becomes Datamation magazine. | IBM overtakes UNIVAC in number of large computers installed. | | |
| 1956 | GUIDE user group for IBM 702 & 705 (large, business oriented) is formed. | First IBM 705 shipped (faster and more reliable version of 702). Three models (I, II and III) are eventually offered, for a combined total of around 190 computers when production ceases in 1960. | System Development Corporation spun off from RAND to work on software for SAGE project. | |
| | After a period of rapid growth, ACM membership reaches 2,305. | Univac introduces first computer based on transistors rather than vacuum tubes. | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | The Controllers Institute of American includes 4,500 financial executives, and boasts 50 chapters across the US, Canada and Puerto Rico. | | | |
| 1957 | Research and Engineering becomes Datamation. Coverage of computer programming, computer applications and professional issues gradually increases. Begins monthly publication in early 1960s. | First IBM RAMAC 305 delivered -- simple computer coupled with relatively large drum memory. Touted for instant reconciliation in accounting applications. | FORTRAN developed -- first widely used and standardized high level programming language. Commonly used by scientists and engineers to perform calculations, often without the aid of specialist programmers. Remained ubiquitous into the 1980s. | |
| | NMAA membership reaches 10,000 people. | The first Univac II is delivered. | IBM & American Airlines give go ahead to the on-line, real-time reservation system that will become SABRE. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1958 | Membership of SPA (Systems and Procedures Association) reaches 2,500. | First IBM 709 is shipped. Adopted primarily as the successor to the 704 for scientific purposes, with faster operation, more memory and simplified programming. The 709 is also promoted for business administration thanks to improved input/output capabilities and rapid conversion from binary to text. | FLOW-MATIC, early high level programming language for business, developed by Honeywell. | Leavitt and Whisler publish "Management in the 1980s" in HBR. Predicts automation of middle management, rise of OR and computer staff into executive ranks. |
| 1959 | SPA conducts survey of its membership, results published as "Profile of a Systems Man". Concentration in practice remains on clerical techniques and machines rather than "re-engineering" of corporate structures and processes. | Transistor based computers enter the mainstream with announcements including the IBM 7090 (a transistorized version of the 709), the NCR 304 and the RCS 501. | Effort to produce standard business language begins, culminates later in COBOL. | Texas Instruments and Fairchild semiconductor both announce the integrated circuit -- building several components on a single piece of silicon. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | First issue of Management and Business Automation (later Business Automation), a glossy magazine covering computers and other advanced administrative technology. Business Automation and Datamation are the two leading computer magazines of the 1960s. | | Computer Sciences Corporation founded -- leading provider of computer services. | Xerox copier becomes a commercial product. |
| | During a period of rapid growth, membership of ACM passes the 5,000 mark for the first time. | | General Electric announces ERMA -- automated check processing system for the banking industry. | The Continuing Seminar on Management Information Systems of the American Management Associations begins to publicly promote the MIS concept. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1960 | R. Calvin Elliot becomes Executive Director of NMAA -- over the next fifteen years he exerts a stronger influence over its operations than any other person. | IBM 1401 "2nd generation" computer is shipped -- inexpensive, reliable, transistorized. It becomes the workhorse of data processing for the next five years. Offered in both card and tape oriented versions, with a 10 or 20 million character disk drive as an option. 12,000 are eventually produced. (BA census estimates 9,000 at peak in 1965). | COBOL -- the standard high level language for the programming of business applications -- is unveiled. It remains the most popular language for new program construction into the 1990s. | |
| | IFIPS (International Federation of Information Processing Societies) is formed -- umbrella group for international exchange, primary focus is on scientific computing and theoretical issues. | IBM 7070 is first shipped -- a new, transistorized, modular design intended to replace both the 702/5 family of large business computers and (in its least powerful configuration) the smaller 650. Despite a much criticized, incompatible design plagued by internal IBM politics, more than 550 machines of this family (including the later 7072 and 7074 models) are installed world wide over the next five years. | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | NOMA, the National Office Management Association, has 177 chapters and more than 17,000 members. | | | |
| 1961 | AFIPS formed though a re-chartering of the ACM/AIEE/IRE committee responsible for convening the Joint Computer Conference. AFIPS acts as the US representative to IFIPS, but holding the JCC remains its primary activity. | IBM Selectric Typewriter introduced | Ross Perot founds EDS computer services firm -- a leader in the much-hyped field of facilities management. | |
| | | First IBM 7080 is installed -- an alternative to the 7070 offering compatibility with existing 702/5 programs and data. Around 43 are installed over the next five years. | | |
| | | IBM 1410 introduced (upgraded model of 1401). | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1962 | CDP examination first administered by NMAA, during its annual meeting in New York City. | Magnetic disk drives replace the smaller, faster and far more expensive magnetic drums as the main form of random access storage. Leading manufacturers include IBM and Bryant. | Informatics, an computer services firm, is founded. It later becomes an important supplier of packaged software. | |
| | NMAA becomes the Data Processing Management Association (DPMA) in an attempt to distance itself from its punch card roots. It has 16,000 members and 190 chapters all across the US and Canada. | Univac III is first shipped. First commercial system to support multiprogramming -- running more than one program simultaneously. About 100 are installed. | | |
| | ACM begins active pursuit of student members through the formation of campus chapters. Spurs involvement of DPMA with school and university students. | | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1963 | The AIEE (American Institute of Electrical Engineers) and IRE (Institute of Radio Engineers) merge. Both organizations had active computing groups -- these are combined as the IEEE Computer Society. The new group is particularly strong in computer hardware and engineering matters. | | The SABRE airline reservations system is fully operational, becoming the first large-scale on-line civilian computer application. | |
| | | | SAGE system fully deployed. | |
| | | | McKinsey report "Top Management and Computer Profits" finds most companies losing money on computer operations, claims top management involvement is key to success. Written up in HBR. | Douglas Engelbart invents the mouse -- diffusion of the technology is slow. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1964 | NOMA, the National Office Management Association, renames itself the Administrative Management Society. | IBM announces System/360 range of "third generation" computers -- intended to replace all current models. These are IBM's first models to successfully span both scientific and business administration tasks. This array of compatible large, medium and small computers introduces concept of computer architecture. | The BASIC language developed at Dartmouth College as a tool for undergraduate programming instruction. | In his article "The Computer of Tomorrow" Martin Greenberger popularizes the concept of the "computer utility" |
| | ACM membership passes 10,000 for the first time. | IBM MT/ST (Magnetic Tape Selectric Typewriter) introduced -- plays important part in early word processing. | PL/1 programming language introduced -- intended for business and scientific use. | |
| 1965 | A record 6,951 candidates sit the DPMA's examination for the Certificate in Data Processing. This level is never again approached. Stringent academic requirements, introduced in 1966, cripple its popularity. | First System/360 models shipped (30, 40, 50, 65). In short supply for some years. | Military contractor SDC begins to promote its expertise in on-line "data base" systems as corporate management tools. | The BASIC programming language is first deployed at Dartmouth College. Designed to be easy to use, accessed by students using teletype units and a time-shared computer. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | | DEC introduces PDP-8 minicomputer -- over 30,000 are eventually sold. Used for many control and experimental purposes. | | Gordon Moore makes the observation that component density on integrated circuits tends to double every 18 months -- applied to memory chips this later becomes famous as Moore's Law. |
| | | | | At MIT, Project MAC becomes fully operational. In development since 1963, the project uses experimental time-sharing to place teletype terminal units across the campus. |
| | | | | First computer science Ph.D. is granted to Richard L. Wexelblat at the University of Pennsylvania. |
| 1966 | | | IBM's OS/360 project runs into trouble, becomes famous case study in difficulty of producing large software systems. | |
| 1967 | Computerworld newspaper launched | | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | SPA membership hovers at around 6,000 -- having dropped slightly after dues were raised. | | | |
| 1968 | A NATO conference held in Garmisch, Germany promotes term "Software Engineering" as the name of an as-yet undefined discipline. | | Software companies Cullinane and Cincom Systems are founded. Both become leading suppliers of database management software during the 1970s. | Douglas Englebart takes the JCC conference by storm. Demonstrates the mouse, telecomputing and the innovative NLS system including windows and mouse controlled collaborative editing. |
| | | | The first complete version of the Mark IV File Management System, one of the most successful software packages of the early industry, is delivered to customers. | ACM publishes its "Curriculum 68" recommendations for computer science education -- puts stress on theory and algorithms over hardware and applications. |
| | Influential McKinsey report "Unlocking the Computer's Profit Potential" reiterates calls for involvement of top management, dismisses practicality of total MIS. | | IBM announces two data base systems, GIS and IMS, and a package soon known as CICS (Customer Information Control System). These tools play a vital role in the widespread development of on-line administrative applications during the 1970s. | Dijkstra's paper "GOTO Seen as Harmful" is published. The paper is later seen as the inspiration of the "structure programming" movement of the 1970s. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1969 | ACM membership stands at almost 23,000 regular members. Bruce Carlson, its Vice President, outlines an ambitious plan to expand this to 100,000 by 1975. Serving as president from 1970 to 1972, Carlson's efforts to expand the association's focus to strengthen its chapters, broaden its appeal to data processing staff, and improve its management fail to produce the desired results. | IBM introduces System/3, a new line of punch card based computer equipment. | IBM "unbundles" its hardware from software and services. Often seen as a reaction to antitrust concerns, the move fuels the development of the independent software product industry. | Bell Labs abandons its commercial development of the MULTICS operating system after four years intense development. Multics involved MIT, GE and Bell Labs in an attempt to build a large scale time-sharing system to be operated as "computer utilities." Enthusiasm for the practicality of computer utilities suffers a major blow. |
| | Despite recent promotion of the slogan "Up and Away With 30K", membership of the DPMA fails to reach even 27,000. This is the end of the DPMA's period of rapid growth. | IBM supplements its MT/ST automatic typewriter with the MC/ST (Magnetic Card/Selectric Typewriter). The new machine uses magnetic cards rather than tapes. | Computer Sciences Corporation becomes first computer software and services firm listed on NYSE. | |
| | First annual meeting of SMIS, the Society for Management Information Systems, is held at the University of Minnesota. SMIS is intended to unite top managers, data processing managers and academic specialists. | Intel begins work on the 4004 -- the first microprocessor. Its original purpose is for a pocket calculator. | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | Under leadership of Bruce Gilchrist, AFIPS constitution is revised to broaden its mandate and encourage more effective actions. | | | |
| | The Systems and Procedures Association (SPA) renames itself the Association for Systems Management (ASM). | | | |
| 1970 | The RBP or Registered Business Programmer Examination, designed for administrative programmers, is offered by DPMA for the first time. | IBM introduces System/370 range, which gradually replaces its /360 range. This evolutionary progression eventually produces the 390 series of the 1990s. | | Xerox founds PARC -- the research center responsible for many key personal computing concepts of the 1980s. |
| | | Memory chip introduced. (Fairchild comes first with a 256 byte model, Intel soon follows with introduces a larger memory chip version with 1024 bits of information. 8 of the larger chips together store 1 kilobyte). | | The first version of UNIX goes into use within Bell Labs. This highly modular operating system introduces the extensible toolset approach to system design. By the late 1980s it had evolved into the dominant system for powerful workstations and Internet servers. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1971 | | Wang introduces its first word processing unit. By the end of the decade, Wang dominates the market for specialized word processing systems. | The Data Base Task Group of the CODASYL computer industry standards group issues an important report, defining a new class of system software: the Data Base Management System. | Gerald Weinberg publishes The Psychology of Computer Programming. |
| 1972 | Calvin Elliot, the long-serving and powerful executive director of the DPMA, leaves the association in acrimonious circumstances. His departure signals a more open relationship with other groups. | Intel introduces 8080 general purpose microprocessor -- basis of many first generation microcomputers | Ray Tomlinson's email program spreads rapidly over the ARPANET (precursor of the Internet) providing it with its most useful application to date. | |
| | Business Automation changes its name to Infosystems. | Office automation and word processing emerge as hot topics in the data processing press. | | |
| 1973 | ICCP (Institute for Certification of Computer Professionals) is formed as an umbrella group of professional societies, under leadership of John Swearingen. Assumes responsibility for CDP and RBP programs. | Under the codename "Winchester", IBM introduces the 3340 disk drive. Much smaller and cheaper than previous drives, it is widely adopted for use in minicomputers, microcomputers and word processors -- and is eventually dubbed the "hard disk drive." | | At Xerox's PARC research center, the first Alto workstation becomes operational. Over the next few years, Altos will be used to pioneer graphical user interfaces (including icons and pop-up menus), laser printing and Ethernet. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | Richard F. Nolan publishes the first version of his "stage theory" describing the evolution of the data processing department. In the next few years, Nolan becomes a prominent expert, writing in the Harvard Business Review about data bases, data processing management and the "data resource function." | The first 8-inch floppy disk for data entry applications is introduced by IBM. Cheaper, faster and more flexible than magnetic tape for small volumes of data, it finally replaces punch cards as storage medium of choice for the cheapest business computing applications. (From 1971 floppy disks had seen specialized use as a microcode store). | | |
| 1974 | DPMA finally joins AFIPS -- after a decade of negotiations, internal bickering and mutual suspicion. | MITS, a small Albuquerque firm catering to the hobbyist electronics market, develops the ALTAIR -- generally regarded as the first personal computer. Although the machine is almost entirely useless, and the purchaser must build it from a kit, it is a huge success. Business applications are limited. | | |
| 1975 | | | Microsoft releases its commercial software package -- a BASIC language for the Altair. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | | | Electric Pencil for the Altair kit-computer becomes the first word processing program to run on a micro computer. | |
| 1976 | | | CP/M, the dominant operating system for 8-bit micro computers, is first released. | |
| 1977 | | Xerox launches its Star 8010 office computer, an attempt to commercialize the research of its PARC center. | | |
| | | Apple introduces the Apple II -- the first microcomputer to sell in large numbers. It remains the leading model into the early 1980s. | | |
| 1978 | | Intel introduces 8086 processor, eventually to be used in IBM-PC machines. | Cullinane becomes the first software products (as opposed to services) company to go public. | Hiltz and Turoff publish "The Network Nation", presenting their vision of a country transformed by computer conferencing. |
| | | IBM introduces its "mid-range" System/38 computer series. Hugely successful, the System/38 is the first commercial system to integrate data base management technology. | | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| | | DEC introduces the VAX -- a 32-bit minicomputer with virtual memory. Becomes the standard for scientific and technical applications. | | |
| | | Xerox launches the 9700 printer, the first commercially available laser printer. | | |
| 1979 | "Information Technology" starts to gain widespread use in the business press as an umbrella term for computers and electronic communication technologies. | | Dan Bricklin and Personal Software introduce VisiCalc for the Apple II -- the first compelling business application program for a personal computer. It sells 100,000 copies in two years. | Chris Evans published The Micro Millennium, summing up widespread predictions made for microelectronics and the personal computer as the driving force behind a social revolution. |
| 1980 | InfoWorld, a computer newspaper, is launched -- joining the longer established Computerworld. | | | William R. Synnott and William H. Gruber publish Information Resource Management: Opportunities and Strategies for the 1980s. This introduces the idea of the Chief Information Officer (CIO). |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1981 | | The IBM PC is introduced. While technologically unoriginal it is well engineered, affordable, highly expandable and enormously successful. It sets hardware and software standards for decades to come. It is followed by the PC/XT in 1983 (with optional hard disk drive) and the more powerful PC/AT in 1984. | | |
| 1982 | | Sun Microsystems is founded by a team associated with Stanford University (SUN originally stood for Stanford University Network). By the late 1980s, Sun dominates the growing market for graphical workstations -- the machines of choice for academics, engineers and financial analysts. | Software startup Lotus announces Lotus 1-2-3, a spreadsheet. Using venture capital to fund a development and marketing drive greater than any previous microcomputer application it sells more than 200,000 copies in its first year and dominates the field for a decade. | An early version of TCP/IP, now the standard Internet protocol, replaces the earlier NCP as the main ARPAnet protocol. The network remains a closed system for research use. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1983 | | Apple introduces the Lisa, a powerful microcomputer including networking capability and a graphical user interface. Although a failure, its technology is adapted for the Macintosh. | Firms such as Fidelity Investment, the New York Times, Knight-Ridder Newspapers, McGraw-Hill and Chemical Bank rush to offer "videotext" on-line services to consumers. The market fails to materialize. | |
| 1984 | | Apply introduces the Macintosh. Although its design includes many elegant features early models lack the power, expandability and application software necessary for corporate success. | IBM has already overtaken Apple in its share of personal computers used by corporations. "Clone" producers such as Compaq soon win a following of their own with cheaper, compatible products. | |
| | | The bottom falls out of the home computer and video game markets. Many companies withdraw from this market or vanish entirely. | | |
| 1985 | | | Microsoft ships Windows 1.0. Slow, primitive and devoid of useful applications it vanishes without trace. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1987 | The ACM boasts around 75,000 members. | Sun introduces its Sparc RISC processor. Its new Sparc Station (1989) cements Sun's hold on the UNIX personal workstation market. By the mid-1990s, Sun is well placed to exploit the boom in Internet servers. | | |
| | CIO Magazine is launched, and soon becomes the main booster of the CIO movement. | | | |
| 1988 | | IBM introduces the AS/400 series of servers, designed for administrative use in smaller companies. The AS/400 is a spectacular success. | | |
| 1989 | | | | Tim Berners-Lee develops the basic concepts and protocols behind the World Wide Web while employed at European high energy physics lab CERN. His original software is a proof of concept -- it is text based and runs only on esoteric hardware. First public release in 1991. |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1990 | | | | Michael Hammer's Harvard Business Review article "Reengineering Work -- Don't Automate, Obliterate" launches the Business Process Reengineering movement and initiates a global boom for consulting firms. |
| 1991 | | | Microsoft launches Windows 3.0, bringing a usable if unreliable graphical user interface to IBM compatible personal computer. Within a few years it has replaced DOS as the main operating system for personal computer use. | |
| | | | Computer science student Linus Torvalds begins work on his "Linux" operating system -- a public domain clone of the UNIX system. Thanks to the labors of fellow enthusiasts it grows quickly, and by the end of the 1990s is challenging traditional UNIX systems for use with many server applications. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1992 | | | German firm SAP launches its R/3 Enterprise Resources Planning software. Taking advantage of the boom in client/server computer products, this becomes one of the most important corporate software products of the decade | |
| | | | Oracle Corporation introduces Oracle7, establishing itself as the leading independent supplier of data base management system software. | |
| | | | Microsoft introduces Windows NT 3.1, its first serious attempt to produce an operating system suitable for corporate use on servers and high performance personal computers. By 1996, its fourth revision of this software (4.0) has begun to gain widespread use to share printers, files, and web pages. | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1993 | | Intel introduces its Pentium processor. After a slow start, this replaces its 386 and 486 as the heart of most personal computers. Pentium Pro, II, III and 4 models follow. | Mosaic, the first widespread graphical browser for the embryonic World Wide Web is released. Its use spreads exponentially among computer science departments and research labs connected to the Internet. | Debate on the "productivity paradox" picks up steam among economists, as evidence for the economic benefits of computerization proves hard to find. It continues to rage for the next decade. |
| 1994 | | | | The backlash against BPR starts to gather force. |
| 1995 | | | Netscape, founded the previous year, files its IPO. By the end of the day its stock has doubled -- ushering in the Internet goldrush and the beginnings of the New Economy bubble. | Data Warehousing, the creation of huge centralized data bases for reporting purposes, gains prominence among academics, computer managers and consulting firms. |
| | | | Microsoft releases its Windows 95 operating system, a much improved replacement for earlier versions of Windows. (NT remains a separate product). | |

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| Year | Professional/ Managerial | Hardware | Software/ Usage | Academic/ Technological/ Theoretical |
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| 1996 | The Association for Systems Management, successor to the SPA, disbands itself after a long period of decline. | 3COM introduces its first Pilot organizers. The first successful pen-based computers, they automate the functions of paper organizers. | | |
| | The DPMA, fighting a long, slow process of stagnation, renames itself the Association of Information Technology Professionals. | | | |
| 1997 | Amid a boom in discussion of Knowledge Management, the new post of Chief Knowledge Officer (CKO) starts to appear. | | Corporations start to take an interest in the Internet. "e-commerce" emerges as a fast growing area of computer applications. | |
| 2000 | Following the lead of Internet and computer firms, other corporations begin to create Chief Technology Officer jobs separate from the CIO. | | | |

**Table 6: Comprehensive timeline of events discussed in this dissertation.**

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# BIBLIOGRAPHY

This bibliography consists of a complete and automatically generated alphabetical list of all published and unpublished sources cited.


Abbott, Andrew Delano. The System of Professions: An Essay on the Division of Expert Labor. Chicago: University of Chicago Press, 1988.

Abrahmson, Eric, and Gregory Fairchild. "Management Fashion: Lifecycles, Triggers, and Collective Learning Processes." Administrative Science Quarterly 44, no. 4 (December 1999): 708-40.

Ackoff, Russell L. "Operations Research - Its Relationship to Data Processing." In Automatic Data Processing Conference, edited by Robert N. Anthony, 161-75. Boston: Graduate School of Business Administration, Harvard University, 1955.

———. "Management Misinformation Systems." Management Science 14, no. 4 (1967): B147-56.

Adams, Scott. The Dilbert Principle. New York: Harper Collins, 1996.

AFIPS, "Minutes of the Sixteenth Board Meeting," 1968, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Minutes, Board of Directors Meeting, February 14," 1973, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Minutes, Board of Directors Meeting, June 9," 1973, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Minutes, Board of Directors Meeting, November 8," 1973, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Minutes, Board of Directors Meeting, November 29," 1973, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

Akera, Atsushi. "Calculating a Natural World: Scientists, Engineers, and Computers in the United State, 1937-1968." Ph.D., University of Pennsylvania, 1998.

———. "Engineers or Managers? The Systems Analysis of Electronic Data Processing in the Federal Bureaucracy." In Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, edited by Agatha C Hughes and Thomas P Hughes, 191-220. Cambridge, MA: MIT Press, 2000.

———. "Voluntarism and the Fruits of Collaboration." Technology and Culture 42, no. 4 (October 2001): 710-36.

Alberts, Warren E. "Proper Perspectives in Developing Management Controls." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 13-27. New York: John Wiley & Sons, Inc., 1960.


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Albrecht, Michael, and James W. Cortada. "Optimizing Investments in Information Technology." National Productivity Review 17, no. 3 (Summer 1998): 53-60.

Alexander Hamilton Institute. Office Management. Edited by Joseph French Johnson. 24 vols. Vol. 19, Modern Business. New York: Alexander Hamilton Institute, 1919.

Alexander, Tom. "Computers Can't Solve Everything." Fortune 80, no. 4 (October 1969): 126-29, 68, 71.

Alt, Franz L. "Fifteen Years ACM." Communications of the ACM 5, no. 6 (1962): 300-07.

American Federation of Information Processing Societies, "Summary of DPMA Respondents to 1971 Personnel Survey," 1972, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

American Management Association: Office Management Division, ed. The Changing Dimensions of Office Management. New York: American Management Association, 1960.

Anderson, Sonya Lee. "The Data Processing Management Association: A Vital Force in the Development of Data Processing Management and Professionalism." Ph.D. Dissertation, The Claremont Graduate University, 1987.

Anonymous. Industrial Arts Index, Vol. 38. New York: H W Wilson Co., 1950.

———. "Questions and Answers." The Hopper 1, no. 1 (September 1950): 2.

———. "The Persevering Systems Man." Systems and Procedures Quarterly 2, no. 4 (1952): 3.

———. "'Bootleg' Forms." Systems and Procedures Quarterly 4, no. 2 (May 1953): 3.

———. "Glowing Future for Machine Accountants Described by Convention Speakers." Journal of Machine Accounting, Systems and Management 5, no. 7 (July-August 1954): 3, 8.

———. "The Office Equipment Industry: They Sell Answers to Problems that Executives Don't Know Exist." Dun's Review and Modern Industry 64, no. 3 (September 1954): 101-19.

———. "Office Managers: They Move Sideways into the Electronic Era." Dun's Review and Modern Industry 64, no. 2317 (September 1954): 82-97.

———. "General Electric and Lockheed Among First to Get IBM 650's." Journal of Machine Accounting 6, no. 5 (May 1955): 18-19.

———. "Editorial: The Genie Out of the Electronic Computer." Systems and Procedures 8, no. 4 (May 1957): 38-39.

———. "Staff Organization and their Training." Computing News 5, no. 95 (February 15 1957): 8-11.

———. "Business Week Reports To Readers On: Computers." Business Week, no. 1503 (21 June 1958): 68-92.

———. "Today's Office--Room For Improvement." Dun's Review and Modern Industry 72, no. 3 (September 1958): 50-51, 79-86.

———. "Is It Overhaul Or Trade-In Time (part I)." Datamation 5, no. 4 (July-August 1959): 24-33.

———. "Is It Overhaul or Trade-In Time (Part II)." Datamation 5, no. 5 (September-October 1959): 17, 19, 21, 23, 25, 26, 44-35.

———. "Basic Elements of Computer Environment." Management and Business Automation 4, no. 5 (November 1960): 28-30, 32, 48.

———. "Market Managing by Data Processing." Management and Business Automation 3, no. 2 (February 1960): 24-26, 33.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "National Survey of Computer Department Saleries." Management and Business Automation 3, no. 6 (June 1960): 20-25, 52.

———. "New Accounting Concept Based on 'Assembly-line' Processing." Management and Business Automation, February 1961, 22-24, 26, 34.

———. "Programming For Cosmetics." Business Automation 6, no. 6 (December 1961): 30-33.

———. "Software on the Couch." Datamation 7, no. 11 (November 1961): 23-24.

———. "DPMA Gives Nationwide Examination." Business Automation 8, no. 4 (October 1962): 66.

———. "The RAND Symposium: 1962. Part One - On Programming Languages." Datamation 8, no. 11 (October 1962): 25-32.

———. "The RAND Symposium: 1962. Part Two- On Programming Languages." Datamation 8, no. 11 (November 1962): 23-30.

———. "Ring Up a Sales Report." Business Automation, November 1962, 33-35.

———. "Annual Survey of Data Processing Salaries (part II)." Business Automation 10, no. 1 (July 1963): 18-23.

———. "Billing at Playboy Serious Business." Business Automation 10, no. 3 (September 1963): 32-33.

———. "Computer Count Mounts to 13,500; Will Reach 20,000 By Next Year." Business Automation 9, no. 1 (January 1963): 42-43.

———. "Editor's Readout: The Cost of Professionalism." Datamation 9, no. 10 (October 1963): 23.

———. "EDP Makes Sense, Means Profit to Bergen Drug." Business Automation 9, no. 5 (May 1963): 36-37.

———. "With the Masters: Frederick W. Taylor." Systems & Procedures Journal 14, no. 2 (March-April 1963): 24-30.

———. "Responsibility Accounting -- Fast and Precise." Business Automation 11, no. 8 (August 1964): 32-33, 36-37.

———. "Annual Survey of Data Processing Salaries." Business Automation 12, no. 6 (June 1965): 38-49.

———. "The CDP Enters a New Phase." Journal of Data Management 3, no. 7 (July 1965): 36-37.

———. "Computer Census -- August 1965." Business Automation 12, no. 8 (1965): 42-44.

———. "Power in Parallel." Business Automation 12, no. 12 (December 1965): 42-46.

———. "Total System in the Mill." Business Automation 12, no. 7 (July 1965): 22-29.

———. "Editor's Readout: EDP's Wailing Wall." Datamation 12, no. 10 (October 1966): 21.

———. "What's In It For Mr. President." Journal of Data Management 4, no. 10 (October 1966): 22-26.

———. "Programming An Information Explosion." Business Automation 14, no. 5 (May 1967): 47-50.

———. "DPMA Long Range Advisory Committee." Journal of Data Management 4, no. 3 (March 1968): 78.

———. "The Software Explosion." Business Automation 15, no. 9 (September 1968): 24-29.

———. "EDP Salary Survey--1969." Business Automation 16, no. 6 (June 1969): 48-59.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "A New Ally for Records Management." Business Automation 16, no. 7 (July 1969): 51-54.

———. "New MIS Society Make Impressive Debut." Business Automation 16, no. 10 (October 1969): 103.

———. "Certify Professionals: Who and How?" Datamation, October 1 1970, 74.

———. "EDP Salaries Report-1970." Business Automation 17, no. 6 (June 1970): 38-49.

———. "Latest Association: Programmers and Analysts." Datamation, October 1 1970, 74, 77.

———. "Management and the Information Revolution." Administrative Management, January 1970, 26-28.

———. "The Mini's Are Moving." Business Automation 17, no. 2 (February 1970): 46-51.

———. "Parker Heads DPMA Officers for 1970-71." Journal of Data Management 8, no. 8 (August 1970): 32-35.

———. "The Supersonic Seventies." Business Automation 17, no. 1 (January 1970): 44-65.

———. "Time Sharing: An Update Report." Administrative Management (March 1970): 20-22.

———. "Data Processing Salaries Report-1971." Business Automation 18, no. 8 (June 1 1971): 18-29.

———. "DPMA: Trouble in the Territories." Business Automation 18, no. 8 (June 1 1971): 15.

———. "Micropublishing: An Emerging Giant with Problems." Business Automation 18, no. 2 (January 15 1971): 6-7.

———. "ACM and DPMA Approve Computer Foundation Concept for Certification Program." Data Management 10, no. 11 (November 1972): 10-11.

———. "AFIPS Replaces SJCC, FJCC , With National Conference." Infosystems 19, no. 8 (August 1972): 12.

———. "Certification and Testing Advisory Committee Formed for EDP Industry." Data Management 10, no. 6 (June 1972): 47.

———. "DPMA Names Donn Sanford Executive Director." Data Management 10, no. 11 (November 1972): 6-7.

———. "Talking Down a Program." Business Automation 19, no. 5 (May 1972): 26-27.

———. "Word Processing-- Hardware/Software." Business Automation 19, no. 9 (September 1972): 44-46, 48.

———. "After the Big Fiche." Infosystems 20, no. 11 (November 1973): 40-41.

———. "Computer Foundation Information Meeting Draws Ten EDP Groups." Data Management 11, no. 3 (March 1973): 34-35.

———. "DPMA Committee Formed to Study Possible Membership in AFIPS." Data Management 11, no. 10 (October 1973): 41.

———. "DPMA Study Committee Recommends Further Exploration of AFIPS Membership Proposal." Data Management 11, no. 11 (November 1973): 38-39.

———. "INFO/EXPO: June 23-26." Data Management 11, no. 12 (December 1973): 38-39.

———. "...MIS, the Impossible Dream?" Infosystems 20, no. 2 (February 1973): 70.

———. "Licensing/Certification." Infosystems 21, no. 4 (April 1974).

———. "1975 Salary Survey: Recession Holds EDP Wages to an Overall Average Gain of 4.9%." Infosystems 22, no. 6 (June 1975): 34-43.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Education Foundation Committee Holds First Meeting." Data Management 13, no. 1 (January 1975): 38.

———. "Making the Mini Move." Infosystems 22, no. 1 (January 1975): 40-41.

———. "FORTRAN Comes to Westinghouse-Bettis, 1957." Annals of the History of Computing 1, no. 1 (July 1979): 72-74.

———. "Business is Turning Data into a Potent Strategic Weapon." Business Week, August 22 1983.

———. "Electronic Publishing Moves off the Drawing Boards." Business Week (August 8 1983).

———. "Los Angeles Cooperative Compiler Project Policy Committee Minutes." Annals of the History of Computing 5, no. 2 (April-June 1983): 139-41.

———. "The Price TI is Paying for Misreading a Market." Business Week, September 19 1983.

———. "Chain information managers face expanded role; data processing managers will be forced to become CIO's: chief information officers." Drug Topics, January 2 1984, 16.

———. "AITP's First 50 Dynamic Years Celebrated." Information Executive, January 2001, 1, 11.

———. About the IEEE Computer Society IEEE Computer Society, 2002 [cited November 20 2002]. Available from www.acm.org.

———. Certification Examination Development IEEE Computer Society,, 2002 [cited November 26 2002]. Available from http://www.computer.org/certification/ExamDevelopment.htm.

———. Certification Requirements IEEE Computer Society, 2002 [cited November 26 2002]. Available from http://www.computer.org/certification/education.htm.

———. Executive Guide: Enterprise Resource Planning Darwin Magazine, August 08 2002 [cited November 6 2002]. Available from http://guide.darwinmag.com/technology/enterprise/erp/index.html.

Archer, Melanie, and Judith R. Blau. "Class Formation in Nineteenth-century America: The Case of the Middle Class." Annual Review of Sociology 19 (1993): 17(25).

Aspray, William. "The Scientific Conceptualization of Information: A Survey." Annals of the History of Computing 7, no. 2 (April 1985): 117-40.

———. "Command and Control, Documentation, and Library Science: The Origins of Information Science at the University of Pittsburgh." IEEE Annals of the History of Computing 21, no. 4 (October-December 1999): 4-20.

———. "Was Early Entry a Competitive Advantage? US Universities That Entered Computing in the 1940s." IEEE Annals of the History of Computing 22, no. 3 (July-September 2000): 42-87.

Aspray, William, and Bernard O. Williams. "Arming American Scientists: NSF and the Provision of Scientific Computing Facilities for Universities, 1950-73." IEEE Annals of the History of Computing 16, no. 4 (Winter 1994): 60-74.

Association for Systems Management. Profile of a Systems Man. Cleveland, OH: Association for Systems Management, 1970.

Auerbach Associates, "An Evaluation of the Electronic Data Processing Division. Report 1848 (for First National Bank of Arizona)." 1971, Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———, "EDP Management Audit. Report 2172 (for Fieldcrest Mills, Incorporated)," 1973, Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Supplement. EDP Management Audit. Report 2172-S (for Fieldcrest Mills, Incorporated)," 1974, Auerbach Associates Records (CBI 30), Charles Babbage Institute, University of Minnesota, Minneapolis.

Auerbach, Isaac L. "Harry H Goode." Annals of the History of Computing 8, no. 3 (July 1986): 257-59.

Auerbach, Isaac L. "The Start of IFIP-Personal Recollections." Annals of the History of Computing 8, no. 2 (April 1986).

Austin, T. "Are Microsoft's Digital Dashboards Perpetual Demoware?" GartnerGroup, 2000.

Backus, John. "The History of Fortran I, II, and III." IEEE Annals of the History of Computing 20, no. 4 (October 1998): 68-78.

Baker, C. L. "The 701 at Douglas, Santa Monica." Annals of the History of Computing 5, no. 2 (1983): 187-94.

Baker, F Terry, and Harlan D Mills. "Chief Programmer Teams." Datamation 19, no. 12 (December 1973): 58-61.

Baldwin, Carliss Y., and Kim B. Clark. "Managing in an Age of Modularity." Harvard Business Review 75, no. 5 (Sept-Oct 1997): 84-94.

Bararb, George J., and Earl B. Hutchins. "Electronic Computers and Management Organization." California Management Review 6 (Fall 1963): 33-42.

Barley, Stephen R, and Julian E Orr. "Introduction: The Neglected Workforce." In Between Craft and Science: Technical Work in US Settings, edited by Stephen R Barley and Julian E Orr, 1-19. Ithaca: Cornell University Press, 1998.

Barley, Stephen R. "Technicians in the Workplace: Ethnographic Evidence for Bringing Work into Organizational Studies." Administrative Science Quarterly 41, no. 3 (1996): 404-41.

———. "What can we learn from the history of technology?" Journal of Engineering and Technology Management 15, no. 4 (September-December 1998): 237-55.

Baron, Ava. Work Engendered: Towards a New History of American Labor. Ithaca, NY: Cornell University Press, 1991.

Bartholomew, Doug. "When Will EIS Deliver?" Industry Week 1997.

Bashe, C J, W Bucholz, and N Rochester. "The IBM Type 702: An Electronic Data Processing Machine For Business." Journal of the Association for Computing Machinery 1, no. 1 (October 1954): 149-69.

Bashe, Charles J, Lyle R Johnson, John H Palmer, and Emerson W. Pugh. IBM's Early Computers. Cambridge, MA: MIT Press, 1986.

Bass, Alison. CIOs Between a Rock and a Hard Place CIO Magazine, October 17 2002 [cited October 25 2002]. Available from http://comment.cio.com/crm/101702.html.

Bauer, Frederick L. "Report of the Ad Hoc Committee on AFIPS Conferences (Attachment 10 to Minutes of the Ninth Meeting of the AFIPS Governing Board, May 22)," 1965, American Federation of Information Processing Societies Records (CBI 44), Charles Babbage Institute, University of Minnesota, Minneapolis.

Bauer, Raymond A. "Our Big Advantage: The Social Sciences." Harvard Business Review 36, no. 3 (May-June 1958): 125-36.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Bauer, Walter F. "On ACM's Role and Its Welfare." Communications of the ACM 7, no. 12 (December 1964): 700.

Baum, Claude. The System Builders: The Story of SDC. Santa Monica: System Development Corporation, 1981.

Beatty, Jack. The World According to Peter Drucker. New York: The Free Press, 1997.

Becker, James L. "Planning the Total Information System." In Total Systems, edited by Alan D. Meacham and Van B. Thompson, 66-70. Detroit, MI: American Data Processing, Inc., 1962.

Bell, Daniel. The Coming of Post-Industrial Society: A Venture in Social Forecasting. New York: Basic Books, 1973.

Bellin, Eugene. "Facilities Management, An Approach to Successful Data Processing Management." Journal of Systems Management 22, no. 1 (January 1971): 18-20.

Bello, Francis. "The Information Theory." Fortune, December 1953, 136-41, 49-50, 52, 54,56, 58,.

———. "How to Cope with Information." Fortune 62, no. 3 (September 1960): 162-67, 80-82, 87-89, 92.

Bemer, Bob. Birth of an Unwanted IBM Computer bobbemer.com, [cited 26-APR-01 2001]. Available from http://www.bobbemer.com/BIRTH.HTM.

Bemer, R. W., "Letter to Robert C. Haavind of 15 July," 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Bender, Virginia. "More Mini Power for Management." Business Automation 19, no. 1 (January 1972): 30-34.

Bendix, Reinhard. Work and Authority in Industry: Ideologies of Management in the Course of Industrialization. Berkley, CA: University of California Press, 1974.

Beniger, James R. The Control Revolution: Technological and Economic Origins of the Information Society. Cambridge, MA: Harvard University Press, 1986.

Benson, Susan Porter. Counter Cultures: Saleswomen, Managers, and Customers in the American Department Store, 1890-1940. Urbana, IL: University of Illinois Press, 1986.

Berkan, Erick. "When Bad Things Happen To Good Ideas." Darwin Magazine, April 2001.

Berkeley, Edmund C. Giant Brains or Machines That Think. New York: John Wiley & Sons, 1949.

Berkman, Eric. "Why We're Still Talking about Alignment." CIO Magazine, January 1 2001.

———. "The State of the CIO: Skills." CIO Magazine, 15 March 2002.

Bernstein, George B. "Are You Ready for Computer Image Processing?" Business Automation 18, no. 11 (September 1971): 30-33.

Biggs, Lindy. "The Engineered Factory." Technology and Culture 36, no. 2 supplement (April 1995): S174-S88.

Bijker, Wiebe, Thomas Hughes, and Trevor Pinch. The Social Construction of Technological Systems. Cambridge, MA: MIT Press, 1987.

Bishop, C.G., and J. R. Woodward. "Two Tabulating Case Studies." Systems and Procedures Quarterly 1, no. 2 (June 1950): 12-15.

Blank, Virgil F. "Electronics -- Possibilities and Limitations." Systems and Procedures Quarterly 6, no. 3 (August 1955): 8-15.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Blatt, John M. "Comments from a FORTRAN User." Communications of the ACM 3, no. 9 (1960): 501-05.

Blau, Peter M., and Marshall W. Meyer. Bureaucracy in Modern Society (3rd Edition). New York, NY: Random House, 1987.

Blodgett, Mindy. "The Wolf at the Door: Worried About the Rise of the CTO? Well, Maybe You Should Be. The Trend Represents Both Threat and Opportunity for Sitting IT Executives." CIO Magazine 2000.

Blose, William F, and William P Carter. "Integrated Data Processing." Data Management 9, no. 3 (March 1971): 14-18.

Bocchino, William A. Management Information Systems: Tools and Techniques. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1972.

Boccomino, John. "The Importance of Program Maintenance." Systems and Procedures 8, no. 3 (August 1957): 9-14.

Bock, Gordon, Kimberly Carpenter, and Jo Ellen Davis. "Management's Newest Star." Business Week, October 13 1986, 160.

Bond, B., Y. Genovese, D. Miklovic, N. Wood, B. Zrimsek, and N. Rayner. "ERP Is Dead — Long Live ERP II." Gartner Group, 2000.

Borchardt, Rudolf. "The Coming Revolution in Information Handling." Systems and Procedures 8, no. 3 (August 1957): 28-31.

Borgmann, Albert. Holding on to Reality : The Nature of Information at the Turn of the Millennium. Chicago: University of Chicago Press, 1999.

Bosak, Robert. "Implications of Computer Programming Research for Management Controls." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 209-14. New York: John Wiley & Sons, Inc., 1960.

Boulden, James B., and Elwood S. Buffa. "Corporate Models: On-Line, Real-Time Systems." Harvard Business Review 48, no. 4 (July-August 1970): 65-83.

Bower, Gordon. "The Relationship of the Machine Accountant to Automated Data Processing." Journal of Machine Accounting 7, no. 1 (January 1956): 9-10, 15.

Bowker, Geoffrey. "Information Mythology: The World Of/As Information." In Information Acumen: The Understanding and Use of Knowledge in Modern Business, edited by Lisa Bud-Frierman. New York: Routledge, 1994.

Boyle, Charles D. "How to Integrate Line and Staff." Systems & Procedures Journal 16, no. 1 (January-February 1965): 8-23.

Boz, Matt W. "Where We Stand Today on Electronics for the Office." The Hopper 5, no. 1 (January 1954): 4-6.

Bradshaw, T. F., ed. Automatic Data Processing Methods. Edited by Robert N. Anthony, Automatic Data Processing Conference. Boston: Graduate School of Business Administration, Harvard University, 1955.

Bramson, A. D. "Unified Operations Management." Business Automation 7, no. 1 (January 1962): 26-31.

Branson, A. D. "A Primary Goal of the Total Systems Concept." In Ideas for Management: 14th International Systems Meeting, edited by Anonymous, 28-34. Detroit: Systems and Procedures Association, 1961.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Braverman, Harry. Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century. New York: Monthly Review Press, 1974.

Bright, Herbert S. "Early FORTRAN User Experience." Annals of the History of Computing 6, no. 1 (January-March 1984): 28-30.

Bright, James R. "How to Evaluate Automation." Harvard Business Review 33, no. 4 (July-August 1955): 101-11.

Brightman, Richard W., Bernard J. Luskin, and Theodore Tilton. Data Processing for Decision-Making: An Introduction to Third Generation Information Systems. New York: The Macmillan Company, 1971.

Brink, Victor Z. Computers and Management: The Executive Viewpoint. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.

Bromberg, Howard. "What COBOL Isn't: A Temperate Evaluation for Implementation." Datamation 7, no. 9 (September 1961): 27-29.

———. "The COBOL Conclusion: End of the Beginning." Datamation 13, no. 4 (March 1967): 45-50.

Brook, George W., Jr. "A New Look." Systems & Procedures 11, no. 1 (February 1960): 7-15.

Brooks, Fredererick P. "The Mythical Man Month After 20 Years." In The Mythical Man Month: Essays on Software Engineering, 252-90. Reading, MA: Addison-Wesley, 1995.

Brooks, Frederick P, Jr. "The Mythical Man-Month." Datamation 20, no. 12 (December 1974): 1974.

———. The Mythical Man Month: Essays on Software Engineering. Reading, MA: Addison-Wesley, 1975.

Brown, John Seely, and Paul Duguid. The Social Life of Information. Boston: Harvard Business School Press, 2000.

Brown, R Hunt. "Computer Comparison and Census Chart." Management and Business Automation 4, no. 1 (August 1960): 34.

Brown, R. Hunt, "Office Automation -- Selecting, Training, and Organizing Computer Personnel," 1959, Market and Product Reports Collection (CBI 55), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Office Automation: A Handbook on Automatic Data Processing," 1959, Market and Product Reports Collection (CBI 55), Charles Babbage Institute, University of Minnesota, Minneapolis.

Browne, Dudley E. "Management Looks at Management Information Systems." In Advances in Management Information Sytems. AMA Management Bulletin No. 16., edited by American Management Association, 13-16. New York: American Management Association, 1962.

Brozo, Cliff, and Kewal Dhariwal. "Should CIOs Value IT Certification." CIO Magazine, February 15 2000.

Bryce, Milt. "Ripoff Reaction." Infosystems 22, no. 1 (January 1975): 6.

Bud-Frierman, Lisa, ed. Information Acumen: The Understanding and Use of Knowledge in Modern Business. New York: Routledge, 1994.

Buegler, Robert H. "Random Access File System Design." Datamation 9, no. 12 (December 1963): 31-33.

Bukowitz, Wendi, and Ruth Williams. "Knowledge Pool." CIO Magazine, July 15 2000.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Bureau of Labor Statistics. "Office and Administrative Support Worker Supervisors and Managers." In Occupational Outlook Handbook, 417-19. Washington, DC, 2002.

Bush, Vannevar. "As We May Think." The Atlantic Monthly 176, no. 1 (July 1945): 101-08.

Butterworth, Stanley R. "Reader Feedback: The Legal Status of CDP." infosystems 22, no. 4 (April 1975): 6.

Buxton, J N, and B Randell, eds. Software Engineering Techniques: Report on a Conference Sponsored by the NATO Science Committee, Rome, Italy, 27th to 31st October 1969. Brussels: NATO Scientific Affairs Division, 1970.

Bylinsky, Gene. "Help Wanted: 50,000 Programmers." Fortune (March 1967): 140-43, 68, 71-3, 76.

Byrne, Harriet A. Women Office Workers in Philadelphia. Washington: US GPO, 1932.

———. Women Who Work in Offices. Washington: US GPO, 1935.

Cady, Susan A. "Machine Tool of Management: A History of Microfilm Technology." Ph.D., Lehigh, 1994.

Cahill, John J. "A Dictionary/Directory Method for Building a Common MIS Data Base." Journal of Systems Management 21, no. 11 (November 1970): 23-29.

Caminer, David Tresman. "The Story of an Innovation." In User Driven Innovation: The World's First Business Computer, edited by David Caminer, John Aris, Peter Hermon and Frank Land, 1-150. London: McGraw-Hill Book Company, 1996.

Caminer, John J., and Gerhard R. Andlinger. "Operations Research Roundup." Harvard Business Review 32, no. 6 (November-December 1954): 132-36.

Campbell-Kelly, Martin. ICL: A Technical and Business History. New York: Oxford University Press, 1989.

———. "Large-scale Data Processing in the Prudential, 1850-1930." Accounting Business and Financial History 2, no. 2 (? 1992): 117-36.

———. "The Railway Clearing House and Victorian Data Processing." In Information Acumen: The Understanding and Use of Knowledge in Modern Business, edited by Lisa Bud-Frierman. London: Routledge, 1994.

———. "Development and Structure of the International Software Industry." Business and Economic History 24, no. 2 (Winter 1995): 73-110.

Campbell-Kelly, Martin, and William Aspray. Computer: A History of the Information Machine. New York, NY: Basic Books, 1996.

Cann, Reg. "The LEO Approach - An Evaluation." In LEO: The Incredible Story od the World's First Business Computer, edited by David Caminer, John Aris, Peter Hermon and Frank Land, 274-85. New York: McGraw-Hill, 1996.

Canning, Richard G. Electronic Data Processing for Business and Industry. New York: John Wiley & Sons, 1956.

———. "Planning for the Arrival of Electronic Data Processing." Journal of Machine Accounting 7, no. 1 (January 1956): 22-23, 30.

———. Installing Electronic Data Processing Systems. New York: John Wiley & Sons, Inc., 1957.

———. "New Light on Error Detection and Control." EDP Analyzer 1, no. 1 (February 1963).

———. "Time to Switch to COBOL?" EDP Analyzer 1, no. 11 (December 1963).

———. "The DPMA Certificate in Data Processing." EDP Analyzer 3, no. 7 (July 1965): 1-12.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "The Corporate Data File." EDP Analyzer 4, no. 11 (November 1966).

———. "New Views on Mass Storage." EDP Analyzer 4, no. 2 (February 1966).

———. "Trends in Corporate Data Systems." EDP Analyzer 4, no. 8 (August 1966).

———. "Application Packages: Coming Into Their Own." EDP Analyzer 5, no. 7 (July 1967).

———. "Fast Response System Design." EDP Analyzer 5, no. 3 (March 1967).

———. "Independent Software Companies." EDP Analyzer 5, no. 11 (November 1967).

———. "Progress in Fast-Response Systems." Systems & Procedures Journal 18, no. 4 (July-August 1967): 20-25.

———. "What's the Status of MIS?" EDP Analyzer 7, no. 10 (October 1969): 1-14.

Canning, Richard G., and Roger L. Sisson. The Management of Data Processing. New York: John Wiley & Sons, Inc., 1967.

Cantrell, Harry N. "Where are Compiler Languages Going?" Datamation 8, no. 7 (August 1962): 25-28.

Carding, Anthony D. K. "Microfilm: EDP's Newest Ally." Administrative Management 31:4, no. April (1970): 38-42, 44, 46-48.

Carlson, Bruce. "Operations Research -- Friend or Foe of Systems?" Systems and Procedures 9, no. 3 (August 1958): 11-15.

Carlson, Walter. "ACM and Special Interest Groups." Data Base 25, no. 2 (1994): 9-12.

Carlson, Walter M. "Unfinished Business: III." Communications of the ACM 15, no. 4 (May 1972): 299-300.

Carlson, Walter M. "Letter from the ACM Vice-President: 'There is a Tide in the Affairs of Men...'" Communications of the ACM 12, no. 10 (October 1969): 537.

———. "ACM President's Letter: 100,000 in 1975!" Communications of the ACM 13, no. 7 (July 1970): 395.

———. "ACM President's Letter: Finding the Real Expert." Communications of the ACM 13, no. 9 (September 1970): 525.

———. "A Letter from the ACM President: Wither our Chapters." Communications of the ACM 14, no. 4 (April 1971): 219-20.

———. "President's Letter: On ACM Goals." Communications of the ACM 14, no. 11 (November 1971): 693.

———. "ACM President's Letter: The Answer Is... Competence, Integrity, and Productivity... What is the Question?" Communications of the ACM 15, no. 2 (February 1972): 69.

———. "ACM President's Letter: Unfinished Business: I." Communications of the ACM 15, no. 3 (March 1972): 131-32.

———. "ACM President's Letter: Unfinished Business: II." Communications of the ACM 15, no. 4 (April 1972): 209-10.

———. "A Letter from ACM's Past President: The Wonderful World of AFIPS." Communications of the ACM 16, no. 5 (1973): 273-74.

Carlyle, Ralph Emmett. "CIO: misfit or misnomer?" Datamation 34:15, no. Aug 1 (1988).

Carlyle, Robert. "The Out of Touch CIO." Datamation, August 15 1990, 30-33.

Carr, William. "No Waiting at Howard Savings." Business Automation 7, no. 3 (March 1962): 30-32.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Carrico, Joseph E. "Research in the Field of Business Systems." In Ideas for Management: 14th International Systems Meeting, edited by Anonymous, 101-06. Detroit: Systems and Procedures Association, 1961.

Cassidy, John. .Con: The Greatest Story Ever Sold. New York: HarperCollins, 2002.

Ceruzzi, Paul E. Reckoners: The Prehistory of the Digital Computer, from Relays to the Stored Program Concept, 1935-1945. Westport, CT: Greenwood Press, 1983.

———. A History of Modern Computing. Cambridge, Mass.: MIT Press, 1998.

Chandler, Alfred D. The Visible Hand: The Managerial Revolution in American Business. Cambridge, MA: Harvard University Press, 1977.

———. Scale and Scope: The Dynamics of Industrial Capitalism. Cambridge, MA: Belknap Press of Harvard University, 1992.

Chandler, Alfred D., Jr. "Recent Developments in American Business Administration and their Conceptualization." Business History Review 35, no. 1 (Spring 1961): 1-27.

———. Strategy and Structure: Chapters in the History of the American Industrial Enterprise. Cambridge, MA: MIT Press, 1962.

Chapin, Ned. "Justifying the Use of an Automatic Computer." The Hopper 5, no. 8 (September 1954): 9-10, 14.

———. "The Machine Accountant's Approach to Systems for Automatic Computers." Journal of Machine Accounting 7, no. 8 (August 1956): 28-32.

Cheek, R. C. "A System for General Management Control." In Control Through Information: A Report on Management Information Systems (AMA Management Bulletin 24), edited by Alex W. Rathe, 5-10. New York, 1963.

Chen, Diane. Certifications 101 CIO.com, 7 September 2000 [cited July 4 2001]. Available from http://www.cio.com/forums/futurecio/edit/certifications101.html.

Childs, Geoffrey S., Edwin J. Clapp, and Bernard Lichtenberg. Office Management., Modern Business: A Series of Texts Prepared as Part of the Modern Business Course and Service of the Alexander Hamilton Institute. New York: Alexander Hamilton Institute, 1919.

Christensen, Jens P. "In Protest." Infosystems 22, no. 5 (May 1975): 6, 75.

Christian, Roger W. "The Total Systems Concept." In Ideas for Management: 14th International Systems Meeting, edited by Anonymous, 15-20. Detroit: Systems and Procedures Association, 1961.

Chu, Albert L. C. "Key-to-Tape: K.O. For the Keypunch?" Business Automation 17, no. 4 (April 1970): 52-59.

Chu, Albert L.C. "Data Entry." Business Automation 18, no. 9 (July 1971): 18-22, 26-27.

Churchill, N C, J H Kempster, and M Uretsky. Computer-based Information Systems for Management, A Survey. New York: National Association of Accountants, 1969.

Clippinger, R F. "Systems Implications of Hardware Trends." Systems & Procedures Journal 18, no. 3 (May-June 1967): 10-17.

Clippinger, R.F., B. Dimsdale, and J. H. Levin. "Automatic Digital Computers in Industrial Research." Journal of Machine Accounting 6, no. 2 (February 1955): 7-11, 14-16.

———. "Automatic Digital Computers in Industrial Research -- Part 2." Journal of Machine Accounting 6, no. 3 (March 1955): 9-11, 19.

Cochran, Anita. "ACM: the past 15 years, 1972-1987." Communications of the ACM 30, no. 10 (October 1987): 866-72.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Cochran, Thomas C. "Business and the Democratic Tradition." Harvard Business Review 34, no. 2 (March-April 1956): 39-48.

CODASYL Systems Committee. Feature Analysis of Generalized Data Base Management Systems. New York: [n.p., Distributed by the Association for Computing Machinery], 1971.

Coffey, Margaret L. "Do We Want Machines That Can Outthink Us? Review of 'The Micro Millennium' by Christopher Evans." Business Week, April 21 1980.

Cohen, Henry M. "A MIS That Scores As A Decision-Maker." Business Automation 14, no. 11 (November 1967): 44-48.

Cohen, I Bernard. Howard Aiken: Portrait of a Computer Pioneer. Cambridge, MA: MIT Press, 1999.

Coleman, John S. "What Price Business Electronics?" Systems and Procedures Quarterly 2, no. 3 (January 1952): 4-7.

Collins, Donald R. "Ripoff Reactions Continue." Infosystems 22, no. 2 (February 1975): 6.

Conway, B., J. Gibbons, and D. E. Watts. Business Experience With Electronic Computers: A Synthesis of What Has Been Learned From Electronic Data Processing Installations. New York: Controllers Institute Research Foundation, 1959.

Cook, Leroy L., and Ronald J. Hastings. "Automated Management Information Systems." In Data Processing XIII: Proceedings of the 1968 International Data Processing Conference and Business Exposition, edited by Data Processing Management Association, 34-44. Chicago: Data Processing Management Association, 1968.

Copeland, Duncan G., Richard O. Mason, and James L. McKenney. "SABRE: The Development of Information-Based Competence and Execution of Information-Based Competition." IEEE Annals of the History of Computing 17, no. 3 (Fall 1995): 30-57.

Cordiner, Ralph J. New Frontiers for Professional Managers. New York: McGraw-Hill, 1956.

Corocran, Carl. "Management of a Data Processing Department: Part 2." In Data Processing 4: Proceedings of the 1961 International Conference of the National Machine Accountants Association, 75-80. Chicago: National Machine Accountants Association, 1961.

Cortada, James. Before the Computer: IBM, Burroughs and Remington Rand and the Industry they Created, 1865-1956. Princeton, NJ: Princeton University Press, 1993.

———. The Computer in the United States: From Laboratory to Market, 1930-1960. Armonk, New York: M.E. Sharpe, 1993.

Cortada, James A. EDP Costs and charges: Finance, Budgets and Cost Control in Data Processing. New Jersey: Prentice-Hall, 1980.

Cortada, James W. Information Technology as Business History: Issues in the History and Management of Computers. Westport, CT: Greenwood Press, 1996.

———, ed. Rise of the Knowledge Worker. New York: Butterworth--Heinemann, 1998.

———. "Using Textual Demographics to Understand Computer Use: 1950-1990." IEEE Annals of the History of Computing 23, no. 1 (January-March 2001): 34-56.

Couch, Gordon C. "The President's Column: Service--The Key to Advancement." The Hopper 5, no. 2 (February 1954): 1-2.

Couch, Gordon G. "New Horizons for NMAA." The Hopper 4, no. 6 (June 1953): 1.

Couger, J Daniel. "Turnabout in the Approach to Educating Future Managers About the Computer." Data Management 9, no. 6 (June 1971): 34-40.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Couger, J. Daniel. "Producing a Computer-Oriented Manager." Journal of Systems Management 20, no. 5 (May 1969): 22-27.

Cover, Jack B. "Licensing--the issues." Infosystems 22, no. 8 (September 1975): 4.

Crane, Roger R. "Operations Research in Industry." The Controller 25, no. 3 (March 1957): 118-21.

Creighton, Sean, and Randy Hodson. "Whose Side are they On? Technical Workers and Management Ideology." In Between Craft and Science: Technical Work in US Settings, edited by Stephen R Barley and Julian E Orr, 82-97. Ithaca: Cornell University Press, 1998.

Cuadra, Carlos A., ed. Annual Review of Information Science and Technology: Volume 1. New York: John Wiley & Sons, 1966.

D. W. "Reader Feedback: Is Boredom Necessary?" Business Automation 19, no. 11 (November 1972): 8.

Dana, Rosamond W, and Henry S Tropp. "Reflections on a Quarter-Century: AFIPS Founders." Annals of the History of Computing 8, no. 3 (July 1986): 225-51.

Daniel, D. Robert. "Getting the Most Out of Your Computer." In EDP: The First Ten Years. Highlights of Management Experience and a Look Ahead, edited by McKinsey & Company, 15-21. Chicago: American Society for Public Administration, 1961.

Daro, E. Philip. "Workshop Seminar on Selection and Training of Personnel." In Data Processing: 1958 Proceedings, edited by Charles H. Johnson, 324-38. Chicago: National Machine Accountants Association, 1958.

Data Processing Management Association, "Executive Committee Minutes, 30 Nov & 1 Dec," 1962, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 24 June," 1963, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes -- 6 November -- Verbatim," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes -- 15 August -- Verbatim," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes -- 21 June -- Verbatim," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Membership Profile, April 1964," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 20 March," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 26 & 27 June," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———, "Executive Committee Meeting Minutes, 5-6 August," 1966, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 18-19 June," 1966, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 21-22 Jan," 1966, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes -- 14-16 September -- Verbatim," 1967, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 16-18 March," 1967, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Chapter Education Manual, Third Draft," 1968, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes -- January 18-19 & 21 -- Verbatim," 1968, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Board of Directors Minutes -- 5th December," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes -- 3-4 & 6th December," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes -- 13-15 June," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes -- 15-18 Jan," 1969, Data Processing Management Association Records, Minneapolis.

———, "Executive Committee Minutes -- 27-29 March," 1969, Data Processing Management Association Records, Minneapolis.

———, "Executive Board of Directors Minutes -- 22 June," 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Board of Directors Minutes -- 9-10 December," 1971, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Board of Directors Minutes -- 20 June," 1971, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "CDP Ambassador guide," 1972, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Executive Board of Directors Minutes -- 26 June," 1972, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Davenport, Thomas H. "The Fad That Forgot People." Fast Company 1, no. 1 (1995): 70.

———. "Putting the enterprise into the enterprise system." Harvard Business Review 76, no. 4 (July-August 1998): 121.

Davenport, Thomas H., Robert G. Eccles, and Laurence Prusak. "Information Politics." Sloan Management Review 34, no. 1 (Fall 1992): 53(13).

Davenport, Thomas H., and M. Lynne Markus. "Rigor vs. relevance revisited: response to Benbasat and Zmud." MIS Quarterly, March 1999, 19(5).

Davenport, Thomas H., and with Laurence Pursak. Information Ecology: Mastering the Information and Knowledge Environment. New York: Oxford University Press, 1997.

Davenport, Thomas H., and James E Short. "The new industrial engineering: information technology and business process redesign." Sloan Management Review 31, no. 4 (Summer 1990): 11-27.

Davenport, Thomas H., and Donna B. Stoddard. "Reengineering: business change of mythic proportions." MIS Quarterly 18, no. 2 (June 1994): 121.

Davenport, Tom. "The Last Big Thing." CIO Magazine, November 1 2000.

———. "The Other Digital Divide: Battle Lines are Drawn as IT Managers and E-Managers Face Off." CIO Magazine, July 1 2000.

Davidson, Harold O. "Railroad Executives' Seminar on Operations Research." Journal of the Operations Research Society of America 2 (May 1954): 210-11.

Davidson, Harold O. "Management, Engineering and Scientific Functions." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 333-47. New York: John Wiley & Sons, Inc., 1960.

———. "Research and Development in Management Controls." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 351-56. New York: John Wiley & Sons, Inc., 1960.

Davies, Margery W. Woman's Place is at the Typewriter: Office Work and Office Workers, 1870-1930. Philadelphia, PA: Temple University Press, 1982.

Davis, Allen Y. "Selling the System." In Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, edited by Gibbs Myers, 395-99. Detroit: The Systems and Procedures Association of America, 1958.

Day, Ronald E. The Modern Invention of Information: Discourse, History, and Power. Carbondale: Southern Illinois University Press, 2001.

De Luca, A. Richard. "Functions of a Systems & Procedures Department." Systems & Procedures 12, no. 2 (March-April 1961): 2-7.

———. "Introduction to Systems & Procedures." Systems & Procedures Magazine 12, no. 1 (January-February 1961): 2-7.

———. "Operating the Systems and Procedures Department." Systems & Procedures 12, no. 5 (September-October 1961): 17-29.

———. "Organizing the Systems and Procedures Department." Systems & Procedures 12, no. 2 (March-April 1961): 4-18.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Placing the Systems and Procedures Function in the Organization." Systems & Procedures 12, no. 3 (May-June 1961): 14-23.

de Vault, Irene. Sons and Daughters of Labor. Ithaca: Cornell University Press, 1990.

de Wit, Dirk. The Shaping of Automation : A Historical Analysis of the Interaction between Technology and Organization, 1950-1985, Publikaties van de Faculteit der Historische en Kunstwetenschappen. Hilversum: Verloren, 1994.

———. "Caught Between Historical Experience and High Hopes: Automation at the Dutch Postal Cheque and Clearing Service, 1950-1965." IEEE Annals of the History of Computing 17, no. 2 (Summer 1995): 9-21.

de Wit, Onno , Jan van Den Ende, Johan Schot, and Jan van Oost. "Innovation Junctions: Office Technologies in the Netherlands, 1880-1980." Technology and Culture 43, no. 1 (January 2002): 50-72.

Dean, Neal J. "Computer Installation -- Will It Pay To Wait?" The Management Review 49, no. 3 (March 1960): 25-28, 79-83.

———. "The Computer Comes of Age." Harvard Business Review 46, no. 1 (January-February 1968): 83-91.

Dearden, John. "Can Management Information be Automated?" Harvard Business Review 42, no. 2 (March-April 1964): 128-35.

———. "How to Organize Information Systems." Harvard Business Review 43, no. 2 (March-April 1965): 65-73.

———. "Myth of Real-Time Management Information." Harvard Business Review 44, no. 3 (May-June 1966): 123-32.

———. "Computers: No Impact on Divisional Control." Harvard Business Review 45, no. 1 (January-February 1967): 99-104.

———. "MIS Is a Mirage." Harvard Business Review 50, no. 1 (1972): 90-99.

Dearden, John, and F. Warren McFarlan. Management Information Systems: Text and Cases. Homewood, IL: Richard D. Irwin, Inc., 1966.

DeMarco, Tom. Structured Analysis and System Specification. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

DeVito, Ludwig J. "Ripoff Reaction." Infosystems 22, no. 1 (January 1975): 6.

Dickey, E.R., Jr.,. "Management Information Systems--Opportunity and Challenge for the Data Processing Manager." In Data Processing Volume VIII: Proceedings of the 1965 International Data Processing Conference, DPMA, edited by Data Processing Management Association, 1-15. Chicago: Data Processing Management Association, 1965.

Dickie, H. Ford. "Integrated Systems Planning at G.E." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 137-55. New York: John Wiley & Sons, Inc., 1960.

Dickinson, G. W., and John K. Simmons. "The Behavioural Side of MIS: Some Aspects of the "People Problem"." Business Horizons 13, no. 4 (1970): 59-71.

Dickinson, Robert M. "Can Centralized Planning for Office Automation Ever Work in a Large Corporation." In Emerging Office Systems, edited by Robert M. Landau, James H. Blair and Jean H. Siegman, 21-38. Norwood, NJ: ABLEX Publishing Corporation, 1982.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Dickson, Garry W., and Jeffrey A. Lasky. The SMIS President's Reading List. Minneapolis: School Of Business Administration, University of Minnesota, 1971.

Diebold, John. Automation, the advent of the automatic factory. New York,: Van Nostrand, 1952.

———. "Automation - The New Technology." Harvard Business Review 31, no. 6 (November-December 1953): 63-71.

———. "Industry and the Automated Future: Problems Along the Way." Journal of Machine Accounting 8, no. 2 (February 1957): 6-8, 28-29, 33.

Dijkstra, Edsger W. "Letters to the Editor: Go To Statement Considered Harmful." Communications of the ACM 11, no. 3 (March 1968): 147-48.

———. "EWD 611: On the Fact that the Atlantic Ocean Has Two Sides." In Selected Writings on Computer Science: A Personal Perspective, edited by Edsger W. Dijkstra, 268-76. New York: Springer-Verlag, 1982.

Dillion, Gregory M. "The Evaluation of Programs and Programmers." In Data Processing Volume VIII: Proceedings of the 1965 International Data Processing Conference, DPMA, edited by Data Processing Management Association, 353-65. Chicago: Data Processing Management Association, 1965.

Dillion, John D., Janus O. Dyal, and Jr. Byron O. Marshall. "Selecting an Application for Mechanization." In Automatic Data Processing Conference, edited by Robert N. Anthony, 110-23. Boston: Graduate School of Business Administration, Harvard University, 1955.

Dillon, John H. Data Processing in Navy Management Information Systems, SecNavInst. P 10462.7. Washington, D.C.: Department of the Navy, 1959.

DiMaggio, Paul J. "Constructing an Organization Field as a Professional Project: US Art Museums, 1920-1940." In The New Institutionalism in Organizational Analysis, edited by Walter W. Powell and Paul J. DiMaggio. Chicago: University of Chicago Press, 1991.

DiMaggio, Paul J., and Walter W. Powell. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." American Sociological Review 48, no. 2 (April 1983): 147-60.

DiStefano, Stephen. "The D.P. Manger and the Corporate Organization." In Data Processing 14: Proceedings of the 1969 International Data Processing Conference and Business Exposition, edited by Data Processing Management Association, 275-79. Chicago: Data Processing Management Association, 1969.

Donham, Paul. "Is Management a Profession?" Harvard Business Review 40, no. 5 (September-October 1962): 60-68.

Donkin, Robert G. "Will the Real MIS Stand Up?" Business Automation 16, no. 50-53 (May 1969): 5.

DPMA Certification Council, "1968-69 Certification Council Report," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Dratell, Alan. "Unbundling: The User Will Pay for the Works." Business Automation 16, no. 8 (August 1969): 36-41.

Driscoll, J. A., "Report to Board of Directors re. CDP and RBPE reviews, September 13," 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Driscoll, Jeffrey Rothfeder and Lisa. "CIO is starting to stand for 'career is over'; once deemed indispensable, the chief information officer has become an endangered species." Business Week, Feb 26 1990, 78-80.

Drucker, Peter. "The Next Decade in Management." Dun's Review and Modern Industry 59 (September 1959): 52-53, 57-58, 60-61.

Drucker, Peter F. The Practice of Management. New York: Harper & Brothers Publishers, 1954.

Drucker, Peter Ferdinand. Concept of the Corporation. New York: John Day, 1946.

———. The Effective Executive. New York: Harper & Row, 1967.

Duening, Tom, and Jack Ivanevich. Managing Einsteins: Leading High Tech Workers in the Digital Age. New York: McGraw-Hill, 2002.

E. Drake Lundell, Jr. "DP Titles Standardized by New GSA Guidelines." Computerworld 6, no. 16 (1972): 1-2.

Earl, Michael J., and Ian A. Scott. "What Is a Chief Knowledge Officer?" Sloan Management Review 40, no. 2 (1999): 29(1).

Edmondson, Brad. "Hail to the Chief (Chief Information Office Statistics)." American Demographics 12, no. 2 (1990): 11-12.

Edwards, Melvin Lloyd. "The Effect of Automation on Accounting Jobs." Doctor of Education, University of Oklahoma, 1959.

Edwards, Paul. The Closed World: Computers and the Politics of Discourse in Cold War America. Cambridge, MA: MIT Press, 1996.

Edwards, Paul N. "The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models." In Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, edited by Agatha C Hughes and Thomas P Hughes, 221-53. Cambridge, MA: MIT Press, 2000.

Eisenberg, Daniel. "History of Word Processing." In Encyclopedia of Library & Information Science -- Vol. 49 (Supplement 12), edited by Allen Kent, 268-78. New York: Marcel Dekker, 1992.

Eklund, Jon. "The Reservisor Automated Airline Reservation System: Combining Communications and Computing." IEEE Annals of the History of Computing 16, no. 1 (Spring 1994): 62-69.

Elliot, Calvin R., "DPMA (document submitted to Executive Committee meeting)," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Elliot, R Calvin, "Letter to Robert S. Gilmore, 10 Jan," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———. "Editorial." Data Management 10, no. 7 (July 1972): 6.

Elliot, R. Calvin, "Letter to Robert S. Gilmore, 7 October," 1963, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Questions and Answers for Datamation," 1963, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "The Elliot Recommendation to the Executive Committee Concerning the Future of the CDP Program," 1967.

———. January 17 1968.

Elliott, R. Calvin. "DPMA: Its Function & Future." Datamation 9, no. 6 (June 1963): 35-36.

Elmendort, W. R., and W.W. Peterson, "A Study of the UNIVAC," 1954, Cuthbert C. Hurd Papers (CBI 95), Charles Babbage Institute, University of Minnesota, Minneapolis.

Emery, James C. "An Overview of Management Information Systems." Data Base 5, no. 2-3-4 (Winter 1973): 1-15.

Emmerling, Walter. "Milestones on Our Road to Professional Status." The Office 51, no. 1 (1960): 90-92.

Ensmenger, Nathan. "From Black Art to Industrial Discipline: The Software Crisis and the Management of Programmers." Ph.D., University of Pennsylvania, 2001.

———. "The 'Question of Professionalism' in the Computer Fields." IEEE Annals of the History of Computing 23, no. 4 (October-December 2001): 56-74.

Ensmenger, Nathan, and William Aspray. "A Commentary on David A. Hounshell's Commentary on 'Software as Labor Process"." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg, 179-82. New York: Springer-Verlag, 2002.

———. "Software as Labor Process." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg, 139-65. New York: Springer-Verlag, 2002.

Eppert, Ray. "A Central Intelligence Program for Management." Paper presented at the Systems and Procedures Association of America 1956.

Erickson, Ethel. The Employment of Women in Offices. Washington: US GPO, 1934.

Essey, Richard P. "How to Increase a Systems Man's Ability to Sell His Ideas to Management." Systems & Procedures Journal 13, no. 4 (July-August 1962): 16-20.

Evans, Bob O. "System/360: A Retrospective View." Annals of the History of Computing 8, no. 2 (April-June 1986): 155-79.

Evans, Christopher. The Micro Millennium. New York: Viking, 1979.

Evans, Marshall K., and Lou R. Hague. "Master Plan for Information Systems." Harvard Business Review 40, no. 1 (January-February 1962): 92-103.

Evans, Philip B, and Thomas S Wurster. "Strategy and the New Economics of Information." Harvard Business Review, no. 5 (September-October 1997).

Evans, Philip, and Thomas S. Wurster. Blown to Bits: How the New Economics of Information Transforms Strategy. Boston: Harvard Business School Press, 2000.

Evans, W. H. "External Support for Data Processing." In Data Processing Volume VI: Proceedings of the 1963 International Data Processing Conference, 116-23. Chicago: Data Processing Management Association,, 1963.

Evslin, Tom. "Unemployment in Wonderland." Journal of Systems Management 22, no. 7 (July 1971): 8-11.

Exhibit Surveys. "Audience Survey of the 1967 DPMA Business Exposition, Boston June 20-23," 1967, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minnesota.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Fair, William R. "The Corporate CIA -- A Prediction of Things to Come." Management Science 12, no. 10 (June 1966): B489-B503.

Falk, Stephen. "AMF Sets EDP Payback Parameters." Business Automation 13, no. 9 (September 1966): 24-29.

Ferguson, David. Therbligs: The Keys to Simplifying Work 2000 [cited 31 August 2002]. Available from http://gilbrethnetwork.tripod.com/therbligs.html.

Ferrara, Raymond, and Richard L. Nolan. "New Look At Computer Data Entry." Journal of Systems Management 24, no. 2 (1973): 24-33.

Field, John W. "Management Information Systems: A Report on Techniques." In Advances in Management Information Systems. AMA Management Bulletin No. 16., edited by American Management Association, 1-6. New York: American Management Association, 1962.

Field, Tom. "IS at the Crossroads: Back from the Brink." CIO Magazine, 15 June 2000.

———. "IS at the Crossroads: Free to Lead." CIO Magazine, June 15 2000.

———. "The State of the CIO: Executive Relationships." CIO Magazine, 15 March 2002.

Fine, Lisa M. Souls of the Skyscraper: Female Clerical Workers in Chicago, 1870-1930. Philadelphia: Temple University Press, 1990.

Fiock, L. R. , Jr. "Seven Deadly Dangers in EDP." Harvard Business Review 40, no. 3 (May-June 1962): 88-96.

Fisher, Amy Waver. "The Development of the ERMA Banking System: Lessons from History." IEEE Annals of the History of Computing 15, no. 1 (January-March 1993): 44-57.

Flamm, Kenneth. Creating the Computer : Government, Industry, and High Technology. Washington, D.C.: Brookings Institution, 1988.

Fleck, Robert A, Jr. "People: Hidden Asset or Liability?" Data Management 13, no. 4 (April 1975): 14-16.

Fligstein, Neil. "The Spread of the Multidivisional Form Among Large Firms, 1919-1979." American Sociological Review 50 (1985): 377-91.

———. The Transformation of Corporate Control. Cambridge, MA: Harvard University Press, 1990.

———. "The Structural Transformation of American Industry: An Institutional Account of the Causes of Diversification in the Largest Firms, 1919-1979." In The New Institutionalism in Organizational Analysis, edited by Walter W. Powell and Paul J. DiMaggio, 311-36. Chicago: University of Chicago Press, 1991.

Fones-Wolf, Elizabeth. Selling Free Enterprise : The Business Assault on Labor and Liberalism, 1945-60. Urbana, IL: University of Illinois Press, 1994.

Forest, Robert. "ERMA Comes of Age." Business Automation 6, no. 3 (September 1961): 20-25.

Forest, Robert B. "The Operations Research Society of America: Interview with ORSA's President." Datamation 9, no. 10 (October 1963): 32-34, 37, 39.

Forester, Tom. The Microelectronics revolution : the complete guide to the new technology and its impact on society. Oxford, Eng.: B. Blackwell, 1980.

———. The Information technology revolution. 1st MIT Press ed. Cambridge, Mass.: MIT Press, 1985.

Forman, Richard L. Fulfilling the Computer's Promise: The History of Informatics, 1962--1982. Woodland-Hills, CA: Informatics General Corporation, 1984.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Forrester, Jay W. "Industrial Dynamics: A Major Breakthrough for Decision Makers." Harvard Business Review 36, no. 4 (July-August 1958): 37-66.

Forsythe, George E., "Letter to Carl Diesen et al, December 9," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Forty, Adrian. Objects of Desire: Design and Society Since 1750. London: Thames and Hudson, 1986.

Fraenkel, Herbert A. "Installing the Punched Card Procedure." Systems and Procedures Quarterly 4, no. 4 (November 1953): 8-11, 21-22.

Frank, Francis A. "Software Services: An Outside Outlook." Business Automation 16, no. 11 (November 1969): 55-61.

Frank, W. L., W.H. Gardener, and G.L. Stock. "Programming On-Line Systems. Part Two: A Study of Hardware Features." Datamation 9, no. 6 (June 1963): 28-32.

Fredericks, Ward A. "A Case For Centralized EDP." Business Automation 19, no. 1 (January 1972): 20-24.

Freedman, David. "Are We There Yet?" CIO Magazine 1991.

Freeman, Peter, and William Aspray. The Supply of Information Technology Workers in the United States. Washington, DC: Computing Research Association, 1999.

Friedman, Andrew, and Joan Greenbaum. "Wanted: Renaissance People; A New Survey of DP Managers Reveals a More Relaxed Management Style and a Desire to Hire Some "Know-It-Alls"." Datamation 30 (1984): 134(6).

Friedman, Andrew L, and Dominic S Cornford. Computer Systems Development: History, Organization and Implementation. New York: Wiley, 1989.

Fritz, W Barkley. "The Women of ENIAC." IEEE Annals of the History of Computing 18, no. 3 (Fall 1996): 13-28.

Gaffney, Joe. "Reader Feedback: Whose Ox is Gored?" Business Automation 19, no. 10 (July 1972): 34-36.

Gallagher, James D. "Organization of the Data-Processing Function." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 120-34. New York: John Wiley & Sons, Inc., 1960.

———. Management Information Systems and the Computer. New York: American Management Association, 1961.

Gallagher, James D., and Douglas J. Axsmith. "Data Processing in Transition: Can Management Manage EDP of the Future?" In EDP: The First Ten Years. Highlights of Management Experience and a Look Ahead, edited by McKinsey & Company, 7-14. Chicago: American Society for Public Administration, 1961.

Galler, Bernard. "President's Letter to the ACM Membership: The ACM Council." Communications of the ACM 11, no. 11 (November 1968): 729.

Galloway, Lee. Factory and office administration, Modern business; a series of texts prepared as part of the modern business course and service of the Alexander Hamilton Institute, [v. 4]. New York,: Alexander Hamilton institute, 1918.

———. Office Management: Its Principles and Practice. New York, 1919.

Garrity, John T. "Top Management and Computer Profits." Harvard Business Review 41, no. 4 (July-August 1963): 6-8, 10, 12, 172, 74.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Garrity, John T., and John P. McNerney. "EDP: How to Ride the Tiger." Financial Executive 31 (September 1963): 19-26.

Garson, Barbara. The Electronic Sweatshop : How Computers are Transforming the Office of the Future into the Factory of the Past. New York, NY: Simon and Schuster, 1988.

Geckle, Jerome W. "What DPMA is Doing to Promote Professional Development of its Members." In Data Processing XIII: Proceedings of the 1968 International Data Processing Conference and Business Exposition, edited by Data Processing Management Association, 335-41. Chicago: Data Processing Management Association, 1968.

Gibson, Cyrus F., and Richard L. Nolan. "Organizational Issues in the Stages of EDP Growth." Data Base 5, no. 2 (Summer 1973): 50-68.

———. "Managing the Four Stages of EDP Growth." Harvard Business Review 52, no. 1 (1974): 76-88.

Gibson, Malcom H. "Automation Should Be Your Whole Philosophy." The Office 51, no. 1 (1960): 134, 36.

Gill, William C. "What is a Systems Man?" Systems and Procedures Quarterly 7, no. 1 (February 1956): 21-23.

———. "Managing a Systems Group in Defense Industries." In Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, edited by Gibbs Myers, 258-71. Detroit: The Systems and Procedures Association of America, 1958.

———. "Systems and the Systems Function." In Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, edited by Gibbs Myers, 349-53. Detroit: The Systems and Procedures Association of America, 1958.

Gilmore, Robert S., "Letter to R. Calvin Elliot, 17 Sept.," 1963, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Glaser, George. "The Centralization vs. Decentralization Issue: Arguments, Alternatives and Guidelines." Data Base 2, no. 3 (1970): 1-7.

Goldstein, Herman H. The Computer from Pascal to von Neumann. Princeton, NJ: Princeton University Press, 1972.

Goldstein, Herman H, and John von Neumann. "Planning and Coding Problems for an Electronic Computing Instrument. Part II, Volume 1." In Papers of John von Neumann on Computing and Computer Theory, edited by William Aspray and Arthur Bucks, 151-222. Cambridge, MA: MIT Press, 1987.

Goldthorpe, John H. "The Service Class Revisited." In Social Change and the Middle Classes, edited by Tim Butler and Mike Savage, 313-29. London: UCL Press, 1995.

Gordon, Robert M. "The Total Information System and the Levels of Data Processing: An Exploratory Analysis of the Uses of Business Data Processors." In Data Processing Today: A Progress Report -- New Concepts, Techniques and Applications -- AMA Management Report Number 46, edited by American Management Association, 23-33. New York: American Management Association, Finance Division, 1960.

Gorry, G. Anthony, and Michael S. Scott Morton. "A Framework for Management Information Systems." In Managing the Data Resource Function, edited by Richard L. Nolan, 87-105. St. Paul: West Publishing Company, 1974.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Gotterer, Malcolm H. "The Impact of Professionalization Efforts on the Computer Manager (Panel)." In Proceedings of the 1971 Annual Conference, edited by Association for Computing Machinery, 367-75. ACM: New York, 1971.

Gouldner, Alvin Ward. The Future of Intellectuals and the Rise of the New Class. New York: Seabury Press, 1979.

Grapp, Edward M. "Adder or Space Machine But Nothing In-Between." The Office 51, no. 1 (1960): 166, 263-64.

Green, George D. "OH1: An Interview with Paul Armer." Minneapolis: Charles Babbage Institute, 1981.

Greenbaum, Joan. In the Name of Efficiency: Management Theory and Shopfloor Practice in Data-Processing Work. Philadelphia: Temple University Press, 1979.

Greenberger, Martin. "The Computers of Tomorrow." The Atlantic Monthly, May 1964, 63-67.

Greenblatt, Stankey. "Delete Delays and Dollars with Direct Data Entry." Infosystems 19, no. 9 (September 1972): 20-25.

Greenwood, Frank. "Education for Systems Analysis: Part One." Systems & Procedures Journal 17, no. 1 (January-February 1966): 13-15.

Gregoire, Jerry. "Hail to the Chiefs." CIO Magazine 2002.

Gregory, Robert H. "Preparation for Logic -- An Orderly Approach to Automation." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 169-83. New York: John Wiley & Sons, Inc., 1960.

Grier, David Alan. "The ENIAC, the Verb "to program" and the Emergence of Digital Computers." IEEE Annals of the History of Computing 18, no. 1 (January 1996): 51-55.

———. "The Math Tables Project of the Work Projects Administration: The Reluctant Start of the Computing Era." IEEE Annals of the History of Computing 20, no. 3 (July-September 1998): 33-50.

———. "The Rise and Fall of the Committee on Mathematical Tables and Other Aids to Computation." IEEE Annals of the History of Computing 32, no. 2 (April-June 2001): 38-49.

Griffith, Lionel E. "An Outline of Organization for the Vice President/Director of Administration: His Responsibilities, Objectives and Contributions as a Top Management Official." In Shaping a New Concept of Administrative Management: Administrative Services as a Top-Level Corporate Function -- AMA Management Report Number 55, edited by American Management Association, 29-47. New York: American Management Association, 1961.

Grindley, Kit. Managing IT At Board Level: The Hidden Agenda Exposed. 2nd ed. London: Pitman Publishing, 1995.

Grosch, H A. "The Digital Computer as a Research Tool." Journal of the Optical Society of America 43, no. 4 (April 1953).

Grosch, H.R.J. "Software in Sickness and Health." Datamation 7, no. 7 (July 1961): 32-33.

Grosch, Herb. "Fireside Chat." Communications of the ACM 20, no. 3 (March 1977): 125-26.

Grosch, Herbert R J. "A Time of Change." Data Management 13, no. 9 (September 1975): 82-85.

Grosch, Herbert R. J. Computer: Bit Slices from a Life. Novato, California: Third Millennium Books, 1991.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Gross, Herbert L. "Card Random Access Memory: Interchangeable Decks in Random Sequential Systems." Datamation 9, no. 12 (December 1963): 27-30.

Gruenberger, Fred, "Second RAND Symposium, Unexpurgated," 1959, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "RAND Symposium Transcript," 1960, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———. "A Diary For Tomorrow's Programmers." Datamation 9, no. 1 (January 1963): 48-54.

———, "RAND Symposium 6," 1963, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "RAND Symposium 11 (Expurgated)," 1968, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "RAND Symposium 14," 1973, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "16th Annual One-Day Computing Symposium (RAND Symposium 16)," 1974, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Problems of the AFIPS Societies Revisited: 17th Annual One-Day Computing Symposium," 1975, RAND Symposia Collection (CBI 78), Charles Babbage Institute, University of Minnesota, Minneapolis.

Guerrieri, John A Jr. "Who Needs Registration." Data Management 8, no. 4 (April 1970): 40-41.

Guest, L. C. "A Temperate View of Data Processing Management and Management Information Systems." In Advances in EDP and Information Systems: AMA Management Report Number 62, edited by Administrative Services Division American Management Association, 7-13. New York: American Management Association, 1961.

Gupta, Roger. "Information Manager His Role in Corporate Management." Data Management 12, no. 6 (June 1974): 24-25.

Hackney, James E., and Norman L. Paul. "The Wheel Exists." Journal of Systems Management 21, no. 11 (November 1970): 40-41.

Haefner, R. R. "The 650 at Savannah River." Annals of the History of Computing 8, no. 1 (January-March 1986): 84-85.

Haga, Enoch J. "The Systems Approach to Effective Management." In Total Systems, edited by Alan D. Meacham and Van B. Thompson, 50-53. Detroit, MI: American Data Processing, Inc., 1962.

Hahn, Trudi Bellardo, Robert V. Williams, and Mary Ellen Bowden, eds. Proceedings of the Conference on the History and Heritage of Science Information Systems. Medford, NJ: American Society of Information Science, 1999.

Haigh, Thomas. "Inventing Information Systems: The Systems Men and the Computer, 1950-1968." Business History Review 75, no. 1 (Spring 2001): 15-61.

———. "Software in the 1960s as Concept, Service, and Product." IEEE Annals of the History of Computing 24, no. 1 (January-March 2002): 5-13.

———. "'A Veritable Bucket of Facts': Origins of the Data Base Management System." In Proceedings of the Second Conference on the History and Heritage of Scientific Information Systems, edited by Mary Ellen Bowden and Boyd Rayward. Medford, NJ: Information Today Press, 2003.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Halbrecht, Herbert. "Through A Glass Darkly." Interfaces 2:4, no. August (1972): 1-17.

Hale, L. J. "Never Underestimate the Importance of People." The Hopper 3, no. 6 (November-December 1952): 8-12.

Hamilton, F E, and E C Kubie. "The IBM Magnetic Drum Calculator Type 650." Journal of the Association for Computing Machinery 1, no. 1 (October 1954): 13-20.

Hammer, M. "Reengineering Work -- Don't Automate, Obliterate." Harvard Business Review 68, no. 4 (July-August 1990): 101-12.

Haney, Frederick M. "The Architecture of Software." Data Base 5, no. 1 (Fall 1973): 5-10.

Hanold, Terrance. "An Executive View of MIS." Datamation 18, no. 11 (1972): 65-71.

Hansell, Saul. "Priceline.com Stock Zooms in Offering." New York Times 1999, 1.

Hansen, John R. "Word Processing Report." Infosystems 22, no. 10 (October 1975): 29-32.

Hapgood, Fred. "CASE Closed?" CIO Magazine, April 1 2000.

Harmon, Amy. "What Have E-Consultants Wrought?" New York Times, 13 May 2001.

Hartmann, H. C. "Totally Integrated Management Operating System: Part II." In Data Processing Vol 5: International Data Processing Conference of the Data Processing Management Association, 272-78. New York City: National Machine Accountants Association, 1962.

Harvey, Allan. "Are Total Systems Practical?" Business Automation 16, no. 6 (June 1969): 72-76, 143.

Haskins & Sells. Introduction to Data Processing: An Outline of Basic Data-Processing Operations and Methods. New York?: Haskins & Sells, 1957.

Haslett, J. W. "The Coming Revolution in Paperwork." Systems and Procedures Quarterly 1, no. 1 (March 1950): 1.

———. "Is the Modern Office Vanishing?" Systems and Procedures Quarterly 2, no. 2 (June 1951): 11-13.

———. "We All Need an 'AI'." Journal of Systems Management 22, no. 5 (May 1971): 46.

Haslett, J.W. "Functions of the Systems Department." In Ideas for Management: 14th International Systems Meeting, edited by Anonymous, 5-9. Detroit: Systems and Procedures Association, 1961.

Haslett, John W. "A New Role for the Systems Man." Management and Business Automation 3, no. 2 (February 1960): 20-22, 40-41.

———. "Is Analysis Yielding to Synthesis." Business Automation 12, no. 4 (April 1965): 34-40.

Hawes, Mary. "Burroughs' Future in Electronics." Paper presented at the Data Processing, St Louis, Missouri 1959.

Hawes, Mary K. "Automatic Programming for Commercial Installations," 1955, Sperry-Univac Company Records, Hagley Museum and Library, Wilmington, Delaware.

Hawkins, Leonard J. "You Want to be Part of Management." Data Management 11, no. 3 (March 1973): 14-16, 21.

Head, Robert V. "Data Base Symposium." Datamation 11, no. 11 (November 1965).

———. A Guide to Packaged Systems. Edited by Richard G Canning and J Daniel Couger, Wiley Communigraph Series on Business Data Processing. New York: Wiley-Interscience, 1971.

Head, Robert V. Real-Time Business Systems. New York: Holt, Rinehart and Winston, Inc., 1964.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Management Information Systems: A Critical Appraisal." Datamation 13, no. 5 (May 1967): 22-27.

———. "Old Myths and New Realities." Datamation 13, no. 9 (September 1967): 26-29.

———. "MIS-II: Structuring the Data Base." Journal of Systems Management 21, no. 9 (September 1970): 37-38.

———. "Twelve Crises -- Comments on the Future of the Software Industry." Datamation 16, no. 3 (March 1970): 124-26.

———. "What a Difference a Decade Makes." Journal of Systems Management 22, no. 11 (September 1971): 16-21.

———. January 31 2002.

Head, Robert V., and Evan F. Linick. "Software Package Acquisition." Datamation 14, no. 10 (October 1968): 22-27.

Headrick, Daniel. The Tools of Empire: Technology and European Imperialism in the Nineteenth Century. Oxford, UK: Oxford University Press, 1981.

Hedstrom, Margaret Lucille. "Automating the Office: Technology and Skill in Women's Clerical Work, 1940-1970." Ph.D., University of Wisconsin-Madison, 1988.

Hendel, Robert A. "Minicomputer Word Processing: A Two-year Case History." Business Automation 19, no. 8 (August 1972): 35-37.

Herrmann, Cyril C., and John F. Magee. ""Operations Research" for Management." Harvard Business Review 31, no. 4 (July-August 1953): 100-12.

Heshka, William. "This Point Cannot Be Overemphasized." Systems & Procedures Journal 17, no. 4 (July-August 1966): 48-49.

Hester, C.M., and G. V. Harris. "Interchangeable Random Access Discs: The IBM 1311." Datamation 9, no. 12 (December 1963): 25-26.

Hill, Lester E. "The Machine Accountant and his "Electronic" Opportunity." Journal of Machine Accounting 8, no. 1 (January 1957): 12-14, 23-25.

Hoare, C A R. "Proof of Correctness of Data Representations." Acta Informatica 1 (271-281 1972).

Hobart, Michael E, and Zachary S Schiffman. Information Ages: Literacy, Numeracy, and the Computer Revolution. Baltimore: Johns Hopkins Press, 1998.

Hockman, John. "Specification for an Integrated Management Information System." Systems & Procedures Journal 14, no. 1 (Janurary-February 1963): 40-41.

Hoffman, D. G. "Opportunity." The Hopper 2, no. 1 (January 1951): 6, 8.

Holmes, C E. "That Was a Rebuttal?" Infosystems 22, no. 5 (May 1975): 75.

Holsapple, Clyde W., and Andre B. Whinston. The Information Jungle: A Quasi-Novel Approach to Managing Corporate Knowledge. Homewood, IL: Dow Jones-Irwin, 1988.

Honeywell. "A Few Quick Facts on Software." Business Automation 7, no. 1 (January 1962): 16-17.

Hoos, Ida R. Systems analysis in public policy; a critique. Berkeley,: University of California Press, 1972.

Hopkins, R. V. "Machine Accounting's Contribution to Management Control." The Hopper 4, no. 1 (January 1953): 7-9.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hounshell, David A. "Hughesian History of Technology and Chandlerian Business History: Parallels, Departures, and Critics." History and Technology 12 (1995): 205-24.

———. "The Medium is the Message, or How Context Matters: The RAND Corporation Builds an Economics of Innovation." In Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, edited by Agatha C Hughes and Thomas P Hughes, 255-310. Cambridge, MA: MIT Press, 2000.

———. "Are Programmers Oppressed by Monopoly Capital, or Shall the Geeks Inherit the Earth? Commentary on Nathan Ensmenger & William Aspray." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg, 167-76. New York: Springer-Verlag, 2002.

Householder, A S, "Letter to Donn B. Parker, October 11," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Householder, Alton S. "Presidential Address to the ACM, Philadelphia, September 14, 1955." Journal of the Association for Computing Machinery 3, no. 1 (January 1955): 1-2.

———. "Presidential Address to the ACM, Philadelphia, September 14, 1955." Journal of the Association for Computing Machinery 4, no. 1 (January 1956): 1-4.

Hughes, Agatha C., and Thomas Parke Hughes. Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, Dibner Institute studies in the history of science and technology. Cambridge, Mass.: MIT Press, 2000.

Hughes, Everett. Men and their Work. New York, NY: Free Press, 1951.

Hughes, J. B., and D. D. McCracken. "IBM 700 Series." Journal of Machine Accounting 7, no. 10 (October 1956): 26-29, 48.

Hughes, Thomas Parke. Rescuing Prometheus. New York: Pantheon Books, 1998.

Hulswit, Frank T. "Let's Talk About Operations Research." Systems and Procedures Quarterly 5, no. 4 (November 1954): 3-5.

Hunt, James A., "Progress Report: College sub-committee, Educational Committee, Kansas City Chapter, NMAA," 1954, Data Processing Management Association.

Hurni, Melvin L. "Decision Making in the Age of Automation." Harvard Business Review 33, no. 5 (September-October 1955): 49-58.

IEEE Computer Society. News Release: IEEE Computer Society Announced New Agreement with STC 2003 19 November, 2002 2002 [cited 26 November 2002]. Available from http://www.computer.org/certification/CSDP_STC_PR.pdf.

Information Technology Association of America. Bouncing Back: Jobs, Skills and the Continuing Demand for IT Workers. Washington, DC: Information Technology Association of America, 2002.

International Data Corporation. "Major Vendor Strategies in the Electronic Office -- Part I." Framingham, MA: International Data Corporation, 1983.

———. "Microcomputer Buying Patterns in Corporate America: Small, Medium, and Large Computers Hardware and Peripheral Analysis." Framingham, MA: International Data Corporation, 1985.

Irvine, Elanor H. "Wanted: A Future." Data Management 11, no. 6 (June 1973): 22-25.

Jackson, Michael A. Principles of Program Design. New York: Academic Press, 1975.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Jacoby, Sanford. Modern Manors: Welfare Capitalism Since the New Deal. Princeton, NJ: Princeton University Press, 1997.

Jacoby, Sanford M. Employing Bureaucracy: Managers, Unions and the Transformation of Work in American Industry, 1900-45. New York, NY: Columbia University Press, 1985.

Jardini, David R. "Out of the Blue Yonder: The Transfer of Systems Thinking from the Pentagon to the Great Society, 1961-1965." In Systems, Experts, and Computers : The Systems Approach in Management and Engineering, World War II and After, edited by Agatha C Hughes and Thomas P Hughes, 311-57. Cambridge, MA: MIT Press, 2000.

Jennings, Edith R., "Special CDP Report," 1968, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Jerome, Willard L. and Loretta Hartford. "RAMAC at Work." Systems and Procedures 8, no. 4 (November 1957): 30-38.

John, Richard R. "Recasting the Information Infrastructure for the Industrial Age." In A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present, edited by Alfred D. Chandler and James W. Cortada. New York: Oxford University Press, 2000.

Johnson, F. M. "Control of Machine Accounting Equipment." Systems and Procedures Quarterly 4, no. 2 (May 1953): 18-22, 26.

Johnson, H. Thomas, and Robert Kaplan. Relevance Lost: The Rise and Fall of Managerial Accounting. Cambridge, MA: Harvard Business School Press, 1987.

Johnson, Harold L. "Can the Businessman Apply Christianity?" Harvard Business Review 35, no. 5 (September-October 1957): 68-76.

Johnson, Laurence A., "Letter to Richard D. Kornblum of Business Automation magazine, re: DPMA Certification Program," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota.

Johnson, Tony. Time to Take Control: The Impact of Change on Corporate Computer Systems. Newton, MA: Butterwoth-Neinemann, 1997.

Jones, Curtis H. "At Last: Real Computer Power For Decision Makers." Harvard Business Review 48, no. 5 (September-October 1970): 75-89.

Joynt, John B. "Planning Procedures for Profit: A Program for Administrative Cost Reduction through Improvement in Management." Systems and Procedures Quarterly 1, no. 1 (March 1950): 4-10, 14-16.

Judge, Elmer F., and R. Calvin Elliot, "Report to the Executive Committee Covering ACM/DPMA Ad Hoc Committee Meeting," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Kaneshige, Tom. "Paper Chase." CIO Magazine, March 1 2000.

Kanigel, Robert. The One Best Way : Frederick Winslow Taylor and the Enigma of Efficiency. New York: Viking, 1997.

Kappler, M. O. "The Opportunity for Innovation in Management Controls." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 3-11. New York: John Wiley & Sons, Inc., 1960.

Kast, Fremont E., and James E. Rosenzweig. "General Systems Theory: Applications for Organization and Management." Academy of Management Journal (1972).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Kaufman, Felix. "Data Systems That Cross Company Boundaries." Harvard Business Review 44, no. 1 (January-February 1966): 141-55.

Kay, Lily E. Who Wrote the Book of Life: A History of the Genetic Code. Stanford: Stanford University Press, 2000.

Keefe, Jeffrey, and Denise Potosky. "Technical Dissonance: Conflicting Portraits of Technicians." In Between Craft and Science: Technical Work in US Settings, edited by Stephen R Barley and Julian E Orr, 53-81. Ithaca: Cornell University Press, 1998.

Keller, Arnold E. "The Man Behind Systems at Shell Oil." Business Automation 7, no. 2 (February 1962): 20-24.

———. "The Third Generation." Business Automation 14, no. 1 (January 1967): 32-36.

———. "You CAN Control Computer Costs." Business Automation 16, no. 4 (April 1969): 46-51.

———. "Editorial: Facilities Management." Business Automation 17, no. 4 (April 1970): 152.

———. "Editorial: Few Members, Better Managers." Business Automation 17, no. 5 (May 1970): 84.

———. "Editorial: Computing for Profit." Business Automation 19, no. 3 (March 1972): 56.

———. "Overview: The Publisher Comments." Business Automation 19, no. 1 (January 1972): 4.

———. "Wrong Way to Professionalism." Infosystems 22, no. 2 (February 1975): 31.

Kelley, George J. "We're Easing into Automation." The Controller 25, no. 2 (February 1957): 66-69.

Kellner, Hansfried, and Frank W Heuberger, eds. Hidden Technocrats: The New Class and New Capitalism. New Brunswick, NJ: Transaction Publishers, 1992.

Kennevan, Walter J. "Structuring and Managing a Management Information System." Data Management 10, no. 9 (September 1972): 58-62.

Kenney, H. D. "Systems from the Management Viewpoint." Systems & Procedures Journal 13, no. 3 (May-June 1962): 10-13.

Kiely, Thomas. "The Once and Future CIO." CIO Magazine 1991, 44-58.

Killian, G. E. "After the Honeymoon." The Hopper 5, no. 9 (October 1954).

Kimball, Ralph. The Data Warehouse Toolkit: Practical Techniques for Building Dimensional Data Warehouses. New York: John Wiley & Sons, 1996.

King, Peggy. "Decision Support Grows Up... and Out." CIO Magazine, November 15 1999.

Kirch, Frederick. "The Computer Language Myth." Data and Control 1 (July 1963): 28-30.

Kircher, Paul. "Breakthrough in Management Information Systems." Journal of Data Management 7, no. 2 (February 1969): 28-31.

Kirkpatrick, Forrest Hunter. "Partners for Tomorrow - Manager and Machine." Business Automation 14, no. 10 (October 1967): 36-39, 54.

Kishi, Tad. "The 701 at the Lawrence Livermore Laboratory." Annals of the History of Computing 5, no. 2 (April-June 1983): 206-10.

Kleiner, Art. "The Battle for the Soul of Corporate America: Hammerism Battles Demingism for How the Corporation (or society) Should Be Governed in the Information Age." Wired 3, no. 8 (August 1995).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Kling, Rob, and S Iacono. "The Mobilization of Support for Computerization: The Role of Computerization Movements." Social Problems 35, no. 3 (June 1988): 226-343.

Knuth, Donald Ervin. The Art of Computer Programming, Volume 2: Sorting and Searching, Addison-Wesley series in computer science and information processing. Reading, Mass.,: Addison-Wesley Pub. Co., 1968.

Koch, Christopher. "The Integration Nightmare: Sounding the Alarm." CIO Magazine, 15 November 1996.

———. "Can You Do the WWW? Your ERP System is Up and Running. Your Business has been Reengineered. But Do You Have E-Commerce? Not Yet If Your Vendor is SAP." CIO Magazine, October 15 1999.

———. "It All Began With Drayer." CIO Magazine, August 1 2002.

Koller, Herbert R., "Letter to Donn B. Parker, October 18," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Konvalinka, J.W., and H.G. Trentin. "Management Information Systems." Management Services 2 (September-October 1965): 27-39.

Kornblum, Richard D. "Annual Survey of Data Processing Salaries." Business Automation 11, no. 6 (June 1964): 26-35.

———. "A Question of Degree." Business Automation 11, no. 6 (June 1964).

Kornblum, Richard D. "A Macro-View of Microfilm." Business Automation 12, no. 10 (October 1965): 32-36.

Kovach, Frank P., Joseph F. Charlow, and Oliver W. Wight. "Totally Integrated Management Operating System: Part I." In Data Processing Vol 5: International Data Processing Conference of the Data Processing Management Association, 257-71. New York City: National Machine Accountants Association, 1962.

Kraft, Philip. Programmers and Managers: The Routinization of Computer Programming in the United States. New York: Springer-Verlag, 1977.

———. "The Industrialization of Computer Programming: From Programming to 'Software Production'." In Case Studies on the Labor Process, edited by Andrew Zimbalist, 1-17. New York: Monthly Review Press, 1979.

Kreis, Steven. "The Diffusion of Scientific Management: The Bedaux Company in America and Britain, 1926-1945." In A Mental Revolution: Scientific Management Since Taylor, edited by Daniel Nelson, 156-74. Columbus: Ohio State University Press, 1992.

Kroeger, Robert H. "Management Looks at Machine Accounting." The Hopper 3, no. 2 (March 1952): 16-22.

Kunda, Gideon. Engineering Culture: Control and Commitment in a High-Tech Corporation. Philadelphia, PA: Temple University Press, 1992.

LaForte, J. W., "Market Analysis -- Electronic Data Processing Machines Types 702 - 703 - 705," 1955, Cuthbert C. Hurd Papers (CBI 95), Charles Babbage Institute, University of Minnesota, Minneapolis.

Lamoreaux, Naomi R., and Daniel M.G. Raff, eds. Coordination and Information: Historical Perspectives on the Organization of Enterprise. Chicago: University of Chicago Press, 1995.

Lappeus, Belford J. "Moving Day... In the Machine Accounting Department." The Hopper 3, no. 3 (May 1952): 20-26.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Larson, Harry T. "EDP: A 20 Year Ripoff." Infosystems 21, no. 11 (November 1974): 26-30.

Larson, Henry T. "How to Become an EDP Hero." Infosystems 22, no. 6 (June 1975): 46-49.

Larson, Magali Sarfatti. "The Production of Expertise and the Constitution of Expert Power." In The Authority of Experts: Studies in History and Theory, edited by Thomas L Haskell, 28-80. Boomington: Indiana University Press, 1984.

Laubach, Peter B. Company Investigations of Automatic Data Processing. Boston: Graduate School of Business Administration, Harvard University, 1957.

Laubach, Peter B., and Lawrence E. Thompson. "Electronic Computers: A Progress Report." Harvard Business Review 33, no. 2 (March-April 1955): 120-28.

Lawson, Charles M. "A Survey of Computer Facility Management." Datamation 8, no. 7 (July 1962): 29-32.

Layton, Edwin T, Jr. The Revolt of the Engineers: Social Responsibility and the American Engineering Profession. Cleveland: Press of Case Western Reserve University, 1971.

Lazzaro, Victor. "The Management Audit." Systems & Procedures 11, no. 2 (May 1960): 2-6.

Leavitt, Harold J., and Thomas L. Whisler. "Management in the 1980s." Harvard Business Review 36, no. 6 (November-December 1958): 41-48.

Lee, J A N. "Howard Aiken's Third Machine: The Harvard Mark III Calculator or Aitken-Dahlgren Electronic Calculator." IEEE Annals of the History of Computing 22, no. 1 (January-March 2000): 62-81.

Leffingwell, William H. Scientific Office Management. Chicago: A. W. Shaw, 1917.

———. "What Is Scientific Management Anyway?" System (July 1929).

Leffingwell, William Henry. Office Management - Principles and Practice. London: A. W. Shaw Company, 1925.

———, ed. The Office Appliance Manual. [n.p.]: Published for the National Association of Office Appliance Manufacturers, 1926.

———. A Textbook of Office Management. New York: McGraw-Hill Book Company Inc, 1932.

Leffingwell, William Henry, and Edwin Marshall Robinson. Textbook of Office Management. 2nd ed. New York: McGraw-Hill, 1943.

———. Textbook of Office Management. 3d ed. New York: McGraw-Hill, 1950.

Leighton, A. J. "The Real Job of Systems and Procedures." Systems & Procedures Journal 13, no. 1 (January-February 1962): 15-17.

Levenstein, Margaret. Accounting For Growth: Information Systems and the Creation of the Large Corporation. Stanford: Stanford University Press, 1998.

Levin, Howard S. Office Work and Automation. New York: John Wiley & Sons, 1956.

———. "Systems Planning for Computer Application." The Controller 25, no. 4 (April 1957): 165-67, 86.

Levy, Joseph. Punched Card Data Processing. New York: McGraw-Hill Book Company, 1967.

Levy, Steven. Hackers: The Heroes of the Digital Revolution. Garden City, NY: Anchor Press/Doubleday, 1984.

Lewis, Bob. "Gartner, take a closer look: Is recruiting really better than retraining your programmers." InfoWorld, November 3 2000.

Lewis, Michael. The New New Thing. New York: W. W. Norton, 2000.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Lewis, Ralph F. "Never Overestimate the Power of a Computer." Harvard Business Review 35, no. 5 (September-October 1957): 76-84.

Licht, Walter. Getting Work: Philadelphia, 1840-1950. Cambridge, MA: Harvard University Press, 1992.

Light, Jennifer S. "When Computers Were Women." Technology and Culture 40, no. 3 (July 1999): 455-83.

Litterer, Joseph A. "Systematic Management: The Search for Order and Integration." Business History Review 35, no. 4 (Winter 1961): 461-76.

Littlefield, C L, and R L Peterson. Modern Office Management. New York, 1956.

Lockwood, David. "Marking Out the Middle Classes." In Social Change and the Middle Classes, edited by Tim Butler and Mike Savage, 1-11. London: UCL Press, 1995.

Lodahl, Thomas M. "Designing the Automated Office: Organizational Functions of Data and Text." In Emerging Office Systems, edited by James H. Blair Robert M. Landau, Jean H. Siegman, 59-72. Norwood, NJ: ABLEX Publishing Corporation, 1982.

Lohr, Steve. Go To: The Story of the Math Majors, Bridge Players, Engineers, Chess Wizards, Maverick Scientists and Iconoclasts--The Programmers Who Created the Software Revolution. New York: Basic Books, 2001.

Lonergan, M. J. "A Look at the Systems Profession." Systems & Procedures 12, no. 2 (March-April 1961).

Long, Robert H. "You Can't Have Your Cake and Eat It!" Systems & Procedures Journal 14, no. 4 (September-October 1963): 20-24.

Lubar, Steven. Infoculture: The Smithsonian Book of Information Age Inventions. Boston: Houghton Mifflin, 1994.

Lubin, John F. "Some Basic Questions." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 267-72. New York: John Wiley & Sons, Inc., 1960.

Luca, A. Richard De. "Functions of a Systems & Procedures Department." Systems & Procedures 12, no. 2 (March-April 1961): 2-7.

———. "Placing the Systems and Procedures Function in the Organization." Systems & Procedures 12, no. 3 (May-June 1961): 14-23.

Lucas, Henry C., Jr. "A Descriptive Model of Information Systems in the Context of the Organization." Data Base 5, no. 2-3-4 (Winter 1973): 27-39.

———. Why Information Systems Fail. New York: Columbia University Press, 1975.

Luke, John W. "Data Base Systems: Putting Management Back In The Picture." CSC Report 9, no. 1 (1975): 8-12.

Lundberg, Abbie. "Courage." CIO Magazine, March 15 2002.

Lundstrom, David E. A Few Good Men from Univac. Cambridge, MA: MIT Press, 1988.

Lustig, Hans A. "At Gibraltar, On-Line Money Spells Profits." Business Automation 12, no. 4 (April 1965): 44-47.

Lyman, Peter, and Hal Varian. "How Much Information?" The Journal of Electronic Publishing 6, no. 2 (December 2000).

Lyon, John K. "The Role of the Data Base Administrator." Data Base 3, no. 4 (Winter 1971): 11-12.

MacKay, Robert Edward. "Managing the Clerks: Office Management from the 1870s Through the Great Depression." Ph.D., Boston University, 1985.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

MacKenzie, Donald. "A View from the Sonnenbichl: On the Historical Sociology of Software and System Dependability." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg, 97-122. New York: Springer-Verlag, 2002.

Madison, James. "Madison to W.T. Barry, August 4, 1822." In The Mind of the Founder: Sources of the Political Thought of James Madison, edited by Marvin Meyers. Indianapolis: Bobbs-Merrill, 1973.

Madrick, Jeff. "Computers: Waiting for the Revolution." New York Review of Books, March 26 1998, 29-33.

Mahoney, Michael S. "Software as Science--Science as Software." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg, 25-48. New York: Springer-Verlag, 2002.

Malcolm, D.G., and A. J. Rowe. "An Approach to Computer-Based Management Control Systems." In Management Systems, edited by Peter P. Schoderbek, 219-27. New York: John Wiley & Sons, Inc., 1967.

Malcolm, Donald G., and Alan J. Rowe, eds. Management Control Systems. New York: John Wiley & Sons, 1960.

Mann, Alan O. "A Publicly Regulated System of Management Control Services." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 245-63. New York: John Wiley & Sons, Inc., 1960.

Mapstone, Robina. "OH 59: An Interview with Paul Armer." Minneapolis: Charles Babbage Institute, 1973.

March, James, and Herbert Simon. Organizations. New York, NY: Wiley, 1958.

Marien, Ray. "Forms Control: A Reappraisal." Systems & Procedures Journal 14, no. 3 (May-June 1963): 44-45.

Markham, Edward. "Selecting a Private EDP School." Datamation 14, no. 5 (May 1968): 33-40.

Marks, Wayne C. "The Systems and Procedures Function." Systems and Procedures Quarterly 2, no. 1 (March 1951): 3-5, 8.

Martenson, Herbert E. "New Techniques Permit Old Solutions." Journal of Systems Management 21, no. 2 (February 1970): 24-27.

Martin, James. Computer Data-Base Organization. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977.

Martino, R. L. "A Generalized Plan for Developing and Installing a Management Information System." Total Systems Letter 1, no. 2 (April 1965): 1-6.

Martino, Roco L. "Creating a Total System for Managment." In Case Studies in Computer-Based Management, edited by American Management Association - Administrative Services Division, 3-11. New York: American Management Association, 1963.

Masuda, Joneji. The Information Society as Post-Industrial Society. Tokyo: Institute for the Information Society, 1981.

Matchlup, Fritz. The Production and Distribution of Knowledge in the United States. Princeton, 1962.

Matthies, Leslie. "The Systems Side of the Story." Systems and Procedures Quarterly 3, no. 1 (June 1952): 4-6, 18.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———, ed. Systems As A Channel of Communications. Vol. 9, Ninth International Systems Meeting (fix). Cleveland, Ohio: Modern Office Procedures, 1957.

———. "The Systems Function in Management." In Ideas for Management: Papers and Case Histories presented at the 1962 International Systems Meeting, edited by Anonymous, 8-26. Detroit: Systems and Procedures Association, 1962.

Matthies, Leslie H. "Systems: Functions, Relations, Pitfalls." Systems & Procedures Journal 16, no. 2 (March-April 1965): 45-49.

———. Personal Effectiveness for the System Man: From the Systemation Letter. Colorado Springs: Systemation, Inc., 1968.

Mauchly, John W. "Electronic Accounting." The Hopper 4, no. 12 (December 1953): 2-4.

May, Paul A . "Machine Accounting -- An Important Adjunct to the Controller." Journal of Machine Accounting 6, no. 6 (June 1955): 17-23.

McCaffrey, John J., "From Punched Cards to Personal Computers," 1989, John J. McCaffrey Memoirs (CBI 47), Charles Babbage Institute, University of Minnesota, Minneapolis.

McCall, J. Henry. "Electronic Data Processing." Systems and Procedures Quarterly 5, no. 4 (November 1954): 12-16.

McCarthy, Jack. Sun Founder Touts 'Real-Time Enterprise' InfoWorld.com, April 9 2002 [cited April 10 2002].

McCartney, Laton. "To MIS but not to MIS at Univac." Infosystems 20, no. 6 (June 1973): 35-38.

McCartney, Scott. ENIAC: The Triumphs and Tragedies of the World's First Computer. New York: Walker & Co, 1999.

McClellan, Stephen T. The Coming Computer Industry Shakeout: Winners, Losers, and Survivors. New York: John Wiley & Sons, 1984.

McConnell, Steve C. After the Goldrush: Creating a True Profession of Software Engineering. Redmond: Microsoft Press, 1999.

McConnell, Steve, and Leonard L Tripp. "Professional Certification: Fact or Fiction?" IEEE Software Magazine 16, no. 6 (November-December 1999): 13-18.

McCormick, W. F. "The Corporate Treasurer's Role." Financial Executive 31 (January 1963): 27-32.

McCracken, Daniel D, "Letter to Herb Grosch, April 13," 1980, Daniel D. McCracken Papers (CBI 43), Charles Babbage Institute, University of Minnesota, Minneapolis.

McCracken, Daniel D. A guide to FORTRAN programming. New York,: Wiley, 1961.

———. "Source Program Efficiency." Datamation 9, no. 2 (Februrary 1963): 31-33.

———. "The Institute for Certification of Computer Professionals: A Call for ACM Action." Communications of the ACM 22, no. 3 (March 1979): 145-46.

McCracken, Daniel D., Harold Weiss, and Tsai-hwa Lee. Programming Business Computers. New York: John Wiley and Sons, 1959.

McCune, Jenny C. "The productivity paradox: do computers boost corporate productivity." Management Review 87, no. 3 (March 1998): 38(3).

McFarlan, F. Warren. "Problems in Planning the Information System." Harvard Business Review 49, no. 2 (March-April 1971): 75-89.

———. "EDP Management Audit." In Managing the Data Resource Function, edited by Richard L. Nolan, 87-105. St. Paul: West Publishing Company, 1974.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

McGee, Marianne Kolbasuk. "Wake-up Call: GE and GM Pumped Up E-business Efforts and Overhauled Their Old-line Businesses to Aggressively Counter Competitors."" Information Week, September 18 2000.

McGee, W C. "Book Review -- Installing Electronic Data Processing Systems." Computing News 5, no. 115 (December 15 1957): 12-14.

McGregor, Douglas. "What Have Computers To Do With Management?" In Management Organization and the Computer, edited by George P. Schultz and Thomas L. Whisler, 105-18. Glencoe, Illinois: Free Press, 1960.

McHugh, Josh. "Binge and Purge." Business 2.0 (June 2000).

McIlroy, M D. "Mass Produced Software Components." In Software Engineering: Report on a Conference Sponsored by the NATO Science Committee, Garmisch, Germany, 7th to 11th October 1968, edited by Peter Naur and Brian Randell, 138-56. Brussels: Science Affairs Division, NATO, 1969.

McKeever, James A. "Building a Computer-Based MIS." Journal of Systems Management 20, no. 9 (September 1969): 1969.

McKenney, James L., Duncan C. Copeland, and Richard O. Mason. Waves of Change : Business Evolution through Information Technology. Boston: Harvard Business School Press, 1995.

McKenney, James L., and Amy Weaver Fisher. "Manufacturing the ERMA Banking System: Lessons from History." IEEE Annals of the History of Computing 15, no. 4 (October-December 1993): 7-26.

McKinsey and Company. Unlocking the Computer's Profit Potential. New York: McKinsey & Company, Inc., 1968.

McPherson, D. J., "Memo to R. C. Elliot re: Entry Level Programmer Examination, June 15," 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Meacham, Alan D., and Van B. Thompson, eds. Total Systems. Detroit, MI: American Data Processing, Inc., 1962.

Meissner, Gerd. SAP--Inside the Secret Software Power. New York: McGraw-Hill, 2000.

Mengel, Milton E. "Electronic Business Machines -- Today--Tomorrow." Systems and Procedures Quarterly 5, no. 4 (November 1954): 7-11.

Menkhaus, Edward J. "Time Sharing is Everybody's Thing." Business Automation 16, no. 9 (September 1969): 26-35, 38.

Menkhaus, Edward J. "Essential Tool in a Total System." Business Automation 12, no. 10 (October 1965): 45-49.

———. "InterLoc: Control Where the Action Is." Business Automation 13, no. 7 (July 1966): 46-53.

———. "The Many New Images of Microfilm." Business Automation 15, no. 10 (October 1968): 32-43, 58.

———. "EDP: Nice Work If You Can Get It." Business Automation 16, no. 3 (March 1969): 41-45, 74.

———. "EDP: What's It Worth." Business Automation 16, no. 11 (November 1969): 48-54.

———. "Time Sharing: More Glitter than Gold." Business Automation 17, no. 11 (November 1970): 36-42.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Microfilm: New Power for Information Systems." Business Automation 18, no. 7 (May 1 1971): 38-42.

Mettler, A. L. "An "Old Shoe" Concept of Systems." Systems and Procedures Quarterly 1, no. 2 (June 1950): 1-3.

Meyer, John W, and Brian Rowan. "Institutionalized Organizations: Formal Structure as Myth and Ceremony." American Journal of Sociology (1977): 340-63.

Meyers, M. Scott. "The Human Factor in Management Systems." Journal of Systems Management 22, no. 11 (November 1971): 10-13.

Micossi, Anita. "MIS Executives Ponder the End-User Question." Computer Decisions, December 16 1986, 33(3).

Milecki, Helen M. "The Future for Data Management." Data Management 10, no. 11 (November 1972): 5.

———. "DPMA's Computer Sciences Man of the Year." Data Management 11, no. 6 (June 1973): 14-20.

———. "An Interview with DPMA's President." Data Management 12, no. 8 (August 1974): 29-31.

Miller, Edward F, and George Lindamood. "Structured Programming: Top-Down Approach." Datamation 19, no. 12 (December 1973): 55-7.

Mills, C. Wright. White Collar: The American Middle Classes. Oxford, UK: Oxford University Press, 1951.

Mills, Geoffrey J. "An Appraisal of British and European Business Systems." In Ideas for Management: Papers and Case Histories Presented at the Eleventh International Systems Meeting, edited by Colver Gordon, 25-36. Detroit: The Systems and Procedures Association, 1959.

Mintzberg, Henry. The nature of managerial work. New York: Harper & Row, 1973.

———. Impediments to the Use of Management Information: A Study Carried Out on Behalf of the National Association of Accountants, New York, NY and the Society of Industrial Accountants of Canada, Hamilton, Ontario, Canada. New York: National Association of Accountants, 1975.

———. "The Manager's Job: Folklore and Fact." Harvard Business Review 53, no. 3 (July-August 1975): 49-61.

———. The Rise and Fall of Strategic Planning : Reconceiving Roles for Planning, Plans, Planners. New York: Free Press, 1994.

Miranti, Paul J., Jr. Accountancy Comes of Age: The Development of an American Profession, 1886-1940. Chapel Hill, NC: The University of North Carolina Press, 1990.

Mizruchi, Mark S, and Lisa C Fein. "The Social Construction of Organizational Knowledge: A Study of the Uses of Coercive, Mimetic, and Normative Isomorphism." Administrative Science Quarterly 44 (December 1999): 653-83.

Mood, A. M. "Review of Methods of Operations Research by Philip M. Morse and George E. Kimball." Operations Research Society of American Journal 1, no. 5 (November 1953): 306-08.

Moore, James P., Jr. "Management Viewpoints on Men, Machines and Methods." In Data Processing: 1958 Proceedings, edited by Charles H. Johnson, 26-31. Atlantic City, New Jersey: National Machine Accountants Association, 1958.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Morgan, Bryan. Total to Date: The Evolution of the Adding Machine: The Story of Burroughs. London, 1953.

Morgan, Howard L., and John V Soden. "Understanding MIS Failures." Data Base 5, no. 2-3-4 (Winter 1973): 157-71.

Morton, David. Off the Record: The Technology and Culture of Sound Recording in America. New Brunswick: Rutgers University Press, 2000.

Morton, Michael S., and Andrew McCosh. "Terminal Costing for Better Decisions." Harvard Business Review 46, no. 3 (May-June 1968): 147-56.

Muns, Frank H. "Problems of Decentralization." In Automatic Data Processing Conference, edited by Robert N. Anthony, 61-70. Boston: Graduate School of Business Administration, Harvard University, 1955.

Murdick, Robert G. Introduction to Management Information Systems. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977.

Murdick, Robert G., and Joel E. Ross. Information Systems for Modern Management. 2nd edition ed. Englewood Cliffs, NJ: Prentice-Hall Inc., 1975.

Murphy, Paul. Weighing the Pros and Cons of IBM's Mainframe Linux LinuxWorld.Com, April 16 2002 [cited October 26 2002]. Available from http://www.linuxworld.com/site-stories/2002/0416.mainframelinux.html.

Naftaly, Stanley M. "Correcting Obfustications By Ordained Linguists." Datamation 9, no. 5 (May 1963): 24-28.

Nasbitt, John. Megatrends: Ten New Directions Transforming Our Lives. New York: Warner Books, 1982.

National Machine Accountants Association, "Board of Directors Minutes, 18 June," 1952, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———. "Board of Directors Minutes, 18-19 Feb.," 1954, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 15 June -- Verbatim," 1954, Data Processing Management Association Records, Minneapolis.

———, "Executive Committee Minutes, 17 Feb.," 1954, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 9-10 Sept.," 1955, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 14 June," 1955, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 27-29 June," 1956, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 23-28 June," 1957, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———, "Executive Committee Minutes, 5-6 Dec.," 1958, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 10-15 June," 1958, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 4-5 Dec.," 1959, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 18-19 Sept.," 1959, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Minutes, 18-20 Feb.," 1959, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 5-6 August -- Verbatim," 1960, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 17 February," 1960, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 20th June -- Verbatim," 1960, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Education Committee Meeting Minutes, 26 June," 1961, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes 1-2, Dec -- Verbatim," 1961, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 8-9 Sept -- Verbatim," 1961, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Board of Directors Meeting, 19 June," 1962, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes , 31 Aug & 1 Sept -- Verbatim," 1962, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———, "Executive Committee Meeting Minutes, 21 Feb -- Verbatim," 1962, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

National Office Management Association. Automation in the Office. Willow Grove, PA: National Office Management Association, 1957.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Naukam, C. H. "Effective Communication or Breaking the Language Barrier." In Data Processing: 1959 Proceedings, edited by Charles H. Johnson, 186-202. Chicago: National Machine Accountants Association, 1959.

Naur, Peter, and Brian Randell, eds. Software Engineering: Report on a Conference Sponsored by the NATO Science Committee, Garmisch, Germany, 7th to 11th October 1968. Brussels: Science Affairs Division, NATO, 1969.

Nelsen, Bonalyn J, and Stephen R Barley. "Towards an Emic Understanding of Professionalism Among Technical Workers, EQW Working Papers WP 29." Washington, DC: Office of Educational Research and Development, 1994.

Nelson, Charles A. "The Liberal Arts in Management." Harvard Business Review 36, no. 3 (May-June 1958): 91-99.

Nelson, Daniel. "Industrial Engineering and the Industrial Enterprise." In Coordination and Information: Historical Perspectives on the Organizational Enterprise, edited by Naomi R Lamoreaux and Daniel M G Raff. Chicago: University of Chicago Press.

———. Frederick W. Taylor and the Rise of Scientific Management. Madison: University of Wisconsin Press, 1980.

Neuendorf, Charles W. "The Total Management Information System." Total Systems Letter 1, no. 1 (March 1965): 1-8.

Neuschel, R. F. "Development of Competent Systems Personnel." Systems and Procedures Quarterly 1, no. 4 (January 1951): 24-28.

Neuschel, Richard F. Streamlining Business Procedures, Industrial Organization and Management Series. New York: McGraw-Hill Book Company, 1950.

———. Management by System. New York: McGraw-Hill, 1960.

Newgarden, Albert, ed. Men, Machines and Methods in the Modern Office. Vol. 5, AMA Management Reports. New York: American Management Association, 1958.

Newlin, Clarke, Jr. "The Changing World of the Data Processing Administrator." Data Management 10, no. 2 (February 1972): 34-40.

Niles, Donald C. "Purchase versus Rental of Data Processing Equipment." Systems and Procedures 8, no. 1 (February 1957): 25-39.

Noble, David F. America By Design: Science, Technology and the Rise of Corporate Capitalism. New York: Knopf, 1977.

———. Forces of Production: A Social History of Industrial Automation. New York, NY: Alfred A. Knopf, 1984.

Nolan, Richard L. "Information Technology Management Since 1960." In A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present, edited by Alfred D. Chandler and James W. Cortada, 217-56. New York: Oxford University Press, 2000.

Nolan, Richard L. "Computer Data Bases: The Future is Now." Harvard Business Review 51, no. 5 (September-October 1973): 98-114.

———. "Managing the Computer Resource: A Stage by Stage Hypothesis." Communications of the ACM 16, no. 7 (July 1973): 339-405.

———, ed. Managing the Data Resource Function. New York: West Publishing Co, 1974.

———. "Effects of Chargeout on User/Management Attitudes." Communications of the ACM 20, no. 3 (March 1977): 177-85.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Managing the Crisis in Data Processing." Harvard Business Review 57, no. 2 (March-April 1979): 115-26.

Norberg, Arthur L. "High-Technology Calculation in the Early 20th Century: Punched Card Machinery in Business and Government." Technology and Culture 31, no. 4 (October 1990): 753-79.

Nowland & Company, "Management Report: Burroughs' Corporate Image Planning and Devlopment," 1957, Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis.

Nunberg, Geoffrey. "Farewell to the Information Age." In The Future of the Book, edited by Geoffrey Nunberg, 103-38. Berkeley: University of California Press, 1997.

Nyce, James M, and Paul Kahn. "A Machine for the Mind: Vannevar Bush's Memex." In From Memex to Hypertext: Vannevar Bush and the Mind's Machine, edited by James M Nyce and Paul Kahn, 39-66. New York: Academic Press, Inc., 1991.

Odgin, Jerry L. "The Mongolian Hordes versus Superprogrammer." Infosystems 19, no. 12 (December 1972): 20-23.

O'Donnell, James Joseph. Avatars of the Word: From Papyrus to Cyberspace. Cambridge, MA: Harvard University Press, 1998.

Oettinger, A G. "President's Letter to the ACM Membership." Communications of the ACM 10, no. 8 (August 1967): 464-67.

O'Grady, James P. "Who Profits From Professional Development?" Data Management 13, no. 1 (January 1975): 30-33.

O'Harien, Patrick J. "Total Systems: Operating Objective or Planning Structure." Journal of Systems Management 21, no. 11 (November 1970): 34-38.

Oldenzeil, Ruth. Making Technology Masculine: Men, Women, and Modern Machines in America, 1870-1945. Amsterdam: Amsterdam University Press, 1999.

Orden, Alex. "The Emergence of a Profession." Communications of the ACM 10, no. 3 (145-147 1967).

Ornsby, R. L. "Are Methods Men Selling Themselves Short?" Systems and Procedures Quarterly 4, no. 4 (November 1953): 3-5,15.

Orr, Kenneth T. "Structured Programming: Not a Fad." Infosystems 22, no. 11 (November 1975): 36-38.

Osborn, Roddy F. "GE and UNIVAC: Harnessing the High-Speed Computer." Harvard Business Review 32, no. 4 (July-August 1954): 99-107.

Osborne, Robert. "'I Don't Like Your Form, Miss Eagar'." Business Automation 8, no. 4 (October 1962): 44-46.

Oswald, Henry. "Maxi-Empire, No! Mini-empire, Maybe?" Business Automation 19, no. 6 (June 1972): 34-36.

Otterbein, J. M. "An Integrated Data Processing Application." Systems & Procedures 12, no. 4 (June-July 1961): 19-30.

Paquin, D. B., "NMAA Executive Communication, August 10," 1959, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "NMAA Executive Communication, November 10," 1959, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Parker, Donn B. "Proposed Resolution (Revised, November, 1965): ACM Position on Requirements and Qualifications for Employment in the Field of Information Processing, Submitted to the ACM Council for Consideration by Donn B Parker, October 1965," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Parker, R. W. "The SABRE System." Datamation 11, no. 9 (September 1965): 49-52.

Parnas, David Lorge. "Software Engineering Programmes are not Computer Science Programmes." Annals of Software Engineering 6, no. (14) (1998): 19-37.

Patrick, Robert L. "Selection Starts the Cycle." In Proceedings of the Seventh Annual SIGCPR Conference on Computer Personnel Research, 7-25. New York: ACM, 1969.

Patrick, Robert L. "The Maturing Field." Datamation 9, no. 1 (January 1963): 25-27.

———. "Minutes of the APMA-ACM Committee's Meeting of 7/9/64," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Patterson, Sam. "...Or Is That the Question?" Infosystems 22, no. 4 (April 1975): 6.

Patton, Susannah. "Amicable Split: Companies are Dividing IS Staffs to Better Compete in the Internet Race." CIO Magazine, September 15 2000.

———. "The Truth About CRM." CIO Magazine, May 1 2001.

Paul, Norman L. "MIS...Are You Ready?" Data Management 10, no. 10 (October 1972): 29-31.

Paulson, R. Lee. "Two Paths Diverge..." Systems & Procedures Journal 14, no. 3 (May-June 1963): 32-35.

Pearson, David. "The Hidden Cost of Data Integration." CIO Magazine, May 1 1999.

———. "Trail to the Chief: A Question For Those Whose Careers Have Plateaued at CIO: Could You Run the Business?" CIO Magazine, August 1 1999.

Penrod, James I, Michael G Dolence, and Judith V Douglas. The Chief Information Office in Higher Education. Boulder, Colorado: CAUSE: The Association for the Management of Information Technology in Higher Education, 1990.

Persson, Per-Arne. "Transformation of the Analog: The Case of the Saab BT 33 Artillery Fire Control Simulator and the Introduction of the Digital Computer as Control Technology." IEEE Annals of the History of Computing 21, no. 2 (April 1999): 52-64.

Peters, John C. "Punched Cards and the Systems Man." Systems and Procedures Quarterly 6, no. 2 (May 1955): 8-13.

Petersen, Melody. "Consultants at Andersen Take Action." New York Times, December 18 1997, D2.

Pettit, John T. "Industrial Dynamics in Action." In Advances in Management Information Systems. AMA Management Bulletin No. 16., edited by American Management Association, 7-12. New York: American Management Association, 1962.

Phillip, Enin-Dor. "Grosch's Law Re-Revisted: CPU Power and the Cost of Computation." Communications of the ACM 28, no. 2 (February 1985): 142-51.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Phillips, Charles A., Joseph F. Cunningham, and John L. Jones. "Recollections on the Early Days of COBOL and CODASYL." Annals of the History of Computing 7, no. 4 (October-December 1985).

Phillips, Dennis. "Workshop Seminar on Thinking Ahead in Education." In Data Processing: 1958 Proceedings, edited by Charles H. Johnson, 361-87. Chicago: National Machine Accountants Association, 1958.

Phister, Montgomery, Jr. Data Processing Technology and Economics. Santa Monica: Santa Monica Publishing, 1976.

Pickering, Chris. E-Comment: The Integration Chimera internet.com, July 18 2001 [cited July 21 2001].

Piehler, Courtland W. "Systems and Related Disciplines." In Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, edited by Gibbs Myers, 246-53. Detroit: The Systems and Procedures Association of America, 1958.

Pierce, James L. "The New Image of Controllership." The Financial Executive 31, no. 1 (January 1963): 13-15, 19, 36, 38-39.

Place, Irene. Administrative Systems Analysis - Michigan Business Reports, Number 57. Ann Arbor: University of Michigan, 1957.

Place, Irene, Charles B. Hicks, and Robin L. Wilkinson. Office Management. Third Edition ed. San Francisco: Canfield Press, 1971.

Plummer, John. "Will Your Computer Pay Its Way?" Business Horizons, no. April (1969): 31-36.

Poliski, Iris. "ACM Wedding Date Set." Business Automation 17, no. 13 (November 15th 1970): 6, 27.

———. "Mission Control at the First." Business Automation 17, no. 3 (March 1970): 56-61.

———. "Facilities Management: Cure-All for DP Headaches." Business Automation 18, no. 5 (March 1 1971): 26-31, 34.

Pollack, Solomon L. "On DPMA's Long Range Advisory Committee." Journal of Data Management 7, no. 3 (March 1969): 74-75.

Pomeroy, Richard W. "Basic Flow Charting Techniques." Systems and Procedures 8, no. 3 (August 1957): 2-8.

———. "The ? Box." Systems & Procedures Journal 14, no. 6 (November-December 1963): 29.

———. "The ? Box." Systems & Procedures Journal 19, no. 1 (January-February 1968): 27.

Port, Otis. "Riding in on a Wave: A Welcome New Age. Review of 'The Third Wave' by Alvin Toffler." Business Week, March 31 1980, 10.

Porter, Randall E. "First Encounter with the 701." Annals of the History of Computing 5, no. 2 (April-June 1983): 202-04.

Postley, John A. "Mark IV: Evolution of the Software Product, a Memoir." IEEE Annals of the History of Computing 20, no. 1 (January-March 1998): 43-50.

Postley, John A. Computers and People: Business Activity in the New World of Data Processing. New York: McGraw-Hill Book Company, Inc., 1960.

Potter, Kurt. "2000 Spending and Staffing Survey Reports." GartnerGroup, 2000.

Powell, Walter W. "Expanding the Scope of Institutional Analysis." In The New Institutionalism in Organizational Analysis, edited by Walter W. Powell and Paul J. DiMaggio, 183-203. Chicago: University of Chicago Press, 1991.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Previts, Gary John. The Scope of CPA Services: A Study of the Development of the Concept of Independence and the Profession's Role in Society. New York: John Wiley and Sons, Inc., 1985.

Previts, Gary John, and Barbara Dubis Merino. A History of Accounting in the United States. Columbus, OH: Ohio State University Press, 1998.

Pugh, Emerson W. Memories That Shaped an Industry: Decision Leading to IBM System/360. Cambridge, MA: MIT Press, 1984.

Pugh, Emerson W., Lyle R. Johnson, and John H. Palmer. IBM's 360 and Early 370 Systems. Cambridge, MA: MIT Press, 1991.

Quillard, Judith A., and John F. Rockart. "Looking at Micro Users." In The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology, edited by John F. Rockart and Christine V. Bullen, 311-22. Homewood, Illinois: Dow Jones-Irwin, 1986.

Rachel, Janet, and Steve Woolgar. "The Discursive Structure of the Social-Technical Divide: The Example of Information Systems Development." The Sociological Review 43, no. 2 (May 1995): 251-73.

Randell, Brian. "The 1968/69 NATO Software Engineering Reports." Paper presented at the Dagstuhl-Seminar 9635: "History of Software Engineering", Schloss Dagstuhl, August 26 - 30 1996.

Rathe, Alex W. "Management's Need for Information." In Control Through Information: A Report on Management Information Systems (AMA Management Bulletin 24), edited by Alex W. Rathe, 1-4. New York, 1963.

Rau, Erik Peter. "Combat Scientists: The Emergence of Operations Research in the United States During World War II." Ph.D., University of Pennsylvania, 1999.

Ream, Norman J. "The Need for Compact Management Intelligence." In Management Control Systems, edited by Donald G. Malcolm and Alan J. Rowe, 82-94. New York: John Wiley & Sons, Inc., 1960.

———. "Advances in Data Communications (Transmission and Reception)." In Advances in EDP and Information Systems: AMA Management Report Number 62, edited by Administrative Services Division American Management Association, 29-50. New York: American Management Association, 1961.

Rector, Robert W. "Personal Recollections on the First Quarter-Century of AFIPS." Annals of the History of Computing 8, no. 3 (July 1986): 261-69.

Reed, Sandy. "New Environment Will Require New Skills for IT Professionals of the Future." InfoWorld (November 16 1998).

Rehburg, Donald L. "Putting IDP to Work." The Controller 25, no. 8 (August 1957): 380-82, 404-05.

Reinstedt, Robert N, and Raymond M Berger. "Certification: A Suggested Approach to Acceptance." Datamation 19, no. 11 (November 1973): 97-100.

Reitzfeld, Milton. "Marketing the Systems Function." Systems & Procedures Journal 16, no. 6 (November-December 1965): 30-35.

Remy, Dan. "Reader Feedback: CDP Opinions Based on Erroneous Premise." Infosystems 22, no. 11 (December 1975): 7-8.

Render, Barry, and Ralph M Stair Jr. "Future Managers Need DP Training." Infosystems 22, no. 10 (October 1975): 41-42.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Revens, Lee. "The First 25 Years: ACM 1947-1962 (sic.)." Communications of the ACM 30, no. 10 (October 1987): 860-65.

Rhind, Ridley. "Management Information Systems: Some Dreams Have Turned to Nightmares." Business Horizons (June 1968): 37-46.

Rhodes, Wayne L., Jr. "It's A Long Fall." Infosystems 35, no. 3 (March 1988): 8.

Rinehart, Robert F. "Threats to the Growth and Development of Operations Research in Industry." Journal of the Operations Research Society of America 2, no. 3 (August 1954): 229-33.

Rockart, John F. "Chief Executives Define their Own Data Needs." Harvard Business Review 57, no. 2 (March-April 1979): 81-93.

———. "The Role of the Executive in the New Computer Era." In The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology, edited by John F. Rockart and Christine V. Bullen, 374-82. Homewood, Illinois: Dow Jones-Irwin, 1986.

Rockart, John F., and Christine V. Bullen, eds. The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology. Homewood, Illinois: Dow Jones-Irwin, 1986.

Roemmich, Herman, "A Descriptive Analysis of the 1963 DPMA Certification Applicants and the Selection of a Punch Card Criterion Population," 1964, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

———. "1963 CDP Breakdown." Journal of Data Management 3, no. 1 (January 1965): 50-51.

Roland, Alex, and Philip Shiman. Strategic Computing:

DARPA and the Quest for Machine Intelligence. Cambridge, MA: MIT Press, 2002.

Roman, Victor H. "The Systems Organization Must Be Sold." Systems & Procedures 8, no. 1 (February 1957): 12-15.

Rosenberg, Charles E. The Care of Strangers: The Rise of America's Hospital System. New York, NY: Basic Books, 1987.

Rosin, Robert F. "Prologue: The Burroughs B 5000." Annals of the History of Computing 9, no. 1 (January 1987): 6-7.

Rosner, W. Norton. "Organizing for Management Information." Systems & Procedures Journal 19, no. 6 (November-December 1968): 35-37.

Roszak, Theodore. The Cult of Information: The Folklore of Computers and the True Art of Thinking. New York: Pantheon Books, 1986.

Rotella, Elyce J. From Home to Work: U.S. Women at Work, 1870-1930. Ann Arbor: UMI Research Press, 1981.

Rowan, T. C. "The Recruiting and Training of Programmers." Datamation 4, no. 3 (May-June 1958): 16-18.

Rowe, Richard R. "You, the CIO; can librarians make the jump to "chief information officer"?" American Libraries 18, no. April (1987): 297.

Rumm, John C. "Scientific Management and Industrial Engineering at Du Pont." In A Mental Revolution: Scientific Management Since Taylor, edited by Daniel Nelson, 175-204. Columbus: Ohio State University Press, 1992.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Ruth, Marvin S. "In Defense of EDP Management." Infosystems 22, no. 2 (February 1975): 36-38.

Rymer, John. "Executives to Unlock Technology's Promise." Computer Decisions, 15 September 1983, 134.

Safford, Herbert B. "Preliminary Evaluation of the First DPMA Registered Business Programmer Examination." Data Management 9, no. 4 (April 1971): 28-30.

Salter, Chuck. "People and Technology - Microstrategy Inc." Fast Company 2000, 190.

Salveson, Melvin E. "High-Speed Operations Research." Harvard Business Review 35, no. 4 (July-August 1957): 89-99.

Sammet, Jean E. "Brief Summary of the Early History of COBOL." Annals of the History of Computing 7, no. 4 (October-December 1985): 288-303.

Sandborn, Stephanie. Back From the Grave Infoworld.com. December 8 2000 [cited. Available from http://www2.infoworld.com/articles/hn/xml/00/12/11/001211hngrave.xml?Template=/storypages/printarticle.html.

Sanford, Donn W. "But the 'A' Means 'American'." Data Management 12, no. 8 (August 1974): 4.

———. "DPMA Tomorrow." Data Management 13, no. 3 (March 1975): 32-34.

Saul, Stacy. "Certification Program for Software Development Professionals Approved." Computer 35, no. 1 (January 2002): 99.

Savage, Mike, James Barlow, Peter Dickens, and Tony Fielding. Property, Bureaucracy and Culture: Middle-Class Formation in Contemporary Britain. London: Routledge, 1992.

Saviano, James P. "Are We There Yet?" CIO Magazine, 1 June 1997.

Schaffir, Walter B. "Developing a Management Control "Instrument Panel": A Practical Approach." In Men, Machines and Methods in the Modern Office, 61-71. New York: American Management Association, 1958.

Schiesel, Seth. "The No. 1 Customer: Sorry, It Isn't You." New York Times, November 23 1997, 1.

Schoderbek, Peter P., ed. Management Systems, The Wiley Series in Management and Administration. New York: John Wiley & Sons, Inc., 1967.

Scholfield, Ethel E. Filing Department Operation and Control. New York: The Ronald Press Company, 1923.

Schrage, Michael. "Wal-Mart Trumps Moore's Law." Technology Review (March 2002).

Schulman, Edward L. and Gerald M Weinberg. "Training Programmers for Diverse Goals." Data Base 5, no. 2-3-4 (Winter 1973): 16-26.

Schulze, J. William. The American Office: Its Organization, Management and Records. Second ed. New York: Ronald Press Company, 1914.

Schulze, John William. Office Administration. New York: Ronald Press, 1919.

Schwartz, Ephraim. Raft of CEOs Critical of IT's Contribution to Business Results InfoWorld Electric, 6:22 AM PT, Apr 30, 1999 1999 [cited. Available from www.infoworld.com.

Scott, W. Richard. Organizations : rational, natural, and open systems. Englewood Cliffs, N.J.: Prentice-Hall, 1982.

———. Institutions and Organizations, Foundations for organizational science. Thousand Oaks, CA ; London: Sage, 1995.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Scranton, Philip. Endless Novelty: Specialty Production and American Industrialization, 1865-1925. Princeton, NJ: Princeton University Press, 1997.

Seares, Al. N. "Advancements in Office Automation." The Hopper 4, no. 2 (February 1953): 6-9.

Seesse, Dorothy Anne. "Initiating a Total Information System." Journal of Systems Management 21, no. 4 (April 1970): 33-38.

Selekman, Benjamin M. "Is Management Creating a Class Society?" Harvard Business Review 36, no. 1 (January-February 1958): 37-46.

Senge, Peter. "Reflection on 'A Leader's New Work: Building Learning Organizations'." In Knowledge Management: Classic and Contemporary Works, edited by Danyl Morey, Mark Maybury and Bhavani Thurasingham, 53-60. Cambridge, MA: MIT Press, 2000.

Shaiken, Harley. Work Transformed: Automation and Labor in the Computer Age. Lexington, MA: Lexington Books, 1986.

Shapiro, Stuart. "Splitting the Difference: The Historical Necessity of Synthesis in Software Engineering." IEEE Annals of the History of Computing 19, no. 1 (1997): 20-54.

Shapiro, Stuart S. "Computer Software as Technology: an Examination of Technological Development." Carnegie-Mellon, 1990.

Shaw, Christopher J. "Programming Schisms and Their Future." Datamation 8, no. 9 (September 1962): 32.

Sheehan, G. M. "An Application to Payroll." In Automatic Data Processing Conference, edited by Robert N. Anthony, 145-57. Boston: Graduate School of Business Administration, Harvard University, 1955.

Shenhav, Yehouda. Manufacturing Rationality: The Engineering Foundations of the Managerial Revolution. New York: Oxford University Press, 1999.

Silberman, Charles E. The Myths of Automation. New York: Time Inc., 1966.

Simon, Herbert A. "The Corporation: Will It Be Managed By Machines?" In Management and Corporations 1985, edited by Melvin Anshen and George Leland Bach, 17-55. New York: The McGraw-Hill Book Company, 1960.

Simon, Leonard, and Roger Sisson. "Evolution of a Total System." Total Systems Letter 1, no. 11 (January 1966): 1-4.

Sinasohn, Roger Louis. "Programming the 1401: An Interview with Leo Damarodas." The Analytical Engine 1, no. 1 (1993): 3-8.

———. "Programming the 1401: An Interview with Leo Damarodas, part II." The Analytical Engine 1, no. 2 (1993): 26-32.

Sinclair, Bruce, and James P. Hull. A centennial history of the American Society of Mechanical Engineers, 1880-1980. Toronto ; Buffalo: Published for the American Society of Mechanical Engineers by University of Toronto Press, 1980.

Skinner, Wickham. "The Anachronistic Factory." Harvard Business Review 49, no. 1 (January-February 1971): 61-70.

Slater, Derek. "I.T.-Rex? Reports of the Mainframe's Extinction Have Been Greatly Exaggerated." CIO Magazine, November 15 2000.

Slater, Robert E. "What Management Has "Discovered" About Computers." Journal of Machine Accounting 6, no. 7 (July-August 1955): 15, 18, 24-25, 32.

Sloan, Alfred P, Jr. My Years with General Motors. New York: Macfadden-Bartell, 1965.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Smith, Ceil O. "Projecting Tomorrow's Information Systems." In MIS In Action, edited by Robert G. Murdick and Joel E. Ross, 697-703. St. Paul: West Publishing Co., 1975.

Smith, Charles C. "Removing the Mystery from Electronic Data Processing." Journal of Machine Accounting 7, no. 7 (July 1956): 12-13, 16-27.

Smith, George Albert, Jr. "Questions the Business Leader Should Ask Himself." Harvard Business Review 34, no. 2 (March-April 1956): 49-56.

Smith, Robert M. "New Horizons for the Office Manager." In The Changing Dimensions of Office Management, edited by American Management Association. Office Management Division., 17-20. New York: American Management Association, 1960.

Smith, Theodore A. "From Burden to Opportunity: The Revolution in Data Processing." In The Changing Dimensions of Office Management, edited by American Management Association. Office Management Division., 26-31. New York: American Management Association, 1960.

Snow, C P. The Two Cultures and the Scientific Revolution. New York: Cambridge University Press, 1959.

Soden, John V. "Understanding MIS Failures." Data Management 13, no. 7 (July 1975): 29-46.

Solow, Herbert. "Operations Research is Business." Fortune 53, no. 2 (February 1956): 128-29, 48, 51-52, 54-55, 58.

Somers, E. F., "Internal Memorandum." 1957, Edward F. Somers Papers (CBI 65), Charles Babbage Institute, University of Minnesota, Minneapolis.

Souza, Robert De, Rika Narisawa, Robert Goodwin, and Kingshuk Hazra. "IT Business Spending to Recover in Late 2003." GartnerGroup, 2003.

Spaulding, A. T., Jr. "Is the Total System Concept Practical?" Systems & Procedures Journal 15, no. 1 (January-February 1964): 28-32.

Speed, John R. "What Do You Mean I Can't Call Myself a Software Engineer." IEEE Software Magazine 16, no. 6 (November-December 1999): 45-50.

Spett, Milton C. "Modern Systems Management and the Systems Game." Systems & Procedures Journal 17, no. 6 (November-December 1966): 22-28.

Spooner, John G. Report: Don't Overspend on Technology News.com, November 1 2002 [cited November 2 2002]. Available from http://news.com.com/2100-1001-964213.html?tag=fd_top.

Sprague, Christopher R. "Barriers to Progress in Information Systems Design: Technical or Not." Data Base 5, no. 2 (Winter 1973): 115-20.

Sprague, Richard E. "The Information Utilities." Business Automation 12, no. 3 (March 1965): 42-47.

Sprague, Richard E. "Are Punched Card Machines on the Way Out?" The Hopper 4, no. 7 (July 1953): 2-7.

———. "Automatic Management Reporting and On Line Real Time Systems." In Ideas for Management: Papers and Case Histories presented at the 1962 International Systems Meeting, edited by Anonymous, 213-19. Detroit: Systems and Procedures Association, 1962.

Stafford, Herbert B. "DPMA -- Long Range Advisory Committee -- Summary of Correspondence from Committee." April 17 1968.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "DPMA -- Minutes of Long Range Advisory Committee Meeting." January 5 and 6 1968.

Standage, Tom. The Victorian Internet. New York: Berkley Books, 1999.

Statland, Norman, and John R. Hillegass. "Random Access Storage Devices." Datamation 9, no. 12 (December 1963): 34-45.

Steere, Ralph E. "How to Win Management's Approval." Systems & Procedures Journal 13, no. 2 (March-April 1962): 14-16.

Stein, Charles, Jr. "Some Organizational Effects of Integrated Management Information Systems." In The Changing Dimensions of Office Management, edited by American Management Association. Office Management Division., 82-89. New York: American Management Association, 1960.

Stein, Theodore. "Managing the Data Processing Department." In International Data Processing Conference of the Data Processing Managment Association, 48-61. Chicago: National Machine Accountants Association, 1962.

Stinchcombe, Arthur. Information and Organizations. Berkley, CA: University of California Press, 1990.

Stoll, Marilyn. "CIO Position Emerges as a New Strategic Force." Datamation, October 20 1987, C1.

Stone, James A., and James Clark. "Integrated Business Systems." Infosystems 19, no. 7 (July 1972): 26-30.

Stone, Milton D. "Data Processing and the Management Information System: A Realistic Evaluation of Data Processing's Role in the Modern Business Enterprise." In Data Processing Today: A Progress Report -- New Concepts, Techniques and Applications -- AMA Management Report Number 46, edited by American Management Association, 14-22. New York: American Management Association, Finance Division, 1960.

Strassmann, Paul. The Squandered Computer. New Canaan, CT: Information Economics Press, 1997.

Strassmann, Paul A. "CIOs should get back to basics." Datamation 40, no. 18 (September 15 1994): 70(3).

———. "The Hocus-Pocus of Reengineering." Across the Board (June 1994).

———. The Politics of Information Management. New Canann: The Information Economics Press, 1995.

Striby, Irene M. "Looking Around." Harvard Business Review 37, no. 3 (May-June 1959): 33-34, 36, 144, 46, 48, 50.

Strom, Sharon. Beyond the Typewriter: Gender, Class and the Origins of Modern American Office Work, 1900-1930. Urbana, IL: University of Illinois Press, 1992.

Strube, John H. "Rational Data Processing." Systems and Procedures 9, no. 4 (November 1958): 12-15.

Swearingen, John K. "Letter to Daniel A. Will, January 3." 1966, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Synnott, William R., and William H Gruber. Information Resource Management: Opportunities and Strategies for the 1980s. New York: John Wiley & Sons, 1981.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

System Development Corporation. "Preprint for Second Symposium on Computer-Centered Data Base Systems. Sponsored by SDC, ARPA, and ESD." 1965. Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis.

———. "SDC: The Total Systems Company." n.d., Burroughs Corporation Records (CBI 90), Charles Babbage Institute, University of Minnesota, Minneapolis.

Systems and Procedures Association of America. "Code of Ethics." Systems and Procedures Quarterly 2, no. 2 (June 1951): 10.

Taylor, Frederick Winslow. The Principles of Scientific Management. New York: Harper & Brothers, 1911.

Taylor, James W., and Neal J. Dean. "Managing to Manage the Computer." Harvard Business Review 44, no. 5 (September-October 1966): 98-110.

Taylor, Robert S. "Professional Aspects of Information Science and Technology." In Annual Review of Information Science and Technology: Volume 1, edited by Carlos A. Cuadra, 15-40. New York: John Wiley & Sons, 1966.

Temin, Peter. Inside the Business Enterprise: Historical Perspectives on the Use of Information. Chicago, IL: University of Chicago Press, 1991.

Terry, George R., and John J. Stallard. Office Management and Control: The Administrative Managing of Information. Eighth Edition ed. Homewood, Illinois: Richard D. Irwin, Inc., 1980.

The Society for Management Information Systems. Research Report One: What Is A Management Information System. Chicago: The Society for Management Information Systems, 1972.

Thesis, John M. "Practical Application of Electronic Equipment." Journal of Machine Accounting 6, no. 3 (March 1955): 5, 7-8, 16-17.

Tolliver, Edward M. "Myths of Data Automation." Journal of Systems Management 21, no. 8 (August 1970): 36-38.

Tolliver, Edwin M. "Myths of Automated Management Systems." Journal of Systems Management 22, no. 3 (March 1971): 29-32.

Tomayko, James E. "Software as Engineering." In Mapping the History of Computing: Software Issues, edited by Ulf Hashagen, Reinhard Keil-Slawik and Arthur L. Norberg. New York: Springer-Verlag, 2002.

Trexler, George E. "Public Utility Customer Accounting on the Type 650 Magnetic Drum Data Processing Machine." Journal of the Association for Computing Machinery 1, no. 4 (October 1954): 173-76.

Trice, Harrison Miller. Occupational Subcultures In the Workplace, Cornell studies in industrial and labor relations. ; no. 26. Ithaca, N.Y.: ILR Press, 1993.

Tuomi, Ilkka. "Data Is More Than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory." Paper presented at the Proceedings of the 32nd Hawaii International Conference on System Sciences, Maui, HI, January 5-8 1999.

Turkle, Sherry. The Second Self: Computers and the Human Spirit. New York, NY: Simon and Schuster, 1984.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Tympas, Aristotle. "From Digital to Analog and Back: The Ideology of Intelligent Machines in the History of the Electrical Analyzer, 1870s-1960s." IEEE Annals of the History of Computing 18, no. 4 (Winter 1996): 42-48.

Ullman, Ellen. Close to the Machine : Technophilia and its Discontents. San Francisco: City Lights Books, 1997.

Urwick, L. Organizing a Sales Office. London: Victor Gollancz, 1928.

———. The Elements of Administration. New York: Harper & Brothers Publishers, 1943.

Useem, Michael. Executive Defense: Shareholder Power and Corporate Reorganization. Cambridge, MA: Harvard University Press, 1993.

Usher, Anne. "Still sinking: MicroStrategy retrenches, but recovery is for from assured." Washington Techway, May 28 2001, 36(2).

Usselman, Steven. "IBM and its Imitators: Organizational Capabilities and the Emergence of the International Computer Industry." Business History Review 22, no. 1 (Spring 1993): 1-35.

Valdez, Maria Eloina Pelaez. "A Gift From Pandora's Box: The Software Crisis." Ph.D., University of Edinburgh, 1988.

Van Horn, Richard L. "Empirical Studies of Management Information Systems." Data Base 5, no. 2-3-4 (Winter 1973): 172-82.

Vance, Sandra Stringer, and Roy V Scott. Wal-Mart: A History of Sam Walton's Retail Phenomenon. New York: Simon & Schuster, 1997.

Vannais, Leon E. "Punched Card Accounting from the Audit Viewpoint." Journal of Accounting 70, no. 3 (September 1940): 200-17.

Various. "Microfilm -- special issue." Infosystems 22, no. 4 (April 1975): 13.

———. "Perspectives on a Quarter Century: AFIPS Presidents." Annals of the History of Computing 8, no. 3 (July 1986): 275-302.

Viscasillas, Stephanie. "Brand I.T." CIO Magazine, January 15 2002.

Vizard, Michael. "Yahoo and IBM head for a collision on the road to business intelligence." InfoWorld.com, 16 February 2001.

Vleck, Tom Van. 1401s I Have Known 14 Jan 1997 1993 [cited 06 June 2001].

———. The IBM 7070 24 Mar 1996 [cited 06 June 2001]. Available from http://www.multicians.org/thvv/7070.html.

Vogt, Leonard F. "Advances in I.D.P." In Data Processing: 1959 Proceedings, edited by Charles H. Johnson, 30-34. Chicago: National Machine Accountants Association, 1959.

Wagner, Harvey M. "Practical Slants on Operations Research." Harvard Business Review 41, no. 3 (May-June 1963): 61-71.

Walker, Virginia C. "COBOL - A Monument to Cooperation." Annals of the History of Computing 2, no. 1 (January 1980): 79-83.

Walkowitz, Daniel J. Working with Class: Social Workers and the Politics of Middle-Class Identity. Chapel Hill: University of North Carolina Press, 1999.

Wall Street Journal, "Management and the Computer: A Wall Street Journal Study of the Management Men Responsible for their Companies' Purchases of Computer Equipments and Services," 1969, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Wallace, Edward L. Management Influence on the Design of Data Processing Systems. Boston: Harvard University, Graduate School of Business Administration, 1961.

Wallace, Frank. Appraising the Economics of Electronic Computers: An Approach for a Company to Determine the Feasibility of Acquiring a Computer. New York: Controllership Foundation, 1956.

Wanner, F. Walton. "Design for Controlled Professional Development." In Ideas for Management: Papers and Case Histories Presented at the Tenth International Systems Meeting, edited by Gibbs Myers, 17-19. Detroit: The Systems and Procedures Association of America, 1958.

Ware, Willis. "Perspective on AFIPS." Datamation 9, no. 4 (April 1963): 42-43.

Ware, Willis H. "AFIPS in Retrospect." Annals of the History of Computing 8, no. 3 (July 1986): 303-10.

Watson, Thomas J. Jr. "Address by Thomas J. Watson, Jr., President, International Business Machines Corp." In Data Processing (1): 1958 Conference Proceedings, edited by Charles H. Johnson, 15-19. Chicago: National Machine Accountants Association, 1958.

Watson, Thomas, Jr., and Peter Petre. Father, Son & Co: My Life at IBM and Beyond. New York: Bantam, 1990.

Weber, Joel R. "The Corporate Command Post." Business Automation 15, no. 12 (December 1968).

———. "Microfilm Makes it Easier to Fly." Business Automation 15, no. 10 (October 1968): 38-41.

Webster, Edward, and Norman Statland. "Instant Data Processing." Business Automation 7, no. 6 (June 1962): 34-36, 38.

Webster, Frank. Theories of the Information Society. New York: Routledge, 1995.

Weinberg, Gerald M. The Psychology of Computer Programming. New York: Van Nostrand Reinhold Company, 1971.

Weiss, Eric. "Obituary: AFIPS." Annals of the History of Computing 13, no. 1 (January-March 1991): 100-01.

Weiss, Eric A. "Commentaries on the Past 15 Years." Communications of the ACM 30, no. 10 (October 1987): 880-85.

Wellisch, Hans. "From Information Science to Informatics: A Terminological Investigation." Journal of Librarianship 4, no. 3 (July 1972): 157-87.

Wendler, C. Clifford. "What are the Earmarks of Effective Total Systems?" Systems & Procedures Journal 17, no. 4 (July-August 1966): 29-31.

West, C E. "Training Equipment in the Provident Mutual." NOMA Forum 9, no. 1 (December 1933): 7-10.

Whinston, Andrew B. and William D Haseman. "A Data Base for Non-Programmers." Datamation 21, no. 5 (May 1975): 101-7.

Whisler, Thomas L., and George P. Schultz. "Information Technology and Management Organization." In Management Organization and the Computer, edited by George P. Schultz and Thomas L. Whisler. Glencoe, Illinois: Free Press, 1960.

White, Robert B. "A Case Against Large-Scale Computers." Infosystems 22, no. 8 (August 1975): 34.

Whitney, Alfred. "How to Prepare Machine Procedures." The Hopper 4, no. 2 (1953): 1-5.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Whyte, William Foote. "Human Relations Theory: A Progress Report." Harvard Business Review 34, no. 5 (September-October 1956): 125-32.

Whyte, William Hollingsworth. The Organization Man. New York: Simon and Schuster, 1956.

Widener, W. Robert. "New Concepts of Running a Business." Business Automation 13, no. 4 (April 1966): 38-43, 63.

———. "New Management Concepts: Working and Profitable." Business Automation 15, no. 8 (August 1968): 28-34.

Wiebe, Robert H. The Search for Order, 1877-1920. New York: Hill and Wang, 1967.

Wilensky, H L. "The Professionalization of Everyone?" American Journal of Sociology 70, no. 2 (September 1964): 137-58.

Wilentz, Sean. Chants Democratic: New York City and the Rise of the American Working Class, 1788-1850. Oxford: Oxford University Press, 1984.

Wilkinson, Robert A. "So, You Want to Be a Manager." Journal of Machine Accounting 7, no. 5 (May 1956): 27-33.

Will, Daniel A. "Memorandum to Billy R. Field, December 1," 1965, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

William F. Cooke, Jr., and William J. Rost. "Standard Cost System: A Module of a Management Information System." Journal of Systems Management 20, no. 3 (March 1969): 11-16.

Williams, Michael R. A History of Computing Technology. Englewood Cliffs, NJ: Prentice-Hall, 1985.

Williams, Robert V. Transcript of Interview Conducted by Robert V Williams Chemical Heritage Foundation, 1997 [cited January 13 2003]. Available from www.chemheritage.org/HistoricalServices/eminentchemists/Garfield/Garfield2ALL.pdf.

Williams, Rosalind. "'All that Is Solid Melts Into Air:' Historians of Technology in the Information Revolution." Technology and Culture 41, no. 4 (October 2000): 641-68.

Williamson, Oliver E. The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. New York, NY: Free Press, 1987.

Winner, Langdon. "Mythinformation in the High-tech Era." In Computers in the Human Context, edited by Tom Forester, 82-132. Cambridge, MA: MIT Press, 1991.

Winter, Charles F. "Second Generation Computers." In Total Systems, edited by Alan D. Meacham and Van B. Thompson, 88-95. Detroit, MI: American Data Processing, Inc., 1962.

Wiseman, R T. "Life Insurance Premium Billing and Combined Operations by Electronic Equipment." Journal of the Association for Computing Machinery 1, no. 1 (January 1954): 7-12.

Wolf, Edwin Deforest. "Workshop Seminar on Planning New Applications." In Data Processing: 1958 Proceedings, edited by Charles H. Johnson, 343-60. Chicago: National Machine Accountants Association, 1958.

Woodall, Pam. "Survey: The New Economy -- Solving the Paradox." The Economist, 23rd September 2000.

Woodbury, David O. "The Translating Machine." The Atlantic Monthly 204, no. 2 (August 1959): 60-64.

Worthen, Ben. "Nestle's ERP Odyssey." CIO Magazine, May 15 2002.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Worthington, John H. "Operating Systems Cut Processing Time." Business Automation 11, no. 7 (July 1964): 27-29.

Worthington, W. B. "Application of Electronics to Administrative Systems." Systems and Procedures Quarterly 4, no. 1 (February 1953): 8-14.

Worthington, William B. "Total Command, Management and Administrative Systems." In Total Systems, 34-49. Detroit, MI: American Data Processing, Inc., 1962.

Wright, Robert G. "Electronics Challenge to Machine Accountants." Journal of Machine Accounting 7, no. 4 (April 1956): 4-7,27.

Wu, Jonathan. Business Intelligence: The Transition of Data into Wisdom DM Direct, November 2000 [cited 26 June 2002]. Available from http://www.dmreview.com/portal_ros.cfm?NavID=91&EdID=2524&PortalID=17.

Wygant, L. F. "About your magazine...." Infosystems 22, no. 8 (September 1975): 4.

Wylie, Harry L. "The Office Manager in a "Systems" World." Systems & Procedures Journal 16, no. 5 (September-October 1965): 40-45.

Wylie, Harry L., Merle P. Gamber, and Robert P. Brecht. Practical Office Management. New York: Prentice Hall, 1937.

Wythes, R W. "Machine Accounting Methods as Applied to Accounts Payable." NOMA Forum 9, no. 1 (December 1933): 10-12.

Xephon Technology Transfer, Ltd. "Office Automation: An IBM User Perspective." Stamford, CT: Gartner Group, 1982.

Yang, Catherine. "MicroStrategy Wants to be an Angel Whispering Data in Your Ear." Business Week (December 21 1999).

Yates, JoAnne. Control Through Communication: The Rise of System in American Management. Baltimore, MD: Johns Hopkins University Press, 1989.

———. "Co-evolution of Information-processing Technology and Use: Interaction Between the Life Insurance and Tabulating Industries." Business History Review 67, no. 1 (Spring 1993): 1-51.

———. "Evolving Information Use in Firms: Ideology and Information Techniques and Technologies." In Information Acumen : The Understanding and Use of Knowledge in Modern Business, edited by Lisa Bud-Frierman. New York: Routledge, 1994.

———. "Application Software for Insurance in the 1960s and Early 1970s." Business and Economic History 24, no. 1 (Fall 1995): 123-34.

———. "Early Interactions Between the Life Insurance and Computer Industries: The Prudential's Edmund C. Berkeley." IEEE Annals of the History of Computing 19, no. 3 (July-September 1997).

———. "The Structuring of Early Computer Use in Life Insurance." Journal of Design History 12, no. 1 (1999): 5-24.

Yoder, Joseph P. "The Machine Accountant: Supervisor or Manager?" Journal of Machine Accounting 7, no. 9 (September 1956): 6-8.

York, Thomas. "Business Specialists Needed: The convergence of business and technology is transforming IT." InfoWorld (April 6 1998).

Young, Don. "Letter to Bruce Gilchrist, February 2nd." 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

———. "Memorandum: AFIPS Roundtable on Professionalism, to R. C. Elliot," 1970, Data Processing Management Association Records (CBI 88), Charles Babbage Institute, University of Minnesota, Minneapolis.

Young, Donald. "Reyerson Turns Paperwork into Working Paper." Business Automation 6, no. 4 (October 1961): 22-27.

Yourden, Edward. Techniques of Program Structure and Design. Engelwood Cliffs, NJ: Prentice-Hall, 1975.

Zabusky, Stacia E. "Computers, Clients and Expertise: Negotiating Technical Identities in a Nontechnical World." In Between Craft and Science: Technical Work in US Settings, edited by Stephen R Barley and Julian E Orr, 129-53. Ithaca: Cornell University Press, 1998.

Zaino, Louis F. "How Does an Operating System Work?" Systems & Procedures Journal 19, no. 1 (January-February 1968): 20-23.

Zani, William M. "Blueprint for MIS." Harvard Business Review 48, no. 6 (November-December 1970): 95-100.

Zmund, Bob. "Editor's Comments: Nature of Topics." MIS Quarterly 19, no. 2 (June 1995).

Zorn, Dirk. "Room at the Top? The Failed Institutionalization of Management Information Systems." Paper presented at the Academy of Management Conference, Washington, D.C. 2001.

Zuboff, Shoshana. In The Age of the Smart Machine: The Future of Work and Power. New York, NY: Basic Books, 1988.

Zunz, Olivier. Making America Corporate: 1870-1920. Chicago, IL: University of Chicago Press, 1990.

Zussman, Robert. Mechanics of the Middle Class: Work and Politics Among American Engineers. Berkeley: University of California Press, 1985.

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