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Information technology and white-collar productivity

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Executive Overview

Despite the hype and fanfare that has accompanied the introduction of the latest information technology, white-collar productivity has not shown appreciable improvement. This article addresses some of the main reasons for this and offers suggestions on how information technology may be used to improve organizational performance. Particular attention is paid to the differences between white-collar and blue-collar work and the problems inherent in the current definition of white-collar productivity. Improved effectiveness in serving internal and external customers is a better basis for judging most white-collar work and that too much emphasis on lowering costs and increasing output may prove counterproductive. A method called process management is described which can enhance internal customer relationships and improve the administrative systems on which an organization depends.

Article

One of the major changes that has occurred during the past forty years is the gradual shift in employment from factory blue-collar manual labor to white-collar information and service work. During the 1970's and 1980's white-collar jobs have grown twenty percent faster than the overall labor force.[1] Less than thirty percent of the United States labor force is now directly engaged in manufacturing.

Significant improvements in manufacturing productivity have recently been achieved through superior work methods, new technology, and improved management on the factory floor.[2] White-collar office workers have not done as well even though huge sums of money have been spent on computers and information technology (IT).[3] Indeed, almost forty percent of United States capital spending is being used to acquire IT—much of it to improve office work productivity. The results have been disappointing. Many managers are questioning the real payoff from IT.[4]

Applying new office technology to white-collar productivity is one of the biggest challenges facing United States industry. A White House conference on productivity concluded that measuring office productivity is one of our most difficult and perplexing issues. Participants agreed that the lack of workable measurement techniques is hampering IT application advances in our domestic offices.[5]

Several reasons for the disappointing results obtained by IT and the dismal growth rate of white-collar productivity are reviewed in this article. Alternative ways of applying IT and supporting white-collar performance improvement are suggested.

Main Reasons For Productivity Improvement Failures

Unclear Method for Managing Office Work and Evaluating White-Collar Productivity

Most manufacturing operations have established methods for managing and

controlling work: jobs are clearly defined and performance standards and objectives are set; the work is planned and scheduled in advance; performance reporting is used to compare actual results to planned goals; and costs associated with the work (raw materials, labor, equipment, and factory overhead) are accounted for and charged to particular products. Under these conditions, calculating manufacturing operations productivity—whether evaluating labor, machine, or raw material utilization—is relatively easy. Management can compare the cost of inputs to volume and value of outputs and derive reasonably accurate measures of productivity.[6]

Office work rarely conforms to any of these accepted methods for managing factory work. Most office work involves processing information rather than physical goods. It includes managerial, professional, and clerical work. Office work is often poorly defined and office workers generally do not have quantified objectives. Only a minority of clerical workers have equivalent performance standards in input-output terms. Typically, performance reporting and measurement is absent and the cost associated with producing a particular unit of work is difficult to collect.[7]

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Despite this, the accepted definition of white-collar productivity has been the equivalent of the blue-collar definition: the ratio of units of output to white-collar payroll expenses that can be broken out at the individual, department, or organization level.[8] Other definitions attempt to measure all inputs (equipment, supplies, office rent, utilities, wages and benefits, etc.) to the volume or monetary value of outputs.

Defining white-collar productivity solely in these terms highlights several weaknesses.[9] First, the traditional model of blue-collar productivity that concentrates on increasing output or lowering input places too much emphasis on efficiency criteria—quantity, time, and cost. Efficiency criteria are important but effectiveness is becoming critical in both white-collar and manufacturing work. White-collar workers are usually evaluated for the quality of what they do, their initiative, innovation, and the results they achieve. Efficiency issues, like performance to budget, may be important but the value of most managers' work cannot be measured by how efficiently they answer the phone or fill out forms. They are paid to make decisions, manage people, and get results. A manager may earn his or her salary in five minutes out of a week through a single shrewd decision or critical negotiation. The traditional model also assumes that there is no difference in evaluating productivity at the individual, department, or organization levels. The same approach is assumed to work equally well for all types of jobs at all levels. As will be discussed later, individual measures for evaluating white-collar work are often either unobtainable or not meaningful for many white-collar jobs.[10]

Inadequate Integration of IT with Other Business Functions

Productivity improvement attempts in the office have depended too heavily on the indiscriminate application of new office technology.[11] Technology typically used to increase office efficiency has included computers, local area networks, internal and external data bases, expert systems, spreadsheet software, word processing, business graphics, electronic mail, teleconferencing and satellite communication. Many of these developments were haphazardly introduced on the assumptions that the technology could be easily integrated and that employees and managers would learn to use it productively.

The burden of integrating most IT has been left to the information services department (ISD).[12] ISDs, which evolved from small electronic data processing units within accounting departments, were limited to processing financial

information. What started as a minor support service is now critical to most firms' survival.

Today, many ISDs are overwhelmed by demands for assistance with factory and office automation, hardware and software acquisition, the development of management information systems, decision support systems, expert systems, user training and support. In many cases, ISDs are not organized, budgeted, or staffed to handle all of these responsibilities.

Most managers and employees have less knowledge about the purpose and role of ISDs than any other business function. As a result, IS personnel are often accused of having a narrow technical orientation. IS personnel counter by accusing managers of being impatient with the technology and unwilling to learn to use it properly. This has resulted in uneasiness between IS professionals and business managers and the slow adoption of information technology.

Lack of Involvement and Oversight by Senior Management
Senior management input and oversight on IT uses and implementation are often conspicuously absent.[13] There are two reasons why this may occur. Senior management may lack understanding of the technology and prefer to leave it to the "experts" or, since the early uses of office technology were applied to routine operations (clerical, accounting, payroll) it may not have seemed worthy of top management's close attention.

As IT applications have moved from narrow routine functions to company-wide operations, decisions have become more strategic. Elaborate information networks and data bases linking departments, divisions, suppliers, and customers necessitate careful long-range planning and large capital investments. Senior management involvement and understanding of the implications of these decisions is essential to realizing competitive advantages from the technology and avoiding costly mistakes.[14]

However, large scale computer systems have often failed to perform as intended and produced massive cost overruns in the process.

In 1982, Sears' subsidiary, Allstate Insurance, started building the most sophisticated computer system in the insurance industry.[15] The system was designed to automate many of Allstate's office operations and shorten the time needed for new policy introduction. Allstate hired Electronic Data Systems (EDS), a systems integration company, to develop the software and install it on the firm's hardware. The target date for completion was December 1987, at a cost of $8 million. By November 1988, the project was $15 million over budget and still not completed. Allstate fired EDS as the systems' consultant and set a 1993 completion date.

This incident typifies large scale systems projects that run out of control. There are often no interim milestones to keep the project on schedule and within budget, few performance clauses to hold consultants legally responsible for meeting deadlines, and insufficient system testing.[16] The project magnitude and expense requires top management's close involvement and oversight.

The Automation of Inefficient Systems
Another typical problem with IT application in the office is that existing work procedures are computerized without sufficient analysis of how to improve systems and procedures.[17] Inefficient work processes that require restructuring are left intact. The systems analysts who handle computer conversions are not sensitive to

business strategy, improved workflow, and job design.[18] Their job is to develop software that increases the speed of information processing. The systems analyst may work with employees to devise systems that fit user needs, but this rarely entails a thorough evaluation of why the work is performed and how the procedures and operations can better support the needs of the business. The main focus of the systems analyst is on the technical interface between the company's other data bases and computer hardware. The new system must conform with systems already in place. Usually, priority is given to how the work may be done more efficiently and at reduced cost.

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Getting users to describe their work processes so that they can be mapped in a flow diagram and converted into simple routines to model on the computer is challenging. Given the time and cost constraints, it is hardly surprising that little consideration is given to fundamental changes in work design. Yet, if inefficient systems remain, major oportunities for streamlining office work are lost.

The Introduction of Incompatible Hardware, Software, and Data Bases
The disparate islands of computer hardware, software, and data bases that have sprung up in different divisions, departments, and offices is another barrier to white-collar productivity. As the number of computer applications have multiplied, individual departments, manufacturing divisions, and branch offices have independently purchased computers and software and started to develop specialized systems and data bases.

The trend toward end-user computing has eased the load on overburdened corporate ISDs but also created a new set of problems. With the advances in network computing and the need for instant information sharing, "connectivity" and "systems integration" are becoming a strategic and operational necessity. Many companies are now faced with the formidable task of linking together separate archipelagoes of information and different types of hardware into manageable networks.[19] The problem is that the decentralized computer systems are often incompatible. They cannot communicate or share information. The diversity of operating systems software used by various types of computers, the alternative versions of applications software, and the different data bases are making integration very difficult to achieve. This is a roadblock to white-collar productivity that is proving very expensive and time consuming to resolve.

Disregard for the Worker-Machine Interface in the Design of Jobs
The conflict caused by the worker-machine interface and the potential oversimplification of office jobs is of growing concern.[20] A major criticism of office computer and electronic technology is that it has ushered in labor specialization comparable to the factory assembly line work introduced in the 1920's and 1930's. Many office workers spend eight hours a day at a keyboard reading and editing the fluorescent letters on VDT screens while sitting in tight rows or cramped cubicles. Clerical positions that previously allowed considerable discretion in the way that the work was performed have sometimes been reduced to the repetition of few specialized tasks. This has led to complaints of physical and mental fatigue and has prompted the active organization of white-collar clericals into union membership.[21] These changes have redesigned the work and physical environment and altered social relationships in the office. Such factors as multiple skill requirements, a sense of identification with the work, the satisfaction of producing a completed task, feedback from the work itself, and an acceptable level of autonomy—all known to influence job satisfaction—are often ignored in the redesign of many clerical jobs.[22]

Improving The Success Of Productivity Programs
What exactly can be done to improve IT application and create successful

productivity programs? A critical first step is to reconceptualize what constitutes white-collar productivity.

Redefine White-Collar Productivity to Include Effectiveness, Efficiency, and Transformations

A growing number of information theorists and researchers are arguing for an expanded definition of white-collar productvity.[23] They contend that a new conception of productivity is needed that is compatible with the information processing systems which are supplanting manufacturing systems. A more comprehensive way to analyze different categories of white-collar work is to examine performance in terms of efficiency, effectiveness, and transformation.[24] Gains in efficiency refer to doing routine work faster and cheaper. Enhanced effectiveness involves improving the quality of existing work processes and services. Transformation is defined as fundamental innovation in how the work is done.[25]

Most white-collar jobs should not be evaluated only in terms of efficiency criteria. The quality of what is produced, the level of service, initiative, and cooperation, is often more important. If this is neglected, white-collar workers are tempted to reduce quality and service to increase output and lower costs. When emphasis is placed on improving quality, costs frequently drop automatically.[26]

This is because a great deal of white-collar work is spent redoing poor quality work. When the work is done properly initially, the costs of corrections are reduced.

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Managers and professionals do virtually everything with an eye to effectiveness—they are not evaluated by how much information they process per hour. Senior management is judged primarily for effectiveness in meeting organizational goals and for leadership (transformations) as opposed to acts of stewardship or management. Sometimes, an innovation (transformation) may greatly increase the effectiveness of the entire organization or a particular department.

What is needed is a balanced approach that gives equal consideration to concerns of effectiveness, efficiency, and innovation. The rest of this article examines white-collar performance from this perspective.

To understand white-collar work, it is helpful to look at: 1) the clarity and stability of the inputs to the work; 2) the specificity of the activities or procedures followed in doing the work; and 3) the tangibility or specificity of outputs or results.[27]

A single white-collar job with a predictable and closely related set of inputs, procedures, and outputs is relatively easy to plan, control, and measure. It is comparable to a routine manufacturing job except that it involves processing information. Repetitive clerical jobs fit this category. With these jobs, effectiveness and efficiency may be equally important. However, because of this simple repetition, computerizing these jobs may increase efficiency.

Linked information processing jobs, each with unique inputs, activities, and outputs, make coordination more difficult—especially, if the entire process takes a long time to complete.[28] Frequently, the work quality suffers when handed off to people across department boundaries. Sometimes responsibility and accountability are not defined. This often occurs with cross-functional processes or

systems with high levels of interdependence between jobs. These systems are often resistant to change because they have become routine ("We've always done it this way!"). They are difficult to observe and track because information is crossing functional lines. These jobs and work processes can be improved through process management, which is discussed later, and by using information technology.

Jobs where only one or two of the process elements (inputs, activities, and outputs) can be defined make planning and control of the work more difficult.[29] Conformance with procedures (bank teller) or sales goals (salesman) can sometimes be used to manage the work. Generally, when inputs only or outputs only can be defined, close integration of related work is difficult to achieve and may be less desirable.

When none of the three process elements can be defined in a job, it provides the biggest challenge for improvement. This is typical of professional and managerial work where discretion and judgment is necessary for selecting and enacting activities or procedures.[30]

On a micro level, a lot of managerial work consists of unpredictable inputs, activities, and outcomes. Much of the work consists of adapting and influencing others in an evolving situation. With these jobs, managers' and professionals' influence on valued outcomes is often indirect and delayed. This is true for research and development work and new product development teams. Individual contributions tend to merge with the group (peers, superiors, subordinates) and months, or even years, may pass before any tangible evidence is available on a decision or a plan of action. This has led practitioners and researchers to place less emphasis on planning and evaluating individual jobs and more on the work group, department, or product group level.[31] It has also led to using performance planning and evaluation measures like management by objectives rather than short-term analysis of inputs and outputs.

Information technology has less potential for producing systematic improvements in professional and managerial work because the work is difficult to program. Improved integration of jobs and people in different departments can be achieved by frequent communication and formal and informal information sharing. Connecting work stations and personal computers will provide greater access to information across organizational levels and functions improving individual, department, and organizational effectiveness. Also, special-use technology such as computer-aided design, may enhance the work of certain categories of professionals (e.g., engineers and scientists).

The diversity of white-collar work has often been ignored when using simplistic prescriptions for white-collar productivity improvement. A clear awareness of the different types of white-collar work is critical for developing realistic methods for managing and evaluating white-collar performance.

Exploit the Strategic Advantages of IT Over Incremental Gains in Efficiency
Executives and senior functional managers can sometimes prove their worth most dramatically by using IT to gain a major short- or long-term competitive advantage.[32] Classic examples of this generally focus on improving customer relations in the distribution channel or creating closer ties with key suppliers. IT has also been used to create tighter links between departments, plants, and offices to enhance operations.

American Hospital Supply, United Airlines, American Airlines, Citicorp, Banc One, and Merrill Lynch have all used IT to strengthen relationships with customers. American Hospital Supply was one of the first companies to put

terminals on customer premises to make reordering easier. United Airlines and American Airlines exerted greater influence over the airline booking distribution channel by placing computerized reservation systems in travel agencies. Citicorp and Banc One improved customer service and increased their market share through early adoption of automated teller machines. Merrill Lynch used IT to create a new product called the Cash Management Account which expanded its customer base and increased its fee income.

For suppliers, on-line computer links between manufacturers and vendors give both parties access to inventory information which is critical in making just-in-time inventory systems work successfully. Similarly, the use of electronic data interchange (EDI)—computer-to-computer information transfer—has allowed documents (purchase orders, invoices, etc.), engineering drawings, and specifications to be transferred in seconds. EDI can reduce paperwork, lower clerical costs, and improve coordination between suppliers and manufacturers. The Big Three United States auto makers now require EDI links as a condition of being appointed as a supplier.

Other companies have used IT to improve internal communication, connect operations, and speed up its response to rapidly changing markets. The implementation of Digital Equipment's global strategy is based on a web of 41,000 computers connecting 124,000 people in 35 countries. The network allows different functions (research and development, engineering, manufacturing, sales) to share information and make decisions worldwide in minutes and hours. Benetton, the Italian sportswear company, has dramatically reduced its new product development time and order-filling cycle by using computers to electronically link retailers, sales people, manufacturing, and warehouse personnel. It has also automated key aspects of the operations that connect them.[33]

Transformations of these external and internal link can give a company a short- or long-term competitive advantage that goes far beyond narrow, "efficiency" interpretations of white-collar productivity. These and other examples represent the potential of the technology; they are not, however, typical.[34] Because of a lack of management interest and involvement the enormous potential of the technology is not being realized. Not only is senior management missing out on strategic advantages, but the lack of careful planning is causing major coordination and integration problems.

Develop an IT Strategy and Introduce Network Standards for Organizational Connectivity

Information technology is expensive. It is also important to the strategy and operations of the business. For these reasons, top-level planning and management of the firm's information resources is vital.[35]

During the 1980s, many companies appointed CIOs (Chief Information Officers) who report directly to the CEO, and are responsibile for managing information systems and technology. Other managers (such as directors of telecommunications, managers of work processing and office managers) also have direct or indirect responsibility for communications, data processing, and electronic equipment. The continual introduction of new equipment, enhancements to existing equipment, and add-on devices with interrelated uses is making close coordination between these specialists and operating managers essential.

Its uncontrolled growth throughout many companies is causing concern as management tries to connect the different types of equipment and data bases.

Many companies are now creating strategies, policies, and standards to constrain the acquisition and widespread use of different forms of IT. Conducting an inventory of existing hardware, software, systems, and data bases reveals the extent of incompatibility and redundancy. Understanding the existing systems' shortcomings helps establish strategies and policies for defining the organization's IT needs and priorities.[36] Senior management involvement with information specialists is essential for combining business strategies with IT needs. Research suggests that the more successful management information systems have executive steering committees comprised of managers from the main functional areas, written plans describing the major systems and their interrelationships, schedule priorities for systems development, and long-term funding commitments for all major system development projects.[37]

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Strategies must also address the level of centralization or decentralization of computing and the policies that will ensure compatibility throughout the company. Traditionally, most companies provided computer-based services with a powerful mainframe from a central site. This was done to achieve economies of scale and maintain control. As more powerful, less expensive, hardware became available, decentralized computing proliferated from multiple sites. To maintain order and control, companies have established mainframe versus microcomputer directives. In firms with more consolidated, homogeneous operations and systems, mainframe computing may be strongly supported and micro computing may be actively discouraged. In companies with highly diverse operations and systems, centralized mainframe computing may make little sense and the emphasis may be placed on micros.

Clearly stated and enforced acquisition policies and IS guidelines are needed for governing the purchase and use of hardware and software.[38] Many firms have established policies or approved vendor lists limiting the type of microcomputers and software that can be acquired. In some instances, all purchases have to be approved by IS staff to ensure compatibility. These policies are the main way that management can direct and coordinate corporate computing.

Poorly organized, incomplete, and untimely information also severely affects a firm's productivity and effectiveness. Data is often stored around individual functional operations by individual application without planning for data-sharing across the organization. An overall assessment of the firm's data base is needed. Who creates, updates, accesses, and needs which data? On what computer does the data reside? Some organizations have created a data administration unit within IS to develop and administer the policies and procedures for the definition, organization, and protection of an enterprises' data resources.[39] By carefully organizing and storing business information throughout the company, data can be shared without needless duplication. By accessing a single source of corporate information, the user can determine what data is available, its precise definition, edit rules, collection dates, and other pertinent information. Eliminating duplication and improving coordination of data collection increases IT's effectiveness.

Encourage User Involvement in the Implementation of IT and Design the Work to Support Employee Performance and Comfort

There is considerable evidence to support the view that user involvement in the development of information systems and the introduction of office technology enhances both systems usage and user satisfaction with the technology.[40] When the users are not consulted or do not participate, the information systems may not meet users' needs or create the necessary psychological commitment to the system. Worker participation helps integrate the technology with existing office routines and increases acceptance and reduces anxiety over the new equipment. Research on the implementation of office technology in nearly 200 organizations found that the most successful implementations of new technology occurred when

users were involved at the earliest stages.[41] Organization members discussed hardware and software issues and user issues related to work roles and job redesign.

With many lower level white-collar jobs, gains in efficiency (producing more with less) is a priority but only if quality standards can be maintained. Changes in job design that try to improve the efficiency of white-collar work frequently have a negative effect on employee motivation and job satisfaction.[42]

The tendency to create work that is too specialized, or invent jobs that are subordinated to the mechanical properties of the equipment, can occur very easily. First National Bank of Chicago's Letter of Credit department that converted to highly specialized jobs and an assembly line operation to process its work is a good example of this.[43] As many as nine or ten people in an assembly line each contributed a different element in the preparation of a letter of credit. One person's entire job consisted of feeding tape into a Telex machine. Slow, average turnround times and poor work quality produced significant customer dissatisfaction. Employees also complained about the fragmented nature of their jobs. After this, employees were counseled for ideas on how the work quality could be improved and how the jobs could be made more satisfying. On the employees' advice, many jobs were redefined to create more individual responsibility and greater emphasis was placed on teamwork and education to teach employees about all the steps in preparing a letter of credit. Performance quality and employee job satisfaction improved as a result of these changes.

When technology radically alters job design, such as repetitive keying at a VDT or computer monitoring, attention to ergonomics, sociotechnical factors, and humane supervisory practices can alleviate some of the strain and boredom of this type of work.[44] Work station design and the office environment have been blamed for various back, neck, and eye problems.[45] Instead of expecting employees to adapt to the technology, the technology needs to be adapted to support employee performance and comfort.[46] Attention to seating, lighting, ventilation, temperature, and improved work station arrangements will reduce worker stress. Job rotation, job sharing, and rest periods will also reduce much of the tedium.

Use Process Management to Make Major Systems and Workflow Improvements

Modifying the major systems that connect the organization with customers and suppliers and link different departments and offices can increase an organization's effectiveness. These workflows need to be carefully analyzed before being computerized.[47]

Modifying the major systems that connect the organization with customers and suppliers will increase an organization's effectiveness.

All businesses depend heavily on basic operating systems for growth and survival.[48] For example, the basic operating systems in a manufacturing company may include order entry, production planning, purchasing, receiving, inventory control, shipping, invoicing, credit and collections, and handling customer returns and complaints. In addition, numerous other systems and procedures originate from marketing, finance, accounting, research and development, and so on. Administrative processes or procedures are far less understood than manufacturing processes and flows. The effects of administrative systems and procedures are difficult to measure because it involves the movement of paper, exchange of information, or the provision of internal service rather than the movement of goods and materials. Major systems do not just affect one department; they often influence many interrelated activities throughout the company. For instance, the order entry system coordinates activities in sales, inventory control, purchasing, production, accounting, and shipping.

The problem is that each department is concerned only about its own part of the work. No department or individual is usually accountable for the effectiveness of the entire system. At IBM, for example, it was discovered that many of these

systems and work processes were gradually adapted for the personal comfort and convenience of particular employees. These adaptations and alterations frequently did not benefit the whole business. This prompted a detailed study of the systems and procedures which led to the development of a methodology called process management described in Exhibit 1.

IBM has used process management to improve the quality of internal and external customer service throughout the company.[50] For example, IBM's billing process consisted of 14 major cross functional activities physically dispersed among 255 marketing branches and 25 regional offices, a similar number of field locations, and several headquarter operations and manufacturing sites. The work was connected by a complex information system. Overall, 96 percent of the invoices were accurate the first time, but because the cost of adjusting them was so high, 54 percent of this system's total budget was spent correcting or preventing errors. By applying process management techniques, much of the system was consolidated in fewer locations, information reporting was simplified, and the cost of quality (error correction, reduction, and prevention) was greatly reduced. This example highlights the need to design a system that prevents errors in the first place rather than fixing the problems at great expense later. It also supports the need to apply process management before installing expensive IT or risk spending still more money to rearrange or retrofit it.

IBM also applied process management to its National Service Division. This division is responsible for providing service and support to IBM's external customer systems. After analyzing the activities of the service department for its effect on customers, it was found that customers were perceiving and defining service quality differently than the Service Division. Critical success factors were rewritten from the customer's view point. These included service dispatch response time, total time from incident to fix, hardware repair time, software support, the preventative maintenance program availability of trained field engineers, spare parts availability, telephone diagnostic capability, and technical back up. Process management applied to each of these activities greatly improved customer service and, concurrently reduced the cost of these operations. For instance, improved dispatching methods, reorganization and assignment of service calls, and increased spare parts testing saved both time and money. Information technology was also used to enhance operations. For instance, automated reporting provided

PROCESS MANAGEMENT

OBJECTIVE: To create a flowchart of all the activities that link "internal suppliers and customers" (employees) in a major work process or procedure

CRITICAL ACTIVITIES

- **Appoint an owner of each system who is responsible for its overall effectiveness**
- **Evaluate the impact of the system on the business**
- **Solicit the input of managers and employees in affected departments**
- **Breakout each activity by related inputs, activities, and outputs to get a complete picture of the entire system**
  - **—Inputs: information and documentation provided by internal suppliers**
  - **—Activities: actions taken by internal customers at each stage**
  - **—Outputs: results of the action which is passed on to the next internal customer**
- **Define relationship expectations at each supplier-customer interface, especially when crossing departments**
- **Develop improvements in each supplier-customer linkage to enhance the effectiveness and efficiency of the entire system**

Exhibit 1. Adapted from IBM's Process Management Methodology.

real-time feedback on customer problems and improved service data analysis helped reduce the sources of service difficulties. The result was a substantial improvement in the percentage of error-free calls taken each day. On average, it was found that error-free calls take only half the parts and one third of the time to complete.

The blind application of new office technology will not solve business problems unless top management evaluates the major uses of the technology and helps develop an information technology strategy for increasing the effectiveness of the entire business.

Other companies have combined process management and IT to improve major operating systems using similar methods. For example, Ford recently revised its system for paying suppliers.[51] A cross-functional task force was brought together from manufacturing, finance, purchasing, and data processing to identify needed changes in the system. Applying Ford's process management methodology, the task force came up with a new process that combined advances in IT with streamlined procedures. This significantly increased processing capability, improved timing, and reduced systems errors. With the new system, 375 jobs will be eliminated by the early 1990s through attrition and transfers.

Intel Corporation introduced a similar approach during the early '80s when its white collar, non-production workers rose to 64 percent of the total labor force.[52] It was able to increase office worker productivity 30 percent by meticulously detailing, redesigning, and simplifying administrative procedures across departments. AT&T has also successfully used this approach.[53] Some of the most significant improvements occur when managers from different departments recognize gaps, overlaps, or unproductive practices across functional areas and change major operating systems, processes, and workflows within and between departments.

Conclusion

In recent years, a lot of effort has gone into improving manufacturing operations and inventory control systems. Far less consideration has been given to ways of improving system support of white-collar, service, and administrative work. The blind application of new office technology will not solve business problems unless top management evaluates the major uses of the technology and helps develop an information technology strategy for increasing the effectiveness of the entire business. As information technology becomes more deeply embedded in all areas of operations, top management must give it personal attention.

Of equal importance is a viable interpretation of the term "white-collar productivity." For many white-collar workers, productivity is a dirty word. It conveys an impression of squeezing out more volume and lowering costs through ever tightening control over existing operations, jobs, and people. With most white-collar jobs, there should be more emphasis on improving the quality of work and encouraging employees to serve their internal and external customers more effectively. With this emphasis, volume frequently picks up and costs tend to go down.

Some of the best opportunities for improving performance involve transforming or streamlining business systems—the main highways or infrastructure of the firm and the foundation on which daily business transactions depend. Here, the process analysis that precedes system computerization can often be more valuable than the actual computer application because it clarifies and coordinates work processes that previously were only dimly understood. No matter how advanced the technology is, it will not make up for poorly structured and organized systems.

Endnotes

[1] See E.A. Finn, "White-Collar Bloat," *Forbes*, October 17, 1988, 34-35. In this paper, "white-collar" work refers to jobs not directly engaged in manufacturing. In other words, the indirect labor that surrounds the manufacturing core (e.g., purchasing, production planning, and control), and all other clerical, professional, and managerial jobs in other

functional areas that are not generally figured into manufacturing productivity which includes only material, labor, and equipment costs directly consumed in manufacturing. White-collar support jobs have been growing rapidly while direct labor has been shrinking due to gains in manufacturing productivity. Most white-collar, clerical, administrative, professional, and managerial jobs are found in offices and hence the term office work is used to distinguish it from work directly engaged in manufacturing.

[2] See R.H. Hayes and S.C. Wheelwright, *Restoring Our Competitive Edge: Competing Through Manufacturing*, (New York: Wiley, 1984); W. Skinner, *Manufacturing: The Formidable Competitive Weapon*, (New York, Wiley, 1985).

[3] For a discussion of this, see W. Bowen, "The Puny Payoff From Office Computers," *Fortune*, May 26, 1986, 20-24; C.L. Harris, J.B. Levine, J.B. Treece, F. Seghers, J. Brott, and R. Mitchell, "Office Automation: Making It Pay Off," *Business Week*, October 12, 1987, 134-138, 142, 146; J.E. Izzo, *The Embattled Fortress: Strategies for Restoring Information Systems Productivity*, (San Francisco: Jossey-Bass, 1987).

[4] See K.F. Curley, "Are There Any Real Benefits From Office Automation?" *Business Horizons*, July-August 1984, 37-42; R.L. Klein, "Does Automation Necessarily Mean An Increase In Productivity," *Journal of Systems Management*, May 1985, 32-34.

[5] *White House Conference on Productivity, Report of the Preparatory Conference on Private Sector Initiatives*, (Washington, D.C.: GPO, 1983), 11-16.

[6] See R.E. Kopelman, *Managing Productivity in Organizations*, (New York: McGraw-Hill, 1986).

[7] For a good discussion of these issues, see J.M. Fredrickson, *Cost Reduction in the Office*, (New York: AMACOM, 1984), 1-12.

[8] P.F. Drucker, "How To Measure White-Collar Productivity," *Wall Street Journal*, November 26, 1985, 17.

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[11] See Izzo, Endnote 3.

[12] For a fuller discussion of these issues, see H.C. Lucas, "Organization Power And The Information Services Department," *Communications of the ACM*, 27, 1, 1984, 58-65; H.C. Lucas, *Managing Information Services*, (New York: Macmillan, 1989).

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[14] M.S. Gerstein, *The Technology Connection: Strategy And Change in the Information Age*, (Reading, Mass: Addison-Wesley, 1987).

[15] J. Rothfeder, "It's Late, Costly, Incompetent—But Try Firing a Computer System," *Business Week*, November 7, 1988, 164-165.

[16] J. Rothfeder, "Using The Law To Rein-In Runaways," *Business Week*, April 3, 1989, 70, 73, 76.

[17] See R.G. Ernst, "Why Automating Isn't Enough," *Journal of Business Strategy*, May/June 1989, 38-42.

[18] See J.D. Martin, *Strategic Data Planning Methodologies*, (Englewood Cliffs, NJ: Prentice Hall, 1982); M.L. Markus, *Systems in Organizations*, (Boston: Pitman, 1984).

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[21] See M.A. Pollock, "Pink-Collar Workers: The Next Rank And File," *Business Week*, February 24, 1986, 116, 118.

[22] See J.R. Hackman and G.R. Oldham, *Work Redesign*, (Reading, Mass: Addison-Wesley, 1980).

[23] See Strassman, Endnote 9; N.E. Meyer and M.E. Boone, *The Information Edge*, (New York: McGraw-Hill, 1987); T.C. Tuttle and J.J. Romanowski, "Assessing Performance and Productivity in White-Collar Organizations," *National Productivity Review*, Summer 1985, 211-224; R.G. Schroeder, J.C. Anderson, and G.D. Scudder, "White-Collar Productivity Measurement," *Management Decision*, 24, 5, 1986, 37; J.H. Boyett and H.P. Conn, "Developing White-Collar Performance Measures," *National Productivity Review*, Summer 1988, 209-218.

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[27] Adapted from Werther et al., Endnote 9.

[28] For a good discussion of ways of analyzing these systems, see J.M. Juran, Endnote 25.

[29] See Werther et al., Endnote 9.

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[40] See J.J. Baroudi, M.H. Olson, and B. Ives, "An Empirical Study Of The Impact of User Involvement on System Usage and Information Satisfaction," *Communications of the ACM*, 29, 3, 1986, 232-238; C.D. Franz and D. Robey, "Organizational Context, User Involvement, And The Usefulness Of Information Systems," *Decision Sciences*, 17, 1986, 329-355; D. Leonard-Barton and W.A. Kraus, "Implementing New Technology," *Harvard Business Review*, November-October 1985, 102-110.

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