The evolution of information systems: their impact on organizations and structures

Ananda Mukherji
Department of Management and Marketing, Texas A&M International University, Laredo, Texas, USA

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Abstract
Information systems and organization structures have been highly interconnected with each other. Over the years, information systems architectures as well as organization structures have evolved from centralized to more decentralized forms. This research looks at the evolution of both information systems and organization structures. In the process, it looks into the impact of computers on organizations, and examines the ways organization structures have changed, in association with changes in information system architectures. It also suggests logical linkages between information system architectures and their "fit" with certain organization structures and strategies. It concludes with some implications for emerging and future organizational forms, and provides a quick review of the effect of the Internet on small businesses traditionally using stand-alone computers.

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Introduction

This article looks at ways in which computerized information systems have impacted modern business organizations. While the influence of these systems on organizations in general has been both powerful and wide ranging, this article focuses primarily on how organization structures have specifically been impacted. To properly frame the various issues that are addressed, this article briefly traces early computers, and mentions their development by generations. Over the decades, both computer systems and organization structures have moved from a centralized to a decentralized design. This movement has had major implications in what organizations are capable of doing in the face of a turbulent environment by adopting organic and network like structures. These organizational metamorphoses have been possible, in large part, by the support provided by information technology that allowed autonomy and distribution of responsibility. A review of information system architecture and organizational form is made to underscore a natural compatibility or fit between information systems and organization structures. In conclusion, attention is drawn to the ways information systems are likely to create organizational interfaces between an organization's suppliers and customers, and how this may result in radically new structures.

Early developments

Modern computers, as we understand them, were essentially designed and developed in the USA around half a century ago. While punched card based unit record machines (URMs) were widely used for limited business data processing in the 1930s, the world's first fully automatic computer is considered to be the MARK I which was set in operation in 1944 (Whisler, 1970a). This was followed by the ENIAC (1946), short for Electronic Numerical Integrator and Calculator, the EDSAC (1949), the Electronic Delayed Storage Automatic Computer, and by the EDVAC (1952), the Electronic Discrete Variable Automatic Computer (Kanter, 1982; Lynch and Rice, 1975; Whisler, 1970a). All these machines had been designed and built for military, scientific, or mathematical purposes. Von Neumann, an early pioneer, who developed the concept of the stored program, was convinced that computers could solve many important unsolved problems in applied mathematics (Ulam, 1980; Whisler, 1970a).

Some time during the 1950s, the potential of computers in the realm of business was recognized, and a powerful impetus was now given to marry technology with commerce. The first commercial computer, a UNIVAC 1, manufactured by Rand Corporation, was delivered to the US Bureau of the Census in 1951, while the first non-government installation, also a UNIVAC 1, was installed at General Electric's appliance plant in Louisville, Kentucky (Kanter, 1982). According to Lynch and Rice (1975), the period from 1956 to 1958 saw three significant developments in computing. These were:

1 breakthroughs in increased core memories;
2 development of more standardized and higher level languages; and
3 the development of a system for operating a computer or the operating system (OS).

Computers in business

Computer development by generations

The field of computers developed by what is now recognized as generations, starting with the first generation half a century ago onto

the end of the fourth generation today. The concept of generations is both artificial and arbitrary, but is a useful framework for understanding developments in this field. Commonly, generations are associated with levels of computer technology and processing speeds. The first generation computers, up to the mid-1950s, were associated with valves and electric relays. The second generation computers, developed in the late 1950s, used transistors instead of vacuum tubes. They occupied far less space than their predecessors, were faster in operation, required less maintenance, and were more reliable.

Third generation computers of the 1960s and early 1970s were characterized by large scale integration (LSI) of integrated circuits. Introduced with the third generation machines was the concept of the family of computers, and users could move upward – adding computing power, storage capacity, and peripheral capability – without costly conversions (Kanter, 1982). Each generation was characterized by a marked improvement in performance, capability, and a fall in prices. Fourth generation computers, from the early 1970s, were characterized by very large scale integration (VLSI), and the use of semiconductor memory and sophisticated software. Computers of this generation, apart from high speed and massive computing power, were characterized by the use of microprocessors, virtual memory, and highly developed communication and database facilities. They not only became powerful and fascinating, but their usage in business generally accelerated the possibilities and potentialities of growth.

Computer installations in business

The combination of increased computing power, powerful software, and continuously falling hardware prices became a very attractive proposition for business organizations, and from the mid-1960s onwards installations in businesses increased rapidly. From an installed base of ten computers in 1950 valued at $0.01 billion, a total of 138,000 computers valued at $53.0 billion were installed by 1980 (Kanter, 1982).

The transformation of the US economy took place in the 1950s when the information age overtook the industrial age. Sprague and McNurlin (1993, p. 2) mention, "It was in 1957 that the USA passed from the industrial era to the information era. In that year, the number of employees in the country whose jobs were primarily handling information surpassed the number of industrial workers". This was important not only in the service or information industry, but also the in the manufacturing industry owing to the dramatic effect of computers and information. Computers have been used to systematize and solve problems in diverse areas of business including planning, R&D, engineering, marketing, procurement, production, storage, distribution, operations and service, and management (Engel, 1969). Very simply, computers allowed the development of planning techniques hitherto too complex to develop, compute, or control. These included the development of systems planning like PERT/CPM models, planned program budgeting, and simulations (Gotlieb and Borodin, 1973), as well as developments in areas like production, automation, and other planning and control systems (Kanter, 1982). Other contributions of computers were in the areas of high volume and repetitive computations, measures for operations control, and as an information and decision tool (Lynch and Rice, 1975). There is no doubt that the contributions of computers are numerous and well-known, and US industry has, on the whole, been radically and beneficially affected by these contributions (Engel, 1969).

Growth of information systems and business organizations

Over the last three decades, computer-based information systems and business organizations developed in unique and special ways. As far as computers are concerned, the manner of hardware and software development resulted in unique architectures evolving over time. At the same time organization structures developed special forms to suit and fit their specific environmental and strategic requirements.

Development of information systems

Computer based information systems are categorized by their architecture or topology (Burch, 1985), which are a set of interconnections or nodes in a network. Categorizing information systems architecturally is appealing since it is not idiosyncratic to particular settings, and further, these architectures are fairly well established and accepted (Leifer, 1988). This section briefly discusses the four main types of information systems architectures or typologies consisting of centralized, distributed, decentralized, and stand-alone systems.

The combination of hardware, software, data, and communication formed the core of information systems. As each of these dimensions developed and integrated, the

concept, design, and capability of information systems underwent massive changes. The earliest systems were the classic centralized systems typically characterized by a mainframe host computer supported by an array of peripherals, including "dumb" terminals, which allowed interactive, information processing activities mostly of a transactional nature (Leifer, 1988). These centralized systems were modest in size in the earlier generation computers, but grew from small, medium to large centralized mainframe systems over time. This was the trend up to the 1970s, and for the first 20 years discussions on data and systems were about techniques to manage data in a centralized environment (Sprague and McNurlin, 1993).

In the early 1960s, the main concern among hardware manufacturers and data processing managers was achieving machine efficiency. With increasing demands and sophistication of users of information, and with the availability of powerful personal computers (PCS), data processing activities became more distributed. This gradual shift from information availability in report form to information becoming available on demand, and forming a part of a decision support system (DSS), accelerated the trend from centralized to distributed systems, consisting of clusters of minicomputers networked through LANs, or local area networks at the intra-organizational level, and the later WANs or wide area networks at the inter-organizational level. The growth and importance of minicomputers, so fundamental to this trend, can be gauged from Table I.

Distributed systems are defined as "peer-to-host systems" (Durr, 1987), and are designed as "spokes" or terminals around a central processor or mainframe. Spokes might have their own processor, storage device, and terminals that have their own computing facilities and databases (Leifer, 1988). Distributed systems are now giving way to decentralized information systems, and the role of the user is becoming paramount. This trend is continuing through the 1990s. Decentralized systems are referred to as "peer networks" (Durr, 1987) and have no central processor through which communications must pass, and hence there are more degrees of freedom in communication, and communication constraints are substantially less than for distributed systems.

Table I
Minicomputers installed 1970-1980; purchase price $ billions

Year	Number	Value
1970	31,000	1.9
1975	202,000	6.0
1980	840,000	19.3

Source: Kanter (1982)

A fourth kind, though less common, are stand-alone systems, typically PCS, used in individual departments or as information systems in small organizations (Leifer, 1988). Because of their limited capabilities and low cost, most large organizations do not plan for them (LaPlante, 1987), and their effect is on the work of individuals rather than on the organization as a whole (Lee, 1986).

Changes in organization structures

Businesses in the USA have changed in many different ways during the course of this century. The earlier trends were essentially the development of single businesses that preferred to retain overall control through vertical integration, and Chandler (1990) has observed that US organizations have invariably stressed the ascendancy and development of functional areas. In the 1960s, there were a spate of acquisitions and mergers primarily as a response to anti-trust laws (Schleifer and Vishny, 1991). Companies went into unrelated businesses and formed huge conglomerates. In the 1980s, this trend changed through a process of readjustment, disinvestment, and restructuring, and the degree of unrelatedness was reduced somewhat, and large diversified businesses were formed. Many structural changes have taken place during the last 30 to 40 years, and the direction of these changes has been to move from centralized to decentralized organizations through various stages. These stages started with the earlier centralized single business organizations which were vertically integrated, and then moved onto the divisionalized structures used at Du Pont, and later at General Motors.

This basically was a movement away from functional control to divisionalized control. This was typical of the M-form of organizations where a division would be given complete autonomy and each division would have its functional areas under its control. The head or corporate office would have an essentially coordinating role, and each division would function with its divisional level corporate setup. These changes took place in order to handle changes more appropriately in the environment, and to have more effective responses to competition. Organizations found that a decentralized setup was in many cases better suited to cope with an

environment marked with rapid changes. Perhaps the one key reason decentralization could meaningfully take place is by the support provided by information systems that allowed decentralized communication and control.

Decentralization has moved further, and later structures have been in the form of matrix, hybrid (Daft, 2001), and network (Miles and Snow, 1986; Snow *et al.*, 1992) organizations. Each of these structures have been found to be a more appropriate response to cope with increasing turbulence in the external environment. In modern business organizations, effectively handling a complex and turbulent environment has been the fundamental problem that top management and organizational administrators must cope with (Milliken, 1987; Thompson, 1967). Again, new structures to cope with new environmental realities have been possible in large part due the possibilities of information and control provided by computers.

An important view of evolving organizations has been the five typology structure provided by Mintzberg (1979, 1981, 1983), and similar typologies have also been suggested by Daft (2001). These typologies are based in part on organizational life cycle, type of business, and the competitive environment. The five part typology of organization structures consists of the following:

1 *Simple structures.* These are characteristic of both young, start-up, entrepreneurial organizations as well as well entrenched autocracies. They are usually small, operating in a market niche within a dynamic environment with few rules.
2 *Machine bureaucracies.* These are characterized by standardization, functional structural design, and large size. These structures are generally differentiated both horizontally and vertically, and are normally associated with standardized, routine, mass production technologies in a stable environment.
3 *Professional bureaucracies.* These rely on standardization of skills as a basis for coordination, and have a high informational component. These organizations are decentralized down to the level of those professionals responsible for carrying out the organizations' tasks.
4 *Divisionalized forms.* These are integrated sets of semi-autonomous entities loosely joined by an administrative framework. The semi-autonomous entities, often referred to as strategic business units (SBUs), determine the strategic portfolio of the organization. They may be decentralized from the perspective of the total organization, but can be centralized from within the division, or may exist in any other combination.
5 *Adhocracy.* These can be construed as divisionalized forms, held together by a strong culture. These are usually small and have the characteristics of a young organization (without necessarily being young). Mutual coordination and cooperation are critical which cause these organizations to behave like project teams. They are essentially highly organic with little formalization.

Integrating computer architectures and organization structures

It is interesting to note, based on the earlier discussion on computer systems and organizations, that evolving computer architectures and changing organization structures bore a similarity of form, in that both evolved from a centralized to a decentralized design. This shift in both cases can be understood as a distribution of power from one central node to a number of decentralized sources because of the many advantages that accrued from such a shift. In both computers and in organizations, such a shift was characterized by a significant reduction in formality, or in computer terms, a reduction in "protocol."

In the computer or information system environment, such a shift from a centralized controller or "authority" had many implications. From a relatively rigid system of a single central processor servicing requirements of peripheral units, and handling requests on a rigid set of heuristic or algorithms, distributed systems distribute both data and processing to multiple machines and results are exchanged (Leifer, 1988). While both centralized and distributed systems required varying degrees of central control and authority, distributed systems had far higher levels of communication and task accomplishment at relatively lower levels. With decentralized systems, there is no central controller, and both communication and task responsibilities have been devolved to independently be able to communicate and share resources with relatively high degrees of freedom. Although terminals or other systems communicate through bridges or gateways and require rules for connectivity, these constraints are substantially less than for distributed systems, and this flexibility gives decentralized systems the capability to cope with a wide variety of information

requirements (Leifer, 1988). In other words, the power of decentralized systems is maximum when protocol or rules are at a minimum. Electronic mail, local area networks, telecommunication systems, group decision-making systems, etc., allow messages to be sent through the network in an interactive mode which results in an increase in the quality, quantity, reliability, and capability of the system to process information (Leifer and Triscari, 1987).

Organizations, in the last half century, have undergone extensive structural changes, in large part due to changes in the operating environment, and also due to advances in management and organization theory. To be highly efficient through a machine bureaucracy like structure was the requirement of an earlier age. Such a structure is still viable in an environment characterized by stability and reduced complexity. Such structures are relatively uncommon today as business organizations have moved from the criteria of efficiency to that of effectiveness, and such moves have seen machine bureaucracies evolving into more organic structures.

Many scholars, including Mintzberg (1983) and Daft (2001), have highlighted that different types of structures are more appropriate for different types of environments. Effectiveness was provided better by divisionalized organizations operating in hybrid or matrix like structures, as is common today, compared to the earlier centralized structures. According to Snow *et al.* (1992), today's competitive pressures demand both efficiency and effectiveness, and firms must adapt with increasing speed to market pressures and competitors' innovations, while simultaneously controlling or even lowering product or service costs. Under these conditions, they suggest that by using a network structure, a firm can operate an ongoing business both efficiently and innovatively, focusing on those things that it does well and contracting with other firms for the remaining resources.

It is quite clear from the above discussion that the move from centralized to decentralized information architectures, coupled with a similar move in organization structures, should be associated with each other because of the way both have such close similarities in their evolution. It must be remembered that both computers and organizations evolved and changed form for different reasons. Computers architectures evolved, at least in the earlier era, due to the pressure and impact of communication technology, while organization structures evolved as they were impacted by a multitude of forces, including the environment, competition, and technology. How is it possible to evaluate and separate this relationship, between computers and organizations, into cause and effect? This is hard to do except to understand that evolving computer architectures impacted and enabled newer organizational forms, and over time changing organizational requirements impacted the shape and design of computer systems and architectures.

Our discussion so far has been to examine the evolution of computer architectures and organization structures separately. In the following sections we combine the separate evolutions and discuss the impact of the relationship between computers and organizations in two ways. First we discuss the impact of computers on organizations in the last few decades. This is then followed by analyzing, based on some conceptual and empirical studies, whether certain computer architectures are associated with certain types of organization structures.

The impact of computers on organizations

One of the earliest and more well known studies of the impact of computers on organizations was undertaken by Whisler (1970b) in the late 1960s. In a study of 23 large insurance firms, the study revealed a number of interesting effects, some contrary to what were expected from computer-based information systems. Perhaps the kind of results highlighted in the study (Table II) were due to the earlier stress on data processing as opposed to the later emphasis of using computers primarily as communication and decision support systems.

The study indicated a decline in the number of levels in the organization structure, greater consolidation and rigidity in decision making, increased centralization of authority, and routinization in the content of lower level jobs. The impact of computers created shifts in power that were not anticipated before. In the initial stages of its introduction, the power of information was in the hands of the departments in which computers were installed, which was typically the accounting department. "Information is power" has become a maxim, and with it the realization that power devolves upon those who gather, process, disseminate, or simply possess information (Gotlieb and Borodin, 1973). According to them, the increasing value of information as a commodity brings with it the potential to change the bases of power and create new ones. Over the years, the availability of decentralized information systems allowed

Table II
Early impact of computers on organizations

Organization structure	Decision making	Authority and control	Job content
Decline in clerks and supervisors	Consolidation of separate decision systems	Centralization of control	Routinization at lower levels and broadening at upper levels
Increase in upper-level managers	Upward shift in decision making	Increase in machine control	Decline in interpersonal communication after computers
Decline in number of levels	Rational and quantified decision making	Control over individual behavior	Increase in communication during system development
Consolidation of departments	Rigidity and inflexibility in decision making	Blurring of traditional lines of authority and control	Decline of skill levels at lower and middle levels Increase in skill levels at upper levels

organizations to go ahead and attempt to decentralize their structures to more effectively cope with their environments. Organic structures such as hybrid, matrix, and network organizations were possible in large part because of distributed and decentralized decision-making powers made possible from new information architectures.

Mintzberg, (1983) has provided extremely compelling illustrations of how inadequacies in the machine bureaucracy structure led to formations of more effective structures, and how management information system (MIS) capabilities were used to form new structures. He mentioned that as the environment remained stable, the machine bureaucracy had no great difficulty in adaptation. As environments changed, generating new non-routine problems, managers at the strategic apex quickly became overloaded due to the high degree of centralization inherent in such structures. One of the ways to overcome these information bottlenecks was to restructure, distribute authority, and decentralize management. A combination of environmental turbulence associated with information systems' capabilities provided a strong impetus and capability for organization structures to constantly reshape.

Phases of computerization in organizations

In many organizations, computers were initially introduced as a part or a section in the accounting department, usually under the title of electronic data processing (EDP), and, for administrative purposes, was also under the control of the accounting department. At this stage, computers were generally centralized systems consisting of low capacity mainframes. As the need, usage, and capabilities of data processing increased, the data processing section in the accounting department became an independent department of its own, usually called the EDP and later the management information system (MIS) department. This department then serviced various departments in the entire organization, and became an information hub. This stage is still characterized by centralized computer systems, but they were generally high capacity mainframes that could take on the increased load. The current state of development in organizations is indicative of a situation where every department is networked into an information and communication system supported by the MIS/IS department. This is the stage of distributed and decentralized systems that are typical of a network environment. The three stages in the evolution of information systems are given in Figure 1.

The network environment presented in Figure 1 is suggestive of an information system that primarily operates as a decision support system (DSS). Here, users or user departments drive the system, communicate with each other, share resources including databases, take greater responsibility for the data and the supporting information system, and use the MIS/IS department mainly for technical and software support. According to Wiseman (1985), over the years information system technologies have evolved from MIS, to DSS, to strategic information systems (SIS), and now serve the purpose of combining with organization structures to serve as competitive weapons.

Another view of the growth, evolution, and impact of computers on organizations is given by Gibson and Nolan (1974). These researchers have provided an excellent four stage framework (Table III), covering the evolution and growth of EDP departments as computers were introduced into the organization.

These four stages were:

1 initiation;

2 expansion;
3 formalization; and
4 maturity.

At each stage they have looked at three specific dimensions, namely, growth of applications, growth of specialized personnel, and management techniques applied.

Initiation

Computers were introduced into the organization with a view to essentially save costs, and computers were looked upon as labor saving devices with great internal utility. Typical applications where organizations realized considerable initial savings were payroll, accounts receivable, accounts payable, and customer billing. Personnel requirements at this stage were oriented to efficient utilization of computers, and the emphasis was on selecting operators, programmers, and analysts. Management within the EDP section was typically lax as the environment was one of system development and getting software projects on stream.

Expansion

This phase was characterized by a profusion of applications which typically dealt with cash flow, general ledger, budgeting, capital budgeting, forecasting, personnel inventory, order processing, sales, and inventory control. As can be seen from the type of applications, the emphasis was on greater sophistication and in creating specific competencies, and computers had considerable capabilities in improving customer and supplier relationships. In terms of personnel, the emphasis was on systems programmers, scientific and business applications programmers, and systems analysts. The department became large in size, and the thrust was to "sell" computer services within the company.

Formalization

Here the applications developed emphasized "control" specifically in the areas of purchasing, production planning, scheduling, and cost control systems. Here the personnel emphasis was on maintenance programmers, and to have functional software specialists (like finance, marketing, and manufacturing). The emphasis in management was control oriented within the department.

Maturity

Along with consolidation of resources, the applications became more sophisticated both in terms of software complexity, and in providing strategic information support to the organization. Applications typically included simulation and planning models, on-line query systems, and complex data base management systems. Networking and teleprocessing at this stage became increasingly more popular. The department was managed as a resource, and its importance was at a total organization level.

Figure 1
Three-part evolution of early information systems

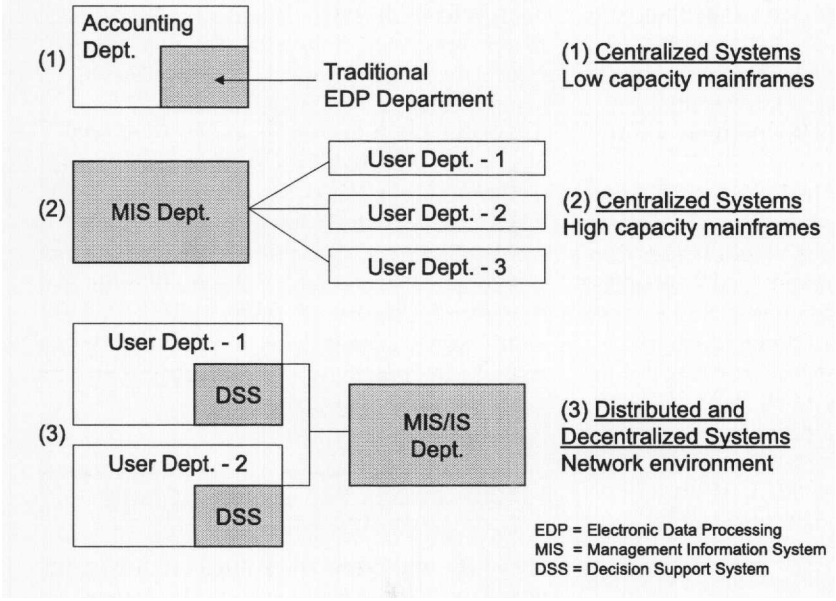


Table III
Four-stage growth of companies in organizations

	Initiation	Expansion	Formalization	Maturity
Applications	Cost reduction	Proliferation of applications	Emphasis on control	Database applications
Growth of personnel	Specialization for computer efficiency	Specialization to develop variety of programs	Specialization for control and effectiveness assurance	Specialization for database technology and tele-processing
Management techniques applied	Lax management	Sales oriented management	Control-oriented management	Resource-oriented planning and control

Source: Gibson and Nolan (1974)

Linkages between computers and organization structures

While organizations evolve to adapt to their environments, the purpose behind such evolutions and transformation is essentially a question of strategy, that is to do with the organization's adaptation, survival, growth, and improved performance. Organization structures, therefore, serve a function which essentially suggests that an organization can function best when it assumes certain forms. The objective of this article is two-fold: one is to examine the evolution of information systems and organization structures, and the other is to assess the relationship between certain computer system architectures and how they support particular organizational structures and forms. Based on the operating environment and competitive strategy, organizations can take certain structural forms as suggested by Mintzberg (1979, 1981, 1983), or certain strategic forms or orientations as suggested by Miles and Snow (1978), or by Porter (1985). While the Mintzberg typologies have been discussed, the Miles and Snow, and Porter organizational strategies basically suggest a proactive "prospector" or "differentiation" strategy versus a less proactive "defender" or "cost leadership" strategy. Miles and Snow (1978) also have an intermediate "analyzer" strategy. Each of these various strategic typologies or strategy types require certain organizational forms.

In a conceptual study by Leifer (1988), there were certain ideal matches between the four information architectures discussed earlier and the Mintzberg typologies. Leifer suggests that certain organization structures are more compatible with certain information architectures. A mismatch, according to him, would result in inferior performance, unless a change was effected onto either the architecture or the structure, or both.

It will be noticed from Table IV that bureaucracies are matched with centralized systems, while professional bureaucracies use both centralized and distributed systems. This is because such organizations need access to mainframe processing capabilities, as well as local processing linked to specialized databases. Divisionalized organizations use centralized, distributed, and decentralized systems because divisionalized structures may take many forms. Some may be loosely coupled, while others may be tightly coupled. The coupling may be by way of formal controls, or through a strong culture. The division may have a centralized or decentralized relationship with its corporate office, and the structure within the division may be centralized or decentralized. Divisions, therefore, depending on the way they are organized, will have unique and different types of information architectures. Adhocracies, on the other hand, are linked with decentralized systems as these are small autonomous structures that are highly organic and behave like project teams.

In an empirical study by Tavakolian (1989), 52 firms were analyzed to verify their strategy-structure relationship with a particular type of information system architecture. It is well accepted that proactive firms are more decentralized and autonomous in their organization structures compared to reactive or less proactive firms. It was presumed that proactive firms following "prospector" (or differentiation) strategies would be characterized by more decentralized information technology (IT) structures compared to "defender" (or cost-leadership) organizations. "Analyzer" organizations would have centralization levels of IT structures somewhere in between these two. The findings of the study indicated that the three strategy types differ significantly in the degree of centralization of their IT or information architectures, in line with the basic hypotheses.

Table IV
Linkage between organization structure and information architecture

Types of organization structure	Type of information architecture
Simple structure	Stand-alone PCs
Machine bureaucracy	Centralized systems
Professional bureaucracy	Centralized and distributed systems
Divisionalized form	Centalized, distributed and decentralized systems
Adhocracy	Decentralized systems

Source: Leifer (1988)

Implications for emerging and future organizations

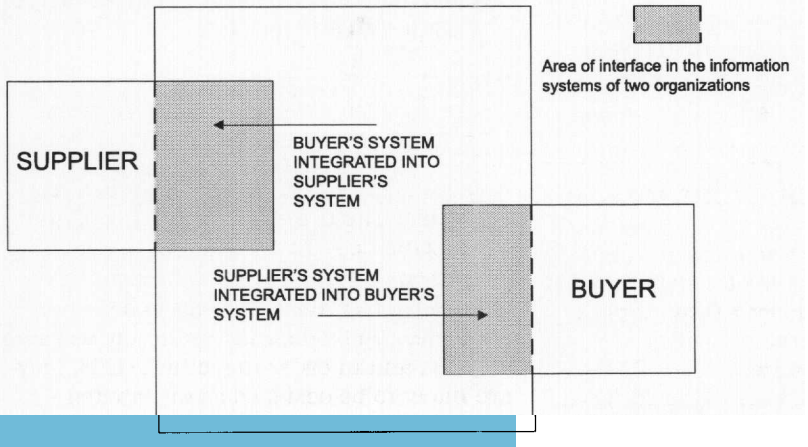
What are emerging and future organizations going to be like? And, what is the role of information systems in shaping future organizations? Many scholars have suggested that environmental factors, managerial attitudes, workforce sophistication, and numerous other factors are likely to affect the form, structure, and functioning of future organizations. According to Galbraith and Lawler (1993), emerging and future organizations are more likely to be characterized by decentralization of decision making, and in order to facilitate this, they are likely to be designed as distributed organizations. The newer structures are

likely to have extremely close links, especially through computer based information systems, with their suppliers and customers. Enhanced coordination is likely to result, as is happening with electronic data interchange (EDI) being increasingly used to integrate the operations of two or more organizations that do business with each other (see Figure 2). Network organizations with their internal and external networks, high performance work teams, flexible work groups, centrality of customers, close coordination with suppliers and contractors, and the ability to respond quickly to changes are perhaps the shape of organizations of the future.

Network structures would be an appropriate response to cope with these complex and dynamic forces facing organizations that include globalization (Bartlett and Ghoshal, 1989; Ohmae, 1990), heightened turbulence and demographic changes (Toffler, 1980; McDermott, 1985; Morris, 1992; Thomas, 1990), and extra-economic goals (Etzioni, 1988; Keeley, 1988; Meyer and Gustafson, 1988). Giving support to the shape of things to come, Gerstein and Shaw (1992) have suggested that due to the forces of technology, competition, oversupply, globalism, customer expectations, government participation, and ownership and workforce dynamics, organizations are being forced to reshape themselves to survive and prosper.

One characteristic of network organizations is the quasi-integration of information systems with both suppliers as well as customers. Such integration is possible because of technology and the environmental dynamics organizations face. What are the implications of such structures that are created from the integration of information systems? One outcome is that organizational boundaries become extremely fuzzy, and become less relevant. Customers can and do directly interface with their producer's manufacturing systems to initiate production, specify production specifications, and change other parameters. Manufacturers, too, can and do interface directly with supplier systems to procure material without actually setting up a formal purchase order. The new structural possibilities bypass traditional transactions, and create levels of interactions and dynamism that organizations may find difficult to cope with. The relationship between organization structures and information systems has a potential that is not very well understood, and a power to create more change than can be currently comprehended.

Figure 2
Areas of interface among emerging organizations



The Internet, stand-alone computers and small businesses

With the advent of the Internet, the greatest impact has been on the role and operations of small businesses. Traditionally, small businesses with simple structures (Mintzberg, 1983) used stand-alone computers. Small businesses were constrained to using relatively simple off-the-shelf software packages that provided standardized solutions for typical business problems. Prior to the Internet, small businesses were neither networked nor were they capable of interorganizational communications using computers. However, the Internet has changed all that and has created completely new dynamics in the way small businesses can leverage the World Wide Web to overcome the disadvantage of size and accessibility.

A recent study indicated that consumers and businesses equipped with personal computers (PCS) and Internet access were poised to bypass paper transactions in favor of electronic information exchange (Friel, 1999). Studies have indicated that 60-67 per cent of small businesses were equipped with a computer and modem, were using online banking functions, and had their own Web pages (*Security Distribution and Marketing*, 1998; Friel, 1999). Another survey revealed that about 61 per cent of small businesses operate some kind of computer network, and 20 per cent of those that do not plan to do so within the next 12 months, and nearly 40 per cent of the survey respondents plan to update their networks within a year (Pepe, 1999). An IBM survey in 1994 indicated that less than half of small business executives were aware of the Internet's existence, while in 1999 the Internet has become an integral part of the daily business operations of small businesses

(Srikonda, 1999). The next Internet growth spurt is expected to be among small- and mid-size businesses (Friedman, 1999), and by about 2006, about 50 per cent of the US workforce will have jobs at Internet-related businesses (Pereira, 1999).

What is of great interest is how small businesses with stand-alone computers can, on account of the Internet, have the same global reach and impact as the largest businesses. The potential for small businesses to take advantage of the Web and leverage it for business purposes is enormous. In practical terms, the Internet is rapidly becoming a primary channel for conducting transactions known in business as purchasing, and in government primarily as procurement (Conhaim, 1999). The use of electronic procurement and purchasing, which was previously dominated by larger companies, is one that has been heavily impacted by the Internet and has been of great benefit to small businesses (Conhaim, 1999). As one can see, not only have computers impacted structures in organizations over the years, but computer-related developments have completely altered the commercial viability of small businesses and their usage of stand-alone computers.

As we can see, the impact of computers on organizations has been considerable. This paper has traced the evolution of changing information system architectures and their impact on organizations. It has suggested that changes in organizational structure, strategy, and decision-making processes have been possible due to changes in computer technology and design. In today's context, a large part of interorganizational relationships are explained from the point of view of computer technology. Finally, the role of the Internet is examined, and how the Internet is becoming a great leveler of size and magnitude, and is allowing small organizations to play roles that were hitherto not available to small firms. In short, computer technology is changing the very fabric and texture of competition as we know it.

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