INTEGRATING INFORMATION TECHNOLOGY AND STRATEGIC PLANNING: COPING WITH TWO PARADOXES

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Information technology creates significant opportunities for firms to gain a strategic advantage over competitors. To be successful, an organization must consider technology's contribution to decisions and the impact the firm's plans have on its existing technology. This paper explores one of the most important management issues for the 1990's: integrating information technology and strategic planning.

The difficulties of integrating technology and planning are apparent now that firms have experience attempting to 1) combine technology and planning and 2) implement information systems to obtain a strategic advantage. An organization is likely encounters two important paradoxes as it develops strategic uses of technology.

Paradox 1

> Information technology offers new opportunities to gain a competitive edge and to change the way the firm operates; at the same time, information technology can constrain the firm and reduce its options.

Paradox 2

> A firm that invests heavily in information technology and becomes a leader in its industry may find that it soon falls behind competitors who copy and extend its innovations; sustaining an advantage requires an ongoing effort.

The purpose of this paper is to discuss these two paradoxes and suggest actions management can take to reduce the

severity or eliminate altogether the problems the paradoxes generate.

INTEGRATION AND THE FIRST PARADOX

A number of authors have argued for the integration of information technology in planning (e.g. see Lucas and Turner, 1982, Parsons 1983); the firm is encouraged to look to the technology for new ideas and opportunities. What actions can the firm take that were not possible before computers and communications technology reached today's levels of development? A company may offer new services to customers, new information based products, connect itself to customers and suppliers and raise barriers to entry to name a few (Parsons, 1983).

Airline Reservations Systems

As an example, how can an airline compete today without offering the services of a computerized reservation system? At first, the airline systems offered better service to customers. When American and United began to install their systems in travel agencies, they gained a competitive advantage. It is estimated that travel agents book over $20 billion of air travel; this total accounts for 70% of total bookings. Observations suggest that most of the time the agent makes a reservation from the first screen of the flight display. The system operators favored their own flights by listing them first on the screen displays; the

owners of the reservations systems captured the vast majority of the flights in their markets.

Complaints from competitors resulted in a more neutral order of presentation for flight information; flights are listed according to duration with shorter flights listed first. Even this approach has led to complaints of unfair competition; Delta charged that American maintains two sets of flight times; actual times and times published in its reservations system. Delta claimed that the published times are shorter than actual, known average flight times. If this allegation is true, the customer will suffer as connections are based on the shorter, published times!

The installation of reservations terminals in travel agencies has created a major strategic advantage for the six U.S. airlines who have been most active in selling services to agents. It is estimated that American's reservations system earned $2 per share in 1985, about one-third of American's earnings for the year. The reservations subsidiary was the most profitable line of business for the airline, providing $100 million in aftertax profits on $350 million in revenue. Over 10,000 travel agencies access American's system. American's computers are connected to over 65,000 terminals; the computer complex has processed nearly 1000 messages per second at peak times.

Where are the Constraints?

The example above describes a highly successful competitive application of information technology. When the

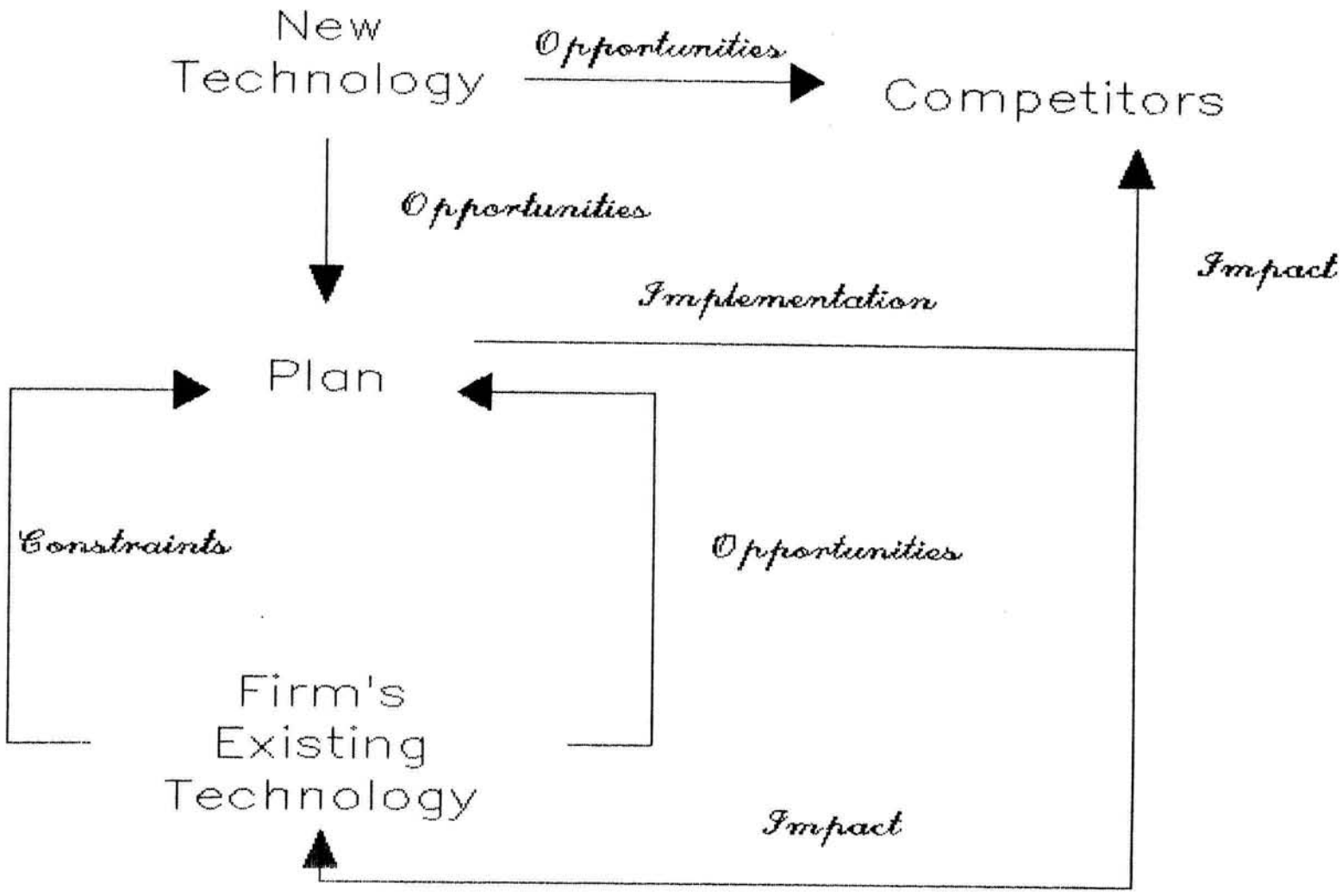
computerized systems were first developed, the airlines were trying to solve an internal, operating problem; they could not keep track of reservations. The systems evolved to become major competitive weapons and sources of revenue in their own right.

How, then, does technology constrain the firm; in the example above it appears to provide only opportunities? Figure 1 is a model of the planning process. New technology provides opportunities to a firm that is engaged in planning and decisionmaking. The firm decides to implement its plan and new technology gradually becomes a part of the firm's existing stock of technology. At the same time, the implementation of new plans has an impact on competitors: new technology provides opportunities to a firm's competitors if they are able to take advantage of it.

The firm's existing stock of technology provides opportunities and constraints. How can existing technology constrain the firm? Perhaps the firm does not have enough experience to successfully implement a strategic system. Possibly the entry cost is too high; it is unlikely that there will be another nationwide hospital supply firm. American Hospital Supply (now a part of Baxter Laboratories) has an order entry system that offers formidable barriers to entry, especially when combined with the other technology-based services AHS provides to hospitals.

A firm's existing technology either manifests or provides three major categories of constraints:

Integration of IT and Strategy
Figure 1



1. Managerial competence
2. The technological infrastructure
3. Existing applications

Managerial Competence. The quality of existing technology is one indicator of managerial competence in dealing with technology in general. There are many firms which are constrained by a lack of managerial interest and involvement in technological decisionmaking. In the 1990's, the ability of management to successful control information technology may well be the major factor determining the success of the organization.

An electronics firm decided to place terminals in its distributors' offices about a year after competitors had already done so. The company wanted to establish separate, logical distributor inventories in its computer system so that distributors' inquiries would be processed only against the items they could sell. The application required only a few new screens for use by distributor personnel and changes to the inventory part of the order entry system. Management assigned a high priority to the project; however, over a year after work began, the terminals sat in the distributors' offices unused because the system was not working yet.

The distributor order entry system was typical of the problems this electronics firm experienced trying to take advantage of information processing technology. As the executive vice president put it, "I take a little time to

look at the computer situation when the noise level gets too high; otherwise I don't bother." The lack of attention and managerial knowledge about technology provides a powerful constraint on the electronics firm's ability to take advantage of new opportunities.

Technological Infrastructure. The lack of a suitable technological infrastructure can be a major constraint in using new technology. What is meant by technological infrastructure? This term refers to all of the technology, hardware, software and communications, that a firm has in place to deliver information services. If there is no infrastructure, it can be very time-consuming and expensive to develop one.

Before its acquisition by Shearson, E. F. Hutton undertook a five-year project to build an infrastructure to support a network of the most advanced broker workstations in the industry. The infrastructure for this project included IBM mainframe computers in New York, Data General Minicomputers in each brokerage office, and a satellite distribution system backed up with terrestrial lines. The NCR microcomputer-based workstation, itself, required extensive design; it would present a variety of custom-tailored information for each of Hutton's approximately 6000 brokers. (As of this writing it is not clear if the merged firm will install the new system).

A communications network often forms one major component of a firm's information technology infrastructure.

Digital Equipment Corporation has developed an internal network connecting 21,000 computer systems and supporting some 60,000 users world-wide. Employees use the system actively to better manage DEC; it assists in inventory management, order processing, financial reporting, printing and publishing, manufacturing, sales, customer support and administration (Hall and McCauley, 1987).

Manufacturers Hanover Bank developed a world-wide packet switched network, GEONET, in the late 1970's and early 1980's; management authorized the project even though it had a negative net present value. The justification for GEONET was based on the ability it gave the bank to provide the same information service any place in the world. New computer applications could be plugged into the network just as one plugs a new appliance into a wall outlet. In developing future computer applications, there is no need to be concerned with simultaneously building a communications network to deliver the service to users; GEONET provides the delivery mechanism.

Existing Applications. Firms have invested vast sums of money to develop their stock of existing applications. Some of these applications are ten years old or older. Technology has changed, yet the cost of redoing old systems is high, both in terms of public relations and actual dollars invested. Most information services departments lack enough staff members to handle requests for new systems and demands for maintenance; undertaking the redesign of an

existing system that still works means some other task will not be completed.

How much will a rewrite accomplish, particularly if the existing system is working? The user may have a new interface and the system will probably be easier to modify. Compared to the appeal of an entirely new application, redoing an existing system does not often win a lot of supporters for information services.

Sometimes, however, firms have become so dependent on existing systems that business opportunities are constrained due to the way the system operates. A large cable television company offers an example; it depended on a packaged system for all of its business functions such as billing customers and keeping track of the special services they ordered.

The cable company wanted to offer "pay-per-view" service in which a customer calls to order a particular event broadcast over a special cable channel. The cable company should automatically turn on the special channel through the decoder box on the customer's TV set at the proper time for the show, record the billing charge, and turn off the decoder box when the show is over.

The computer system, however, was not designed with a pay-per-view option. The developers added a module to handle pay features; the module processed all subscribers to the pay event in batch mode following the event. The only problem with this strategy was that the cable company

offered each event twice during the day. Because the program processed charges after the second showing, the customer's decoder who watched the first showing could not be turned off until the program processed charges at the end of the second broadcast. Otherwise, there would be no record of the customer's order. The customer could in theory watch the event twice and be billed only once, which placed the Cable firm in violation of its contract with the studios providing the pay-per-view features.

Because of this problem and a number of other limitations of the package, the cable company eventually worked with a vendor to develop the "next generation" package to remove these constraints. Managers at the cable firm felt that they could not have handled their approximately 100% growth over the past four years without the new system. The old system constrained their use of the technology and their business.

Referring to Figure 1, managers must consider the constraints their existing technology imposes on the opportunities provided by new technology. The stock of existing technology may provide both opportunities and constraints, and managers have to identify its role in strategic planning.

STRATEGIC APPLICATIONS AND THE SECOND PARADOX

Figure 2 illustrates the second paradox, the need for the firm to sustain a competitive advantage. An

Time	Event
t	Technology <--->Strategy
t+1	Competitor: Copy & enhance
t+2	Sustain strategy --> invest in new technology

Sustaining an Advantage

Figure 2

organization develops and successfully implements a system to provide a competitive edge. Its competitors observe the impact of the system and build their own, similar applications. Because the competitor is tackling a problem that is better understood, it may be able to build a more innovative and successful system than the firm which originated the idea. (Things do not always happen this way, Merrill Lynch appears to be dominant in the cash management account business even though there are a number of competitors.)

A case in point is the airline reservations system described earlier in the paper. American Airlines developed the Sabre system first, but United has been a fierce competitor in the travel agency business. The estimated agency shares are as follows (Business Week, June 22, 1987):

American	38%
United	30%
System One (Texas Air)	15%
TWA/Northwest	10%
Delta	7%

Since a large number of U.S. agencies are automated, the airlines have been trying to convert agencies from rival systems. To prevent switching, the airlines have forced agents to enter into extremely restrictive contracts. For example, any time an agent orders a new piece of equipment (such as a terminal or printer) the contract term of five years begins again.

In addition, the agency contracts contain clauses calling for liquidated damages of 80% in some cases if an agency abandons the system. One example is of a Minneapolis agent who generates $1 million in fees for United, even though 95% of his flights are not booked on United. The United reservations system issues the ticket, and the actual carrier must pay United $1.85 for each leg of the trip. Thus, the airline operating the reservations system makes money regardless of whether its flights are chosen. If the Minneapolis agent tried to switch systems with five years to run on his contract, he would owe 80% of 5 years x $1 million a year or $4 million in liquidated damages, a very high switching cost.

For new business, US airlines are attempting to sign up European travel agencies. Alarmed by this trend, two consortia of European airlines have been formed to develop their own travel agency applications. United and Texas Air have been retained as advisors, one for each European consortium. (It was reported that American would not participate without an equity share in the European system.)

What is the next source of competition? Both American and United are planning to replace some, if not all, of the dumb reservations terminals in agency offices with microcomputers. The local micros will run programs to help the agencies better manage their business. For example, the reservations systems provide flight information and let the agent make reservations. However, they do not keep track of

corporate accounts, perform agency accounting or provide similar functions.

What is the cost of sustaining an advantage? In the case of the airlines, it has been estimated that United and American invested between $250 and $500 million each to build their reservations systems in the first place. The estimated cost for further agency automation with microcomputers is $1 billion, two to four times the cost of the original innovation.

The airlines offer an extreme case. However, leaders in using information technology for strategic advantage can not rest; they must continue to explore ways to sustain the advantage by refining and expanding the role of technology in their business strategy.

INTEGRATION: THE MANAGEMENT CHALLENGE

Firms that succeed in the 1990's will integrate information technology with planning and decisionmaking. Particularly in developing strategy, managers need to understand the opportunities presented by the technology and the constraints provided by their unique circumstances. In addition, management needs to be aware of the likely outcome of being an innovator with a strategic application: the cost is one of sustaining that effort for the foreseeable future.

A key problem in using the technology to gain an advantage are the constraints described earlier in the paper. How can management act to remove the constraints so

that it can take advantages of developments in technology? See Table 1.

ACTION	REASON
Build technological infrastructure	Prepare to deliver all types of information technology unconstrained by hardware/ software and communications
Be involved in systems analysis and design	Set policy, review system functions, guide development
Coordinate information processing	Avoid suboptimal decisions, look for common systems, establish compatibility needs
Search for opportunities	Find new ways to use technology creatively
Hands-on use	Demonstrate interest, become more familiar with technology, obtain benefits of technology personally

Table 1
Management Steps to Minimize Constraints

Building an Infrastructure

The first task is to provide a suitable technological infrastructure. In many firms, this effort will involve developing a plan for a systems architecture. What type of hardware and software will the firm offer its users? Where will information services be managed? Will the firm be centralized, decentralized or distributed with respect to hardware, systems development and the management of information systems? For a discussion of some of the issues involved in developing this type of a plan, see Lucas, 1986.

In today's environment, communications is an important part of the technological infrastructure. For many firms, developing an architecture to support the development of new applications will require configuring a network. For a good discussion of the benefits and the development process for a network see Hall and McCauley (1987).

Systems Analysis and Design

This paper and others have argued for substantial management involvement in decisions about information technology. At what point does this commitment stop? Do managers need to be involved in anything more than planning and monitoring the execution of technology plans? Given the scope of major systems, the investment required to develop them, and their potential impact on the firm, managers have an important role to play in systems development.

The manager does not have to design the system, but he or she should set its objectives and review key decisions about the new application. An example will help to illustrate the role of management in systems analysis and design.

A carpet manufacturing firm formed a design team to develop a new, expanded order entry system. This firm had one of the first on-line order entry applications in the industry; the system set new standards for customer service and provided a competitive edge. However, ten years later, the competition had developed new and better systems. This innovative firm now had to meet the competition.

Managers in the firm wanted to make a number of changes in the operation of the company; they viewed the information systems development project as a good opportunity to change the way they did business. Professional designers had a good idea of what management wanted, but management objectives were not spelled out in the design documentation nor were they made clear to users on the design team.

As a result, users drew implications about the impact of the system; many were upset by changes they saw coming. As the project was behind schedule, the design team issued a set of "preliminary specifications" in a three-inch thick binder. They circulated the specifications widely and sent copies to the president and the chief operating officer, the executive vice president. Both men became nervous when they could not understand much about the system from the specifications.

When a consultant reviewed the systems development effort, it became clear that there were a lot of misunderstandings about this important application. The consultant and the designers made a list of major policy decisions management had made, but not announced. The EVP began a subsequent review meeting with all potential users by listing some of his objectives for the system including:

1. Unified customer service; the firm would form a new customer service department merging two existing units.

2. A single forecast to be used by marketing and production (instead of each department making its own forecast.)

3. A forecast at the color and style level, not just at the carpet grade level.

4. An ABC inventory analysis in which restocking policies differ according to the item's sales as reflected in its class A, B or C.

The EVP's involvement helped to remove blame from the system for unpopular changes; it was clear that the changes were management, not system objectives. A system could have been designed to support the existing way of doing business, just as it would be designed to support management's desired new approach to business.

Senior level managers need to be involved in systems development at the policy level. They have to communicate the objectives of a system, attend review meetings and help make some of the high-level decisions about how a system will process information. Management also has to monitor the development process to keep systems on track.

Coordinating Information Processing

An earlier paper describes the growing importance of the coordination task in managing information services (Lucas, 1986). Many firms with diverse subsidiaries have created headquarters staffs to coordinate and support divisional computing. It is very important to be aware of what is happening with respect to information technology in

different divisions and to provide an appropriate level of coordination. Can the efforts of one division be applied to the problems of another? Should several divisions work together to solve a common problem?

Searching for Opportunities

One key management activity is seeking ways to improve organization performance. In an increasingly service-oriented economy, many opportunities for improvement will come from information technology (Quinn, et. al., 1987). Manufacturing and distribution firms use the technology to improve customer service, not just production. This approach to finding strategic applications has been called "top down scanning" (Krcmar and Lucas, forthcoming).

Does the technology offer a solution to a key problem? How is the competition using the technology? Can the organization adapt an innovation used by a firm in an entirely different industry? Several firms in the eyecare business are providing personal computers with packages for running an optician's office in return for a guaranteed percentage of the optician's business. This strategy seems very similar to those adopted by the airlines and American Hospital Supply Corporation.

In addition to searching for opportunities via top down scanning, management has to recognize good ideas when the arise in the organization through "bottom up inventing" (Krcmar and Lucas). It is important to provide resources when an innovation surfaces in the firm; management does not

have to be the source of creative ideas, but it has to help them flourish (Mintzberg and McHugh, 1985).

Hands on Computer Use

One of the least interesting debates in the information systems literature in past years has been the question of whether or not managers should have hands on use of computers (Dearden, 1983). Using a computer can both help a manager in his or her work and can provide a level of comfort with technology. It is not possible to force a computer on a senior level managers, and individuals in the field who promote technology probably have to realize that there are "anti technology" managers who will never work on a machine.

How can technology help a senior manager? There are a number of ways to encourage computer literacy and use by senior management; three which have proven particularly successful include:

1. Electronic mail. Electronic mail is an unstructured form of a communication and information system; the system provides an information sharing capability, but does not determine what information is distributed or to whom. Senior executives including the chairman of DEC are among the 60,000 users of its electronic mail system. If a senior manager is convinced to use this medium, electronic mail will rapidly become pervasive as managers at other levels want to be sure they are included in communications.

2. Executive Information Systems (EIS). An EIS is no different than any other information system, except its user population is supposed to be the top management of a firm. Possibly being included in the users of an EIS is flattering as it connotes that one is a senior executive. Another possibility is that the term EIS calls attention to the fact that the information system is a high visibility application and had better work well. Several companies offer sophisticated user interfaces including touch screens and interactive graphics as shells to deliver the key information that a firm's executives want to see.

Quaker Oats is a company which has developed an EIS. Managers use the system to monitor key sales and financial statistics and to see how the competition is performing. Senior executives access the data through hands-on use of a microcomputer. The information services department purchased an EIS package and developed programs to consolidate data from multiple sources for management (PC Week, January 19, 1988).

3. Managerial Workstations. Having succeeded in getting a manager to work with a terminal, one can add applications until the terminal becomes a workstation. With current and coming technology, a manager can easily undertake a variety of information processing tasks from composing a memorandum to asking "what if" questions of a spreadsheet model.

A managerial workstation should have a good menu program to hide the underlying operating system. Other attractive general purpose software for a workstation includes a spreadsheet program, word processor, presentation graphics, and a communications program for mail and for sending and receiving documents. Custom programs might include an EIS application or other ways to access data on the firm's transactions processing computers.

Impact

How do these management actions address the three classes of constraints described earlier? By undertaking the actions in Table 1, management demonstrates competence and the will to manage information technology. The recommendation to build a technological infrastructure is intended to remove a major class of constraints. The creation of an infrastructure will require management to coordinate information processing in the organization. Management attention to an infrastructure and involvement in systems design should help produce new applications which offer the minimum number of constraints in the future. Finally, hands on use of a computer familiarizes the manager with technology; it and a search for opportunities help the firm develop robust technology.

CONCLUSIONS

The integration of information technology with planning and decisionmaking is crucial. Technology has become so

pervasive that it is hard to imagine a major decision which does not have technological ramifications. This paper has described two paradoxes the manager will encounter in trying to integrate technology with planning: the fact that existing technology may constrain the firm in using new technology and the need to sustain a competitive advantage once it has been achieved.

By taking some of the actions suggested in the paper, managers can reduce the constraints on their ability to utilize new opportunities presented by the technology. When planning a competitive system, the manager has to be prepared for future investments to sustain the competitive edge the system provides. Technology offers tremendous opportunities, but it must be integrated with decisionmaking and strategic planning to make its maximum contribution to the organization.

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