THE IMPACT OF INFORMATION TECHNOLOGY ON ORGANIZATIONAL FLEXIBILITY

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ABSTRACT

This paper argues that information technology can have a significant impact on organizational flexibility. Information technology (IT) contributes to flexibility by 1) changing the nature of organization boundaries and the time at which work takes place and 2) altering the nature and pace of work. IT also has important second and third order impacts on organizations and industries. The paper presents examples to illustrate the impact of information technology on two industries and three companies. The paper concludes that management should consider the use of information technology to increase flexibility and should predict the higher order impact of their actions on the organization and their industry.

INTRODUCTION

It has been estimated that over half of capital expenditures in the United States are devoted to technology, but there has been little concrete evidence to show that this investment has improved the effectiveness of organizations. What ways can information technology (IT) contribute to organizational effectiveness? One measure of effectivenss is flexibilty (Campbell 1977).

What is organizational flexibility? For a manufacturing firm, Hall (1983) defines flexibility as meaning "that plants should be capable of switching quickly from one product to another, or from one part to another...almost instantly." "Flexibility offers the capability to cope with environmental uncertainty (Swamidass and Newell, 1987)." "Flexibility enables the organization to adapt to current market realities and to react appropriately as market forces change over time (Severance and Passino, 1988). "Flexibility provides the means to achieve the ends of increased growth and resource acquisition (Quinn and Rohrbaugh, 1983)"

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These definitions suggest that flexibility provides the organization with the ability to adapt to change and respond quickly to market forces and uncertainty in its environment. Flexibility should allow a firm to respond to competitors and take advantage of new opportunities. A flexibile organization is the opposite of a rigid bureaucracy. The purpose of this paper is 1) to illustrate the impact of information technology on organizational flexibility and 2) explore the implications of that impact for management.

INFORMATION TECHNOLOGY

Information Technology (IT) refers to hardware, software, procedures, personnel, and data employed in the production, dissemination, and utilization of information, both formal and informal, in an organization (Davis and Olson, 1985). While traditionally IT has been defined to include only "formal" information systems, such as reporting systems generated by a database, increasingly IT is utilized to facilitate informal interpersonal communication. The key technologies include computers, computer-controlled devices, and telecommunications networks; we also include electronic mail, teleconferencing, voice mail, and facsimile transmission as part of IT.

IT consists not only of tangible pieces of equipment and programs; it represents the capacity of the organization to produce, disseminate, and digest information. IT has been used in a number of ways including the mechanization of information processing, the augmentation of knowledge work, and for supporting coordination in the organization.

A significant amount of investment in IT is for basic mechanization of the records of production and distribution of goods and services (e.g., invoices) or the actions themselves (e.g, electronic money transfer). A centralized database makes it possible to produce and disseminate information for management control as a by-

product of mechanization. This category also includes technology used for manufacturing such as CAD/CAM and computer-integrated manufacturing (CIM).

Information technology also contributes to the support of individual workers. Drucker (1964) identified "knowledge work" as a specifically human activity, distinct from physical labor which could be automated. The notion of augmentation was first defined by Englebart (1963) as "increasing the capability of a man (sic) to approach a complex problem situation, gain comprehension to suit his particular needs, and to derive solutions to problems" (p. 1). Today, personal computers are used widely by individuals to augment knowledge work.

Increasingly IT is being used to increase the ease of connection between individuals, organizational units, and even different organizations. Applications such as electronic mail, voice messaging, and facsimile transmission facilitate the communication and coordination of information required for organizational processing. Some terms used for this class of applications are: interpersonal computing (Goldberg, 1987), coordination technology (Holt, 1988; Malone, 1988), groupware (Richman, 1987a), and computer supported groups (Johansen, 1988).

Information Technology and Flexibility

We argue that information technology **can** make a major contribution to organizational flexibility. We do not claim that increased flexibility has been the case with every organization employing technology or that it will be in the future. Examples cited later in the paper provide evidence to support our primary contention that technology has the **potential** to dramatically impact organizational flexibility.

How can IT contribute to adaptability and change? IT impacts flexibility in two major ways:

1. IT can alter the time and place of work, generally by changing boundaries on **where** tasks are accomplished and removing constraints on **when** tasks are performed.

2. IT affects the nature and pace of work; most often it **speeds up** the processing of information.

Communications technology helps remove the constraints of time and place in decision-making. Technology removes organizational boundaries by making it possible to communicate easily without having those involved in the same location. IT provides asynchronous communications so that the time of day and time zone are not a constraint when exchanging information.

The ability to react quickly means that one can perform tasks rapidly in order to take advantage of new opportunities. Technology speeds the processing of information so that it can be used to make timely decisions. Technology is the "factory" for many financial services; speed and processing power is required to provide the service or product to the customer. IT can make it possible to reconfigure manufacturing lines quickly through flexible manufacturing systems.

Figure 1 shows the contribution of IT to flexibility. By altering boundaries, removing time constraints and speeding the nature and pace of work, information technology helps to loosen organizations and reduce the rigidity inherent in many organizational structures. The contribution of technology to speed helps the organization respond quickly. Figure 1 shows how IT has the potential to increase organizational flexibility, to help organizations adapt and change to meet new demands on them.

Flexibility for Whom?

Information technology may increase flexibility for the firm developing it, but in many instances the benefits of increased flexibility accrue to customers or suppliers. The use of e-mail within the firm primarily benefits the organization

installing the system. However, extending the system to customers provides them with added flexibility. In financial services, building more processing power provides benefits for the developer who can generate more revenue, and it provides more flexibility for the customer who can react faster.

Thus, the benefits of increased flexibility accrue to both the developer and related organizations and individuals like customers and suppliers. The flexibility of the developing firm may not be increased dramatically from some applications of technology, however the technology has increased flexibility for the industry involved. In the remainder of the paper, we discuss flexibility regardless of whether the greatest change affects the developer or others who interact with the developing organization.

The Flexibility Paradox

Cameron (1986) suggests that paradox characterizes the modern corporation when adapting to turbulent conditions. The difference between organizational and technological flexibility is one such paradox. Technology can contribute to organizational flexibility, but technology is often considered inflexible, itself. The technology that provides flexibility soon becomes old and hard to maintain so that the organization tends to become more inflexible over time. Many systems that provide flexibility are complex and difficult to modify. It took one airline over two years to track frequent flyer mileage in its reservations system; in the meantime passengers had to paste scannable labels on their ticket coupons to get mileage credit for a flight.

Leading organizations deal with the paradox by changes and improvements in the technology, e.g. reservations systems undergo constant technological updating and change. Hopper (1990) argues that the movement toward very powerful, open systems will make it possible to implement and modify complex technology more easily in the future.

Higher-order Effects

It has been suggested that there are additional impacts beyond those intended from implementing technology (Malone et al.,1987; Malone, 1988). In conducting research for this paper, we found a number of impacts which went beyond the original intentions of the firm implementing technology. These impacts may be positive or negative for different groups affected by the technology.

For purposes of this paper, we define second-order effects as impacts on the organization implementing the technology beyond the immediate justification for the technology. For example, airline reservations systems were first justified on the need to improve the efficiency of the reservations process. A positive second-order impact was large improvements in customer service resulting from the systems. Third-order impacts affect the industry when a number of firms adopt a similar technology. The entire airline industry has been changed dramatically by computerized reservations systems.

A further subdivision of higher-order impacts is helpful in understanding the impact of IT. Intended impacts are foreseen by the firm and industry. Unintended impacts are those not reasonably foreseen; sometimes the unintended impacts affect groups never considered when a system was designed.

A TAXONOMY

The discussion above suggest a taxonomy for viewing the impact of IT on organizational flexibility. The technology will haev a primary impact on boundaries and the time of work and on the nature and pace of work. As sugested by Malone, IT will also have second order impacts on the firm and third order impacts on the industry. These higher order impacts may be intended or unintended.

The purpose of the taxonomy is to help understand the impact of technology on organizational flexibility and especially how this impact can extend beyond the

original purpose of a system. To provide evidence of this impact we discuss two industries and three companies in the next sections using the taxonomy:

Primary impact

Boundaries and time of work

Nature and pace of work

Second-order impacts on the firm

Intended

Unintended

Third-order impacts on the industry

Intended

Unintended

The assignment of impacts to different categories in the analysis below is based on our interpretation of published articles and statements from the developers of systems. Can we prove that no one in the airline industry in 1958 foresaw the impact of a CRS on airline competition in 1991? If one examines publications about the motivation for developing reservations systems and studies their history (Hopper,1990), it is highly unlikely that this third-order impact was planned over thirty years ago when the SABRE system was being developed. This paper presents our interpretation of the evidence; we invite the reader to consider our conclusions carefully and critically before accepting them.

Any study of impacts has to deal with the question of causality. We argue that information technology has had an impact on organizational flexibility, but we cannot prove that program trading works only because of stock exchange electronic order routing systems or computer programs that scan for arbitrage opportunities. It is possible that program traders wanting to buy or sell a basket of stocks could use preprinted trading tickets delivered with great speed to floor traders. Again, the analysis of technological impacts is based on our interpretation of the literature

reviewed for this paper and from personal experience. The reader is cautioned to consider other possible causal explanations for the data presented.

THE IMPACT OF IT IN THE AIRLINE INDUSTRY

Stage One

American Airlines developed the first fully Computerized Reservations System (CRS) in 1961; the system was motivated by a need to handle increasing passenger loads and to provide better customer service (Copeland and McKenney, 1988; Hopper, 1990). The airline's agents used the system to make reservations for passengers. For the first time, the airline could associate a passenger name with a reservation on a specific flight.

As shown in Table 1, the first stage CRS removed the boundary created by the manual, partially centralized reservations process. Instead of allocating seats to offices for sale, an agent had information locally on all seats available. The boundaries around the reservations process moved from a central department to each distributed agent. The CRS created more flexibility for passengers as reservations could be made 24 hours per day. These reservations were made and confirmed instantaneously.

Table 2 suggests that an intended second-order impact was better customer service. In addition, a positive, unintended impact of IT was the advantage that CRS airlines began to develop over their competitors. Since the industry had a small number of firms and the actions of each firm were highly visible in the market, other airlines began developing CRSs shortly after American.

Table 3 describes possible third-order impacts of CRSs on the industry; clearly the systems improved inter-airline communications. They accomplished their purpose of allowing airlines to cope with the advent of jet travel and increased air traffic in general. A likely unintended impact of IT was the tendency of CRSs to

become a barrier to entry. The need for a reservations system significantly raised the cost of entering the airline business at a time when government deregulation was on the horizon.

Stage Two

During the late 1960s and early 1970s the airline industry talked of a single, cooperative reservations system that would be distributed to retail travel agents (Copeland and McKenney, 1988). In 1976 United and American Airlines began to market their systems to travel agents.

Travel agents could now make airline reservations through a direct connection to the airline computer; they did not have to contact an airline reservations staff member by telephone. The first stage of CRS automation moved the reservations boundary to the airline's agent; the second stage moved it to the travel agent. See Table 1.

As the systems matured; the airlines added the ability for the travel agent to provide boarding passes with tickets, eliminating the need for the passenger to wait in line for a seat assignment and boarding pass at the airport. The system moved part of the enplanement process from the airport to the travel agents' office, altering the boundaries of airport operations and speeding the boarding process for the passenger. Some agents began to offer 24 hour travel assistance for any customers who needed rerouting while on a trip.

Retail automation altered the nature and pace of work for the travel agent as well; it took far less time to make a reservation for a customer. In addition, all of the CRS systems include ticket printers in the agents' office; significant gains in agent productivity were experienced as tickets were printed by the computer rather than by hand. These first-order impacts are summarized in Table 1.

An intended second-order impact of the agency CRSs was improved customer service and convenience. The airlines also hoped to become closer to travel agencies and earn their loyalty, or at least their business.

As the systems matured, the airlines began to replace their "cohost" programs with charges for services. A likely unintended second-order impact of IT was the use of CRSs to generate non-flight revenue directly. The two major CRS vendors, American and United, began to charge other airlines for reservations made for them on Sabre or Apollo; the fees were $1.85 per leg ticketed.

It was estimated that in 1985 Sabre earned $143 million on revenues of $336 million and that it contributed more than $2 per share to American's earnings, about one third of American's total earnings and its highest margin business (Copeland and McKenney, 1988; Forbes, December 30, 1985.) When AMR Corporation (American's parent) announced it would consider bids for selling shares in Sabre, Wall Street valued the system at $1.5 billion. At the time, AMR's market value was $2.9 indicating that Sabre had grown to slightly exceed American's core business in value (Clemons and Weber, 1990).

Table 3 shows the third-order impacts of the technology on the airline industry. The CRS vendors, for the most part, developed exclusive arrangements with travel agents using their CRS. The airlines hoped to gain from the halo effect, expecting their agents to be more likely to book a flight on the CRS vendor's airline than another when given a choice.

A significant unintended impact on the industry was a dramatic barrier to entry once the reservation systems were in place in travel agencies. Donald Burr, founder of People Express, laid much of the blame for the demise of his airline to its inability to utilize CRS technology.

Another unintended third-order impact of information technology has occurred on firm structure within the industry; the major airlines have created

subsidiaries from their reservations units. While United was a takeover target, it sold half share of its Covia CRS subsidiary to a consortium of European airlines and US Air for $500 million having invested an estimated $250 to $300 million. Before selling half of Covia to US Air, KLM Swissair and British Airways, United had already agreed to form an alliance with the European airlines to develop a system for European agency automation. Texas Air entered into a similar alliance with Air France, Lufthansa, Iberia and SAS. Given the problems with Texas Air, this alliance turned to American Airlines for assistance in 1990. The sale of part of the American Airlines Sabre system to Delta was recently disapproved by the government who feared the power of the combined systems. New organizational boundaries have been created (the CRS subsidiaries) and new strategic alliances formed as a result of reservations automation.

THE SECURITIES INDUSTRY

The securities industry has made major investments in information systems and services due to intensive information processing requirements. The securities industry consists of individual and institutional investors, brokerage and financial services firms and a group of exchanges.

Automation in the securities industry has focused on individual systems designed for a specific purpose. With the exception of the exchanges, most securities systems have had their primary impact on the firm that developed the application. Exchange applications, of course, affect all of those who use a particular exchange. There are also national and international trading systems like the NASDAQ system (over-the-counter stocks) and Instinet, a computerized exchange owned by Reuters (Lucas and Schwartz, 1989a).

Back Office Systems

Organizations adopted information technology first for processing large volumes of transactions. A brokerage firm must keep track of customers' accounts; the stock exchanges and clearing firms must clear all of the day's transactions. Large, back office computer systems help accomplish these tasks. These systems give firms the ability to process huge volumes of transactions and meet stringent time limits.

Once a brokerage firm has information in a database about the customer, it can make that information available to the broker in a branch office to supplement the quotation information typically purchased from an outside vendor like Quotron. See Table 4. The technology removes boundaries on the availability of account information; it is now easily available at the broker's desk rather than from a bulky printout or through a phone call to a central processing site.

Table 4 shows that the back office systems also contributed to extending the time for trading. In the 1960s, inadequate capacity led to early closings of the New York Stock Exchange so that securities firms could catch up on transactions processing; today systems are in place to eliminate this time constraint. The back office systems also accomplish one of their major objectives; they greatly speed the processing of customer trades.

Table 5 describes the second-order effect of IT used for back office processing. An intended impact was improvements in customer service. A possibly unintended consequence is that these systems have generally made it easier to trade large blocks of stock. When we look at all of the firms in the industry together in Table 6, a third-order impact of IT is to allow a larger volume of trades at the exchanges, something desirable from the brokerage firms' and exchanges' standpoint. An unintended consequence of back office IT is a large increase in fixed

costs; at least two firms are considering combining their back offices, a first in the industry for two large, rival brokerages.

Trading Systems

Faced with steadily increasing volume and concerns about the ability to complete trades in sufficient time, major exchanges have undertaken different programs of automation. The NASDAQ system provides an electronic market for over-the-counter stocks for the U.S. and several foreign countries (Wall, 1989). Reuters handles about 30% of the world's foreign exchange transactions over its financial network (Clemons and Adams, 1989); its Instinet subsidiary offers an electronic market in a number of stocks (Reuters Case, 1988).

The New York Stock Exchange has developed its SuperDot (Designated Order Turnaround System) to directly route orders to specialists, avoiding the floor broker; SuperDot is available for trades of up to 30,099 shares and limit orders of 99,999 shares (Allen and Zarembo, 1989).

The impact of information technology on flexibility of the trading system is dramatic. See Table 4. Brokers are able to route orders to the specialist on the exchange floor directly without using a floor broker, removing a boundary. Electronic exchanges make it possible to eliminate an exchange floor all together.

IT has also been an enabler for 24 hour trading. Brokerage firms routinely "pass the book" on their foreign currency transactions from London to New York to Tokyo. One discount broker accepts phone trades all night and a computer user can send trades to a broker at any time. The trades are not executed until an exchange opens, but that is expected to change in the next few years.

The ability of computer systems to process data at extremely high speeds also makes it possible to offer products that could not have been considered before computerization because of the time required to perform computations, e.g. calculating the stock distribution in an indexed fund.

A second-order effect of trading technology, shown in Table 5, has been to make new strategies like program trading possible; one has to be able to execute simultaneous buys and sells on different exchanges within two minutes (Wood, 1989). It is likely that exchanges and firms wanted to encourage new trading strategies; it is not clear if the large amount of program trading was intended or not. The stock exchanges appear to be uneasy with these trades while the futures exchanges encourage them.

Unintended third-order consequences of technology for the financial markets and the economy has a whole have been extensively debated since October 19, 1987 and the near meltdown of the securities markets (Lucas and Schwartz, 1989a). See Table 6. An intended impact has been to improve the efficiency of trading in general and to help the small customer obtain favorable execution of his or her orders.

Has the technology unintentionally facilitated trading strategies which adversely affect liquidity and volatility? Was there insufficient processing capacity in October of 1987; did information technology provide more constraints than it removed? On October 19, 1987 one portfolio insurer sold $1.7 billion of assets while three other firms sold over $800 million each. Specialists and others bought $700 million; they could not meet the liquidity demands of modern technology (Wood, 1989). There has been some speculation that delays caused by insufficient systems capacity served to buffer the October crash; trades were delayed and price discovery was almost impossible at certain times during the day (New York Times, October 16, 1988).

Since the crash, individual investors have largely been absent from the market (Leavitt, 1989). The individual investor may perceive that only large firms have the technology to provide the needed information for decision making and access to various exchanges in order to trade efficiently. One unintended third-

order consequence of information technology in the securities industry may be to drive the individual investor out of the market.

THE IMPACT OF IT ON FLEXIBILITY IN THREE FIRMS

The section above presents evidence for the impact of IT on organizational flexibility in two large industries. The analyis is at a high level of generality; in this section we discuss evidence based on three specific firms' use of IT.

Discount Stores

This organization is a large retailer of a complete line of goods from clothing to food to electric appliances. The company deals with over 900 suppliers of goods, servicing nearly 80,000 products. Purchasing must obtain accurate sales information from hundreds of stores; the company deals with a fixed set of suppliers, so the task of purchasing is highly structured. The primary information exchanged is price and delivery times.

The company is experimenting with Electronic Data Interchange, or EDI. A primary objective of the technology is to reduce costs through reduced error rates. Since volume of sales in stores cannot be predicted with accuracy, the company must also incur inventory carrying costs or risk loss of sales because of items out of stock. The solution to this problem is to use EDI to help reduce the time from out-of-stock condition to replenishment from suppliers.

Table 7 shows the expected first-order impact of this technology on Discount Stores; EDI clearly reduces the organizational boundaries between Discount and its suppliers. Discount can also order at any time during the day. EDI dramatically speeds ordering and should reduce stockouts.

Table 8 describes the second-order impacts of EDI on Discount Stores: here the intended impact is to create operating efficiencies. In addition to speeding order entry, the presence of EDI should make it possible to operate the entire store

more efficiently; it is economical to order small quantities of merchandise and to maintain fewer items in stock.

Table 8 suggests an unintended impact of EDI on Discount Stores: the firm may lose some of its ability to negotiate prices with suppliers since it is so closely tied to them. In addition, having contract arrangements with a large number of suppliers may reduce the attractiveness of expansion through vertical integration. There may be less incentive for Discount stores to buy individual suppliers.

Mrs. Fields' Cookies[2]

Mrs. Field's Cookies is a chain of small retail outlets, typically found in shopping malls, which sell several varieties of cookies and a few other selected food items. Currently there are approximately 500 retail stores world-wide. Stores follow a formula of consistent, uniform quality and price regardless of location. However, Mrs. Fields' Cookies has a unique organizational structure; except for a small middle layer of specialist advisors, the company has a completely flat structure with centralized control. Every shop is wholly-owned by the company rather than franchised, and the company is under the strong centralized control of Mrs. Fields and her husband. The unique organization of Mrs. Fields' Cookies allows the owners maximum flexibility in adapting its offerings to the changing tastes of customers in a "fad" business.

IT is an integral part of the structure of Mrs. Fields' Cookies. Each store is connected on-line to a central database, and there is extensive mechanization of production quotas, sales volumes, etc. based on recent daily sales records for each store. In fact, each store is given hourly sales projections and reports hourly sales results. All ordering of supplies (e.g., chocolate chips) is done automatically from the central database with direct delivery to the store.

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[2] The material in this section is adapted from (Richman, 1987b).

Flexibility in terms of product mix, sales quotas, even special promotions, is easily maintained across all stores worldwide. The company also uses IT for coordination; through voice mail and electronic mail, each store manager has direct personal interaction with Mrs. Fields herself. Company-wide announcements are frequently broadcast to each store by voice mail, significantly personalizing the announcement over memos and reports. Each manager may send Mrs. Fields electronic messages for particular problems and expect a personal response within forty-eight hours.

As shown in Table 7, the first-order impact of technology at Mrs. Fields has been to reduce boundaries between stores and headquarters; the technology has created a flat structure. It is also easy to communicate across time zones using voice and e-mail. The technology affects the nature and pace of work through detailed store operational control, freeing personnel for more sales work.

Table 8 describes the second-order impacts of technology; as intended IT lets Mrs. Fields standardize quality across stores and products. Recently the firm has expanded rapidly straining its financial resources. Is it possible that one unintended result of technology has been to instill a sense of confidence that may be unjustified? Mrs. Fields technology does not necessarily apply to financing acquisitions or converting an acquisition to its business practices.

East Coast High Tech

This company is one of the leading US computer manufacturers and is well known for its highly matrixed organizational structure. The environment is turbulent and highly competitive; new advances in technology frequently cause competitors to change marketing and engineering plans radically. In addition, new product development times (after research and technology transfer) are typically two to three years.

The organization structure of East Coast High Tech can best be described as highly fluid. Reporting relationships change frequently and matrix relationships are common. Because of the environment and nature of the product, a structure which allows for coordination by lateral relations across all parts of the organization (except perhaps manufacturing) is required. However, the costs of maintaining such an organization are high and, as the number of parties requiring contact increases, the needed coordination becomes highly complex and time-consuming.

One of the authors studied a sub-unit of East Coast High Tech which is responsible for defining new products in a segment of the market relatively new to the company, financial services. The sub-unit defines application requirements based on input from industry marketing and "sells" these requirements to engineering groups for development. Similar groups in the organization compete for scarce engineering resources based on their ability to convince management of the market for a proposed product. Frequently, multiple competing products are under development in different parts of the organization. Given the structure, there is no formal mechanism for coordinating multiple activities. Product groups can take it upon themselves to form coalitions to consolidate their resources on single rather than multiple products, or to use the knowledge gained from coalitions to differentiate and justify each product.

The major IT for East Coast High Tech is an extensive data communications network which connects every part of the organization, across all functions world-wide. The network is primarily used for coordination through electronic mail and computer conferencing. The technology vastly increase the number of connections available to employees of the firm.

Table 7 suggests that the technology at East Coast High Tech reduces geographic boundaries; work groups form despite the physical location of the participants. The technology lets groups or individuals communicate together at

one time or asynchronously. The end result should be faster communications and project completion.

Table 8 suggests that an intended impact of technology is to increase the number and type of connections in the firm; IT also makes expertise available widely across the organization. A possible unintended consequence is to promote a fluid organization structure with minimal vertical authority; in this case, such a structure appears to be consistent with management's objectives.

DISCUSSION

The evidence presented above shows that information technology can have an impact on organizational flexibility; it has had an effect on the airline and securities industries and the three companies in the discussion. Technology has also had unintended higher order impacts in the examples. This section summarizes the evidence from the discussion of how IT affects boundaries and time of work and the nature and pace of work along with the higher order impacts of IT.

Boundaries and Time of Work

In the case of Discount Stores, Mrs. Fields Cookies and East Coast High Tech, communications technology reduced organizational boundaries among customers and suppliers and within the firm. Communications technology has helped Mrs. Fields Cookies grow without a concomitant increase in the number of middle managers to process information.

For the airlines industry, the time and place for making and processing reservations changed with a CRS. In the securities industry, brokers can bypass the floor trader; a broker can work in his or her office and route orders directly to the specialist on the exchange.

Nature and Pace of Work

For Discount Stores technology has increased the speed of ordering allowing a reduction in safety stocks. Mrs. Fields can make immediate change to all stores through the computer programs each is provided for managing store activities. East Coast High Tech can coordinate its projects better and make faster progress on joint tasks through its use of communications technology.

CRS have made travel agents far more productive than in the past. Technology has allowed dramatic increases in the volume of stock traded on the exchanges.

Higher-Order Effects

The examples also show IT can have higher-order intended and unintended consequences for the firm and industry. Second-order effects impact the firm developing a system. Discount Stores has improved its operating efficiencies while Mrs. Fields Cookies can standardize product and quality across stores. East Coast High Tech has increased the types of conections in the firm and made expertise more widely available, promoting a more fluid organizational structure.

The airline CRSs have provided much better customer service and have given CRS vendors an advantage over the competition. In the securities industry, the technology has improved customer service to the extent that some customers with personal computers are able to submit trades directly to their brokerage firm (which may be a bank or other financial institution). IT has also facilitated new trading strategies especially those involving program trading and other forms of arbitrage

Third-order impacts from IT affect an entire industry. Airline CRSs have raised barriers to entry for airline firms; they have created new organizational structures and alliances such as CRS subsidiaries and agreements with European carriers to develop CRSs. Some have argued that the flexibility provided by

electronic systems has had a destabilizing impact on the securities markets, particularly by contributing to increased volatility.

IMPLICATIONS

What are the implications from this analysis of the impact of IT on organizational flexibility? The evidence suggests that IT can have an impact on organizational flexibility. Flexibilty helps a firm react to the marketplace and to the actions of other firms. Flexibility can contribute to competitiveness. Organizations should design systems and use technology that increases their flexibility. Firms should also think about the higher order effects that technology can have to avoid negative unintended impacts.

On an operational level, senior management must be involved in setting technology strategy, goals and implementation (e.g. Randy and Debbie Fields). Applications like e-mail, EDI, and voice mail require senior management to take a major role in implementation. Managers also need to be open to new ideas and the use of outside parties to build and integrate new technology (Hopper, 1990).

One of the most difficult tasks for management is investing in building an infrastructure when there may be no immediate payoff (Vincent 1990). Yet, without an infrastructure the firm is not in a position to react quickly when an opportunity arises. An infrastructure is necessary to take advantage of the flexibility offered by technology.

The unintended higher-order impacts of some systems may raise national policy concerns and be significant enough to impact the economy (e.g. securities trading systems). Managers and designers have a responsibility to anticipate the impact of their systems beyond the immediate objectives of the application.

The designer of IT must consider the impact of the technology on the organization as well as on the particular task for which the technology is intended;

the IT designer also inevitably designs at least some parts of the organization. Management should consider information technology as a major variable in the design of the organization and think about how IT can contribute to effectiveness.

Increasingly the design of organizations will involve specifying the type of information technology the organization needs to employ. For example, Hopper (1990) suggests that IT will change hierarchical organizational structures into networks of task forces and problem solvers. Technology can contribute to creating the organizational structure desired by management, and in some cases technology may be what makes a particular structure possible.

One theme for the 1990s is competitiveness; organizational flexibility can contribute to competitiveness by helping the organization react more quickly to the marketplace and take advantage of new opportunities. One challenge for management in the 1990s is to take advantage of information technology to increase organizational flexibility.

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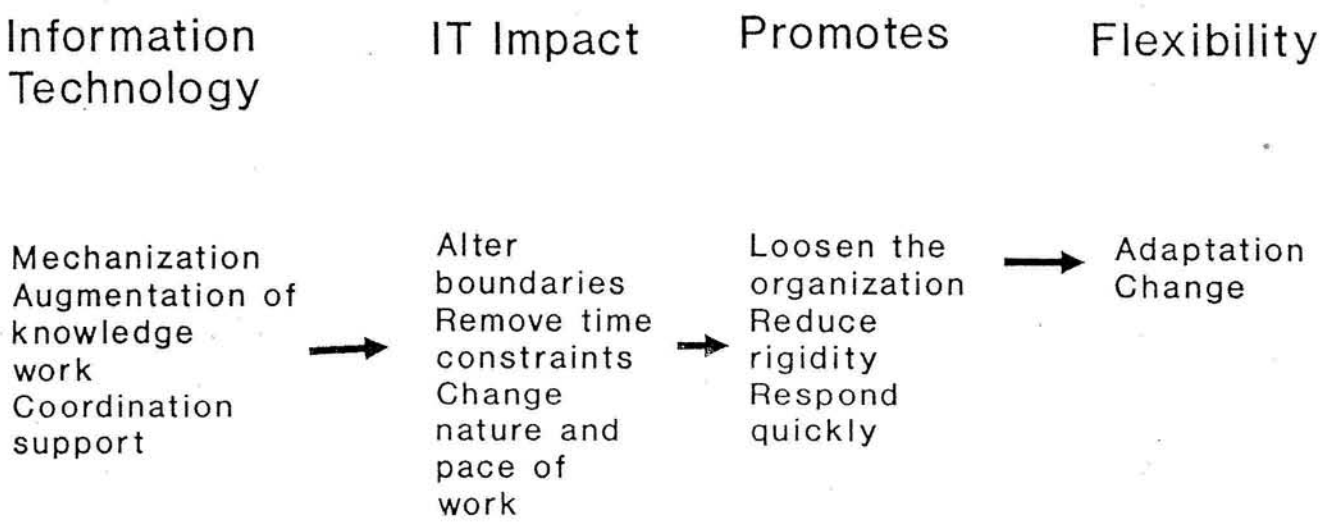

IT and Organization Flexibility

Figure 1

First-Order Impact
on Developing Firm

Organization	Boundaries	Time	Nature and Pace of Work
CRS Stage 1	Remove boundary of manual centralized processing; make reservation at any location	Make reservation any time	Confirmed reservation made instantaneously
CRS Stage 2	Boundary for making reservation shifts to agent from airline; airport boarding pass moved to agency	Extra service by agent, e.g. 24 hour assistance	Travel agent becomes more productive

First-Order IT Impact
From Airline Reservations Systems

Table 1

Second-Order Impact
On Developing Firm

Organization	Intended	Unintended
CRS Stage 1	Better customer service	Offer advantage over non-CRS airline
CRS Stage 2	Increase the ease of making reservation; improve convenience for customer; develop travel agent loyalty	Provide a mechanism to generate non-flight revenue; allow for yield management program and and micro-pricing

Second-Order IT Impact
From Airline Reservations Systems
Table 2

Third-Order Impact
On Industry

Organization	Intended	Unintended
CRS Stage 1	Improve interairline communications; allow airlines to cope with jets and increased air travel	Began to raise barriers to entry
CRS Stage 2	Became exclusive carrier for travel agent to the extent possible	Dramatic increase in barriers to entry; set stage for alliances with European airlines for CRS; created new organizational structures in form of CRS subsidiary; sold parts of CRS subsidiary

Third-Order IT Impacts
From Airline Reservations Systems
Table 3

First-Order Impact
On Developing Firm

Organization	Boundaries	Time	Nature and Pace of Work
Securities firm back office	Make data available to brokers on-line	Eliminate need to close exchanges early	Greatly speed processing of trades
Trading at exchanges and member firms	Able to route orders without intervention of floor broker; floor an extension of the brokerage office; remove need for floor, e.g. NASDAQ, London Stock Exchange	Movement toward 24 hour trading; passing the book around the world for currency: NYC to London to Tokyo	Able to execute trading decisions instantaneously

First-Order IT Impact
On the Securities Industry
Table 4

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Stern School of Business
Working Paper IS-92-14

Second-Order Impact
On Developing Firm

Organization	Intended	Unintended
Securities firm back office	Improve customer service	Facilitated trading large blocks of stocks
Trading at exchanges and member firms	Facilitate trading; enable new trading strategies	Encouraged trading of baskets of stocks and program trading

Second-Order IT Impact
On the Securities Industry
Table 5

Third-Order Impact
on Industry

Organization	Intended	Unintended
Securities firms back office	Allow larger daily volume of trades on exchanges	Increase fixed costs; force firms to consider centralized processing and joint processing as volumes drop
Trading at exchanges and member firms	Improve efficiency of trading process; help small customer obtain favorable execution	Increased volatility; linked linked equities and futures exchanges; withdrawal of small investor; need for regulatory circuit breakers

Third-Order IT Impact
On the Securities Industry
Table 6

First-Order Impact
on Developing Firm

Organization	Boundaries	Time	Nature and Pace of Work
Discount Stores EDI	Reduce boundary with suppliers	Order at any time	Increase speed of ordering; reduce stockouts
Mrs. Fields Cookies E-mail, voice mail and store control;	Bring stores closer to headquarters; create flat structure	Communicate across time zones	Automate micro-level management of store; free personnel for sales
East Coast High Tech Teleconferencing	Reduce geographic boundaries	Communicate as a group or asynchronously	Faster communications and project completion

First-Order IT Impact
in Three Companies
Table 7

Second-Order Impact
on Developing Firm

Organization	Intended	Unintended
Discount Stores	Impose Operating efficiencies	Less leverage over suppliers; less vertical integration
Mrs. Fields Cookies	Standardize quality across stores and products	Encouraged expansion?
East Coast High Tech	Increase number and type of connections and provide wide access to expertise	Promote a fluid organization with minimal vertical authority

Second-Order IT Impacts
In Three Companies
Table 8