

COMPUTER SUPPORT FOR MANAGERS

Today's business data processing systems do not serve managers' information needs well. Most application systems have been developed to perform operational jobs—keep records, prepare invoices, write pay checks, and so on. Yes, some things have been done to help managers—summary reports, for instance, and some analyses of data. But only a small fraction of the information that a manager needs comes from the computer. The higher on the management scale that the manager is, the more this is apparent. But we think that the computer environment of the 1980s will try to change this situation significantly. New hardware and software products will be offered that *directly* help managers to do their jobs. In this report, we get into this subject by discussing what activities managers perform that are amenable to computer support.

Continental Illinois National Bank, with headquarters in Chicago, is a large international bank; it is the seventh largest in the U.S., according to *Fortune* magazine, but is fourth among the U.S. banks in its international operations. The bank has over \$27 billion in assets and employs more than 10,000 people. It has commercial representative offices in nine U.S. cities and subsidiaries and branches in many other countries of the world.

Like many major companies, by the mid-1970s the bank had been looking at ways that computer technology could aid office functions. A technical planning and review effort had been organized, to systematically look at where the technology was going and the opportunities that new technology offered. Several somewhat independent projects were initi-

ated for improved office functions, including the installation of some word processing systems.

Then, in the fall of 1977, a significant change took place, as an outgrowth of the technical planning and review. Bank management saw that the plunging costs for information processing and storage would soon begin to impact the office in a major way. More benefits would be realized by an integrated effort on office systems; independent projects would not be sufficient.

Also, management began to see a new way to solve a familiar problem. This problem was their huge end-of-quarter printing workload, involving some ten million lines of print per day. A significant portion of this printing was made up of listings of all records in specific

files (such as journal files and some customer account files) that office workers would use for quick lookups.

In the past, this growing printing problem had been solved by obtaining more and faster printers. But on the horizon was new technology that would allow the bank to store much of the report data on-line, with indexes for fast retrieval. Employees could then use terminals to retrieve specific information upon demand, eliminating the need for the quick lookup reports. The goal was to cut down the printing, not give in to it.

So, in late 1977, an overall 'office automation' project was created and a team formed; it was officially in business on January 1, 1978. Management decided that this overall project should chart a path by which the bank could move ahead with new office systems and, at the same time, take advantage of the projects that were already underway.

What the bank has accomplished in the past eighteen months consists of a number of elements, some of which were already underway when the overall project was formed. Following is a list of the key elements.

Quick reports. A few years back, if managers wanted special reports prepared from computer files, they had to submit their requests for the required programming. It then usually took several weeks before a report was delivered, and the cost was about \$2,000. Consequently, very few such reports were requested. Then a file management system was obtained; with it, the delay was cut to about two weeks and the cost reduced to a few hundred dollars. The number of requests went up, and so did the load on the central printers. In late 1977, the systems department developed CARL, a 'quick batch' reporting system. With CARL, user department people enter report specifications on a terminal. The resulting report is printed out (or displayed graphically) at the terminal, often within 30 minutes and at a cost of under \$20. Bank management now requests about 60 such reports per day, but without a consequent load on the central printers.

On-line queries. The next step taken to improve performance and reduce the load on the central printers was to install an on-line query

system, which the bank calls IRIS. IRIS currently uses IBM's STAIRS inverted file system which allows users to retrieve records on the basis of specified values of data fields.

Special IRIS files have been set up, which are managed by STAIRS. These files are loaded with data selected from the regular data processing files, on a daily basis. In addition to such internal data, some external data is also purchased, such as financial data on company sales and earnings. So far, this external data is quite limited; it is expected that more will be provided in the future.

Since many of the user departments already had terminals, for other applications, IRIS was ready to go by the spring of 1978. By the end of last year, several hundred managers and professionals (for instance, sales people for selling bank services) were regularly using the system.

The use of IRIS is expected to spread, as the number of terminals increases. Eventually, all managers, professionals, and secretaries may have terminals at their desks. Sometimes a shocked silence greets this proposal, they told us, until it is pointed out that a low-function dial-up terminal now costs the bank less than an electric typewriter. As a point of interest, about one-half of the managers and professionals who now use IRIS use the terminals themselves; the other half work through intermediaries.

Both CARL and IRIS have eliminated a large fraction of the programming time previously required to write retrieval and reporting programs. Programmers generally did not like this work anyway, as it interrupted their regular work. However, custom programming is still required at times, when special formatting of output is desired.

Graphics. Originally, CARL and IRIS retrieved data and presented it in numerical form. To aid the comprehension of the data, the office automation project has developed a color graphics system, that uses a color CRT for soft copy and a multi-color pen plotter for hard copy. Also, some data analysis routines have been provided.

In the use of this system, the user asks CARL for the desired data. When satisfied that the appropriate data has been retrieved, the user

calls on one or more of the analysis routines, such as fitting trend lines to the data. The graphical data is then displayed on the CRT. If hard copy is desired, output on the plotter is requested. Also, each graph is customized, with the axes scaled according to the data.

This is the information system that is most impressive to senior management at the bank, we were told.

Computer message system. The bank has had a communication network in place for some time, that ties headquarters to all bank locations. A computer message system has been added, as a network service. A 'friendly' user interface has been developed, to encourage direct use by managers and professionals.

With this system, each user is assigned a 'mail box' number, and messages for that user are directed to that number. There is no output until the user asks to see the messages in the mail box. Routines are available that make it easy to send replies or to forward the message to other users.

This system is quite new and, as yet, most managers and professionals do not have their own terminals. But the system is beginning to replace inter-office mail.

Word processing. The bank has standardized on one brand of word processing equipment, for compatibility. And this has made the task of interfacing the word processing systems with the communication network much easier. The word processing equipment is used in its conventional sense—to prepare letters, memos, reports, etc. by ultimately typing them on paper. But there are some not-so-conventional uses, too, as the following example will show.

Consider the case, we were told, where the Brussels branch of the bank wants to prepare a cash management proposal to submit to a Belgian subsidiary of a U.S. company. The branch people in Brussels would prepare the initial draft of the proposal, using the word processing equipment. They might then send it to New York, via the network, where it would be received, stored, and printed out on the word processing system there. The New York people would study the proposal, perhaps make some changes, and send it on (via the network) to Chicago headquarters. Some further changes

might be made there, and then the proposal would be sent back to Brussels, for printing out and delivery to the customer. If it were necessary, this whole process could be done in one day.

'Home word clerks'. Many companies are experiencing a shortage of competent secretarial help. Continental Bank has put its word processing and computer message system to work for alleviating this problem. The bank has begun employing young mothers, retired persons, and handicapped persons for a position called 'home word-processing clerk.' These people do typing on word processing equipment that the bank has installed in *their homes*.

In use, a principal dictates a letter or memo over the phone to the central dictation recording system. At that point, the message can be assigned either to the in-house word processing center or to a home word clerk, for transcribing. In the latter case, the message is transmitted to the home over the phone line and recorded there on dictation equipment. The word clerk transcribes the message, using the word processing equipment, and then transmits it to the principal via the computer message system. This approach allows the bank to hire skilled people who otherwise might not be able to do such work.

Answer phones. The office automation team recognized that answering a telephone is a very interruptive activity for a manager or professional. This activity not only takes up time but also it interrupts the person's thought processes.

Somewhat surprisingly, the telephone turns out not to be as efficient a communications process in the business environment as one might think. Why? Studies have indicated that, on the average, managers are at their desks and willing to receive phone calls only about 25% of their working time. The other 75% of the time, they are either away from their desks or are engaged in activities where interruptions are not desired.

So what happens when a call comes in during that 75% of the time. There are four cases. Case 1: The person has a personal secretary, who answers the phone and takes the message

(and perhaps decides if an interruption of a meeting is warranted). The secretary can deliver the message just as soon as the person returns or the meeting ends. Case 2: The person shares a secretary or receptionist with a number of other people. In this case, the secretary or receptionist generally answers the phone only after it has rung a number of times. If the person is holding a meeting, this ringing is disruptive. And, because the secretary or receptionist may be located some distance away, the message may not be delivered as promptly. Case 3: The person may be in the midst of a meeting, would prefer not to be interrupted, but decides to answer the call anyway, in case it is from the boss. And, often as not, the call is not that important and could have been delayed. Finally, in case 4, the call is not answered, resulting in a waste of the calling party's time.

But the problem does not end there. Suppose, in cases 1 and 2 above, a message is taken that asks the recipient to call back to the originator. Now the process can be repeated all over again.

(One of our friends, who tells us he makes dozens of phone calls a day, says these statistics do not surprise him. They are about what he experiences, he says.)

However, we are still not at the end of the problem. We have been seeing articles in business magazines that point out that good secretaries are a disappearing breed. The capable ones are moving into other, more rewarding jobs. A shortage is developing, driving up salaries—so personal secretaries for managers and professionals will become fewer and fewer.

What is the answer? The office automation team at Continental Bank decided to try using automatic telephone answering devices (answer phones), one for each manager who wanted to participate. When these managers are away from their offices, or do not want to be disturbed, they turn on the answer phones. If the phone rings during a meeting, it only rings once and the device then takes the message. The managers know that they can get the messages a short time later, when their meetings are over. Result: fewer interruptions to answer the phone.

But the benefits do not end there. An answer phone was selected that does not limit the calling party's message to a few seconds. So the calling party can leave an entire message that either requires no response ("Let's meet at 10 tomorrow morning at Fred's office; if OK with you, no need to call back") or saves a phone call ("I need such and such data; do you have it or can you get it for me?").

What the bank has found from this experiment is that the answer phone has cut the telephone time of the managers using it *almost in half*. This is a significant reduction in the number of interruptions, without reducing the flow of information.

At Continental Illinois National Bank, office automation is aimed more at serving the 'officers' than at serving the office. The goal is to increase the effectiveness and efficiency of the executives, managers, and professionals who are directing the bank's activities. The office automation team is seeking ways to reduce the number of interruptions these people encounter, and to provide them with selective, timely information that they desire for running their operations.

How can computers serve managers?

Up to the present, data processing systems have served mainly operational ends. The computer has been of relatively little *direct* help for managers. And the higher the person is in the management hierarchy, typically the less the help from the computer.

We think this is going to change, and in the not-too-distant future. As the computer field becomes more competitive, due to the emerging micro computers and plug-compatible computers, we think that the suppliers are going to look at this relatively untapped market as the source of new business. We think they will try to expand their markets by offering unique new products and services to serve managers.

To set the stage for discussing how computers can be expected to serve management, it will be helpful to discuss what it is that managers do. Out of a manager's many activities,

some will (hopefully) show up as amenable to computer support.

If that discussion sounds like a tall order, it normally would be. However, as luck would have it, we came across two excellent books that address this question—which of the activities that managers perform and which of their decisions are the most suitable for computer support? One book is *The Nature of Managerial Work*, by Henry Mintzberg (Reference 1). The other is *Decision Support Systems, An Organizational Perspective*, by Peter W. G. Keen and Michael S. Scott Morton (Reference 2).

We will first consider just what makes up the job of the typical manager, as reported by Mintzberg.

Managerial work

In developing his views on the manager's job, Mintzberg draws not only on his own research involving a number of chief executives but also on the work of several other researchers. In total, these studies covered organizations ranging in size from a few employees to many thousands, in both government and private industry, and from the foreman level to the chief executive. Variations were observed, but those variations were mainly differences in the degree that certain activities were emphasized. In general, each manager studied had the same set of activities.

Just what were those activities? They were not, Mintzberg emphasizes, the classical functions of management—planning, staffing, organizing, directing, co-ordinating, etc. Not that these things were not done; it is just that when managers were asked to classify the things they had been doing, the response was never in terms of these activities. These 'classical' activities of management tend to become very inter-mingled.

The approach followed by Mintzberg, and the other researchers he draws upon, was the work activity study method. In this approach, either the managers are asked to keep diaries of what they do and then go over the activities with the researchers at the end of the day, or else the researchers sit in with the managers for a period of time, keeping records of what the managers are doing.

The different studies quoted by Mintzberg gave remarkably consistent results. From these, he developed his ideas of the characteristics of a manager's work and the different roles that a manager is called upon to play.

Characteristics of the job

Mintzberg sees six main characteristics of a manager's job, whether that manager is a foreman or a chief executive.

Much work is done, at an unrelenting pace. The manager's job is an open-ended one; there is always more that can be done. At the lower levels of management, the manager may be able to stop work at the end of the normal work day, although during the day, his or her pace may have been hectic. In the higher levels of management, managers often work longer than the regular hours, and also take work home with them.

Brevity, variety, and fragmentation are characteristics of the job. In the lower and middle levels, the manager may handle from 200 to 1000 incidents a day—a work life of constant interruptions. Chief executives have a lower number of incidents, perhaps in the order of 50, but each is on a distinct issue. In general, over one-half of the activities consume less than nine minutes each. Part of this is tolerated, or even encouraged, by the managers in order to gather information. Another cause of this work environment is the number of different roles that the manager must play. We will discuss these two causes in more detail shortly.

Preference for live action. Managers tend to prefer activities that are current, specific, well-defined, and non-routine. Mail processing is considered to be a burden, since mail is not current and has no immediate feedback. To gather the current information that the manager seeks, telephone calls and unscheduled meetings are given priority.

A communications node. Managers are the nerve centers for the organizations they direct. Information from superiors, from subordinates, from peer managers in other units, and from outside sources funnel into the managers. Also, they disseminate information back to those parties.

The work activity studies have shown that managers typically spend between one-third and one-half of their time in communication with subordinates, less than one-fifth time in communication with superiors, and from one-third to one-half time communicating with outsiders. The outsider contacts break down as follows: about four-fifths of it with various people inside the company and one-fifth with people outside the company. These are average figures. Chief executives, for instance, spend a larger percentage of their time dealing with people from outside the company. These include business associates, suppliers, customers, government and trade organizations, lawyers, and so on.

Preference for verbal media. Managers have five ways for receiving and disseminating information. These are: mail, telephone, unscheduled meetings, scheduled meetings, and tours (walking through the organization, observing, and conversing).

The handling of written media is considered to be a chore. Mail is processed just as quickly as possible; only about 25% of it deals with something of current interest to the manager. Periodicals are skimmed, to see if anything catches the manager's attention. The same is true of reports, and particularly lengthy reports.

On the dissemination side, managers dislike to write their messages. Words have to be more carefully chosen than for verbal messages. And, generally, written communications involve slow feedback.

From this, it should come as no surprise that managers prefer to communicate verbally. Further, telephone calls and unscheduled meetings represent about two-thirds of the verbal contacts; scheduled meetings and tours make up the rest.

Scheduled meetings take up some 59% of the average manager's *time*, Mintzberg reports. These meetings are for ceremony, for negotiation, for strategy making, and so on. All are time consuming and involve many participants. But they do provide an opportunity to receive or disseminate important information (perhaps unrelated to the subject of the meeting).

Because of this preference for verbal media, Mintzberg observed that local subordinates re-

ceived much more attention than remotely located subordinates. The local people could use the telephone or face-to-face conversations, which the managers prefer, while the remote people were often forced to use the mails.

Blend of rights and duties. To what extent is a manager in control of his time and to what extent is it controlled by others? Most of the manager's daily contacts are initiated by others. In studying the activities of a manager, one does not get the impression that the manager is like the conductor of an orchestra, leading and directing everything. In fact, the impression may be just the opposite—that the manager is more like a puppet, controlled by others.

These impressions are not quite correct, says Mintzberg. Managers *can* decide on many long-term commitments. If they agree to such commitments, then those commitments control many of the managers' day-by-day activities. So control is exerted in terms of a few crucial decisions, some of which must be made soon after the managers assume their offices.

Breakdown of the manager's time. Mintzberg reports that, on the average, managers spend 59% of their *time* in scheduled meetings, 22% at desk work, 10% in unscheduled meetings, 6% on the telephone, and 3% on tours.

In terms of the *number* of activities or events that managers must handle, desk work represents 33% of the total number, telephone calls 24%, scheduled meetings 19%, unscheduled meetings also 19%, and tours 5%.

These, then, are the main characteristics of the managers' jobs. Now let us look at the various roles that managers are called upon to play.

A manager's roles

Mintzberg sees ten types of roles that make up the manager's job. In theory, a manager must play all ten roles. In practice, some roles are less relevant to a particular job, or a manager may delegate some roles to subordinates. But it is the manager's ultimate responsibility to see that all ten roles are played.

A point to make at the outset is that these ten roles have a fair amount of overlap among them. And some roles are supportive of others.

The first three roles concern inter-personal relationships, tied to the manager's status and authority. The manager plays these *as a person*, so that computer technology would be of little help to the manager in performing these roles. Thus we will just list them.

The manager is the *figurehead* for the organization, the symbol of authority. And the manager is the *leader* of the organization, giving guidance and motivation. Thirdly, the manager must perform *liaison* with individuals and groups outside of the organization.

The next three roles identified by Mintzberg are the *informational* roles. Since one might expect computer technology to provide support here, we will describe them a bit more fully.

Monitor role. In order to detect changes in the environment, identify problems, and build up knowledge in order to be prepared when decisions must be made, the manager seeks information. The typical manager is successful in this—and is literally bombarded with information.

Mainly via verbal media, the manager receives information on internal operations, external events, analyses that people have made, ideas on trends in the environment, and pressures from others seeking to influence the manager.

The formal reporting system is generally of little help to the manager for gathering all of this information, Mintzberg says. Formal reports deal mostly with history and with summaries of events. The manager seeks current information that is specific to situations.

Some managers enmesh themselves in operating problems, he says. A good manager might do this in order to keep informed on the decisions that are being made, and not be left at the mercy of subordinates as to what information is received.

A point to note: because of the manager's figurehead, leadership, and liaison roles, no other person in the organization receives the variety of information that the manager does.

Since the bulk of the information is received verbally, the manager must remember it. Notes are often made, but an excellent memory is a definite asset to the manager. The manager filters the information received and then

disseminates selected portions—to superiors, to subordinates, and to outsiders.

Disseminator role. Since so much of the manager's information is received verbally and stored in memory, it is difficult to disseminate all relevant information to the appropriate parties. Verbal transmission is time consuming and imprecise. Human memories are typically faulty, thus garbling the information.

Slow or not, garbled or not, the manager *must* disseminate information. And because it is almost impossible to disseminate all relevant information to subordinates, this means that no subordinate can really assume the roles of the manager in the manager's absence. Because of this difficulty of communication, delegation of responsibilities is constrained. (It should be noted, of course, that some managers deliberately hold back relevant information from subordinates, in order to keep certain types of decisions in their own hands.)

Spokesman role. Dissemination means passing information on to others, particularly to subordinates. But the manager must also be the official spokesman for the organization, for conveying information to superiors and to outsiders.

One might expect that computer technology could help the manager in the functions of receiving, storing, and disseminating information. But it is also clear that the business data processing systems in existence today have not been designed to do that.

We will shortly have more to say about how computer technology might help. First, though, let us consider the last four roles—the *decisional roles*.

Entrepreneur role. The manager is the initiator and monitor of most of the controlled change in the organization. The manager searches for areas of possible improvement, perhaps for adapting the organization to a changing environment, and then sets up improvement projects.

Disturbance handler role. Another general type of decision that the manager must make is the detection and correction of troubles within the organization. These can be from many causes—inadequate procedures, employee mistakes, actions by other organizational units, actions by customer or suppliers, etc.

Since the manager is responsible for the detection and correction of troubles, whether caused by internal or external parties, this is one reason for the manager seeking information from so many sources. And since so many of these possible troubles would not be detected from the formal reports, this is why informal, verbal contacts play such an important role in the manager's business life.

Resource allocator role. The manager must schedule his or her own time, must assign work to subordinates, and must authorize actions that subordinates request. This is the type of decision most often mechanized by operations research and management science practitioners.

Negotiator role. The manager occasionally must deal with other organizations or individuals, to negotiate the use of the organization's resources. The manager plays the role of the figurehead and the spokesman here, and is the one person in the organization who can make a decision on the use of resources.

Here, then, are four general types of decision areas—initiating improvements, handling troubles, allocating resources, and negotiating with others—that the manager is involved with. Since the early 1950s, there have been a lot of hopes and much research work on the idea of using computers to aid such decision making. But the problems have proved to be complex and difficult to solve; accomplishments have fallen far short of expectations.

Why have computer technology, operations research, and management science not been more successful in aiding management decisions? And how might this picture change in the future? To consider these questions, let us now turn to the work of Keen and Morton.

Computer-aided decisions

Keen and Morton (Reference 2) have been deeply involved with the development of computer-based decision support systems that have been both experimental and real-world prototypes. In addition, they have kept abreast of relevant developments in other decision making disciplines, such as operations research, management science, management information systems, and behavioral sciences.

Like Mintzberg, they have classified the decision making process into a number of categories. One classification is in terms of the schools of thought on how decisions are made.

Schools of thought

Keen and Morton see five main schools of thought on the decision making process.

Rational manager. This viewpoint comes from the economists, who see decisions made on the basis of an analytic definition of the variables involved and precise criteria for choosing a solution. Today there are very few supporters of this view of decision making in its pristine form, say the authors. Decisions just are not made as rationally as this viewpoint indicates. At the same time, a degree of rationality does exist, but is tempered by other considerations.

'Satisficing' view. This school of thought sees managers as seeking 'good enough' solutions to problems—better solutions, not the best. Managers try to improve on an existing process. They move away from ills, more than toward goals.

Organizational procedures view. This school sees decisions being reached through the joint efforts of a number of people—in short, management by consensus. This consensus does not occur haphazardly; rather, standard operating procedures are set up to insure that all decisions of significance go through the review and consensus process.

Political view. This viewpoint recognizes that power centers exist within every organization. Some managers simply have more power to influence decisions than do their peer managers. So decisions must be made in conformance with the likes and dislikes of these power centers. There is little use, say the followers of this school, in trying to push through a decision that is sure to be vetoed by someone in power.

Individual differences view. Managers make decisions. Managers are people. Every manager is an individual, with an individual decision making style. Some managers like to receive a lot of information before making a decision, while others seek very little. Some use analysis, others use intuition. Some like to consult with

other people, while some are almost dictatorial in their decision making.

Where lies the truth among these five schools of thought? There is no single view that embodies the truth, conclude the authors; each of the five contains part of the truth. In order to develop a decision support system that will be both useful and used, all five of these viewpoints must be considered during its creation.

It seems to us that this observation by the authors helps to account for the relatively slow acceptance of operations research and management science decision models. Those models seek optimum solutions, and are based mostly on the 'rational manager' viewpoint. They often have not been accepted, not necessarily because the models were poorly designed but rather because the designers may have ignored these other viewpoints.

This observation by the authors also seems to imply that hardware and software suppliers will have a very difficult time developing and selling general purpose decision support systems. The observation says to us, "Every organization is unique, if one accepts the validity of these five viewpoints; therefore, it is unlikely that a decision support system built outside the organization can be successfully imposed on that organization. A decision support system must be built to meet the unique needs of the organization."

But suppliers might provide *tools* with which decision support systems can be built.

Somewhere within the wide variety of decisions that a manager must make there must be areas where computer technology can assist. If the most that can be expected is hardware and software tools, and not complete decision support systems, where might those tools be used most successfully?

The authors identify nine types of decisions, as a way of pinpointing where computer-based methods have the best chance of success.

Types of decisions

Keen and Morton draw on the work of Robert N. Anthony (as presented in his book *Planning and Control Systems: A Framework for Analysis* (1965)), for one dimension of decision making. Anthony identified three general levels

of decisions: operational control, management control, and strategic planning. Operational control is concerned with the present; it uses detailed, accurate data that originates within the organization, and is performed frequently. At the other extreme, strategic planning is more concerned with the future; it accepts data that is less detailed and less accurate, seeks information about the external world, and is performed infrequently.

For their other dimension of decision types, the authors classify decision areas as: structured, semi-structured, and unstructured. With a structured decision, all of the rules are known and can be programmed into a computer. In a semi-structured decision, only some of the rules are known and can be programmed; human judgment must be used for the remainder of the decision process. And in unstructured decisions, human judgment is everything.

With these three levels of decisions and three levels of structure, the authors propose a nine element matrix. That is, for operational control, there are structured, semi-structured, and unstructured decisions—and the same for management control and strategic planning. We will explain each of the nine types briefly, by way of examples.

Structured decisions. At the operational control level, an example of a structured decision is the inventory reordering decision. This decision has been highly mechanized at a large number of organizations. At the management control level, the decisions are more complex and involve more variables. The use of linear programming models in the petroleum industry, for scheduling work into refineries, is an example. And at the strategic planning level, an example of a structured decision is one that determines in what part of the country to build a new warehouse facility.

The authors point out that much of the successful operations research work has been done in this area of structured decisions. The three examples given—inventory reordering, refinery scheduling, and warehouse location—are all classic OR models.

Even with decisions that are 'completely' programmed, human judgment can be used to

override the decisions. This may occur if factors that were considered of secondary importance, when the model was built, suddenly assume a much greater importance.

Semi-structured decisions. As mentioned, part of these decisions can be programmed but other parts must be handled by human judgment. At the operational control level, an example might be a cash management decision, for moving funds into and out of both short term and longer term investments. The model might say to move funds to another country, to get the current higher rate of interest there. But the newspapers might warn the company treasurer that a currency devaluation is quite possible in that other country. So human judgment would override the funds management model.

Moving up to the management control level, an example might be the development of a department's annual budget. The computer might be used to provide a budget worksheet—this year's budget, year-to-date actual, and the model's estimate of next year's budget, for each budget line item. But the manager would be expected to apply judgment, based on what can and cannot be accomplished by the organization. And at the strategic planning level, models can be (and have been) developed for analyzing merger and acquisition decisions. Such things as pro-forma financial reports can be prepared by the computer, under several 'what if...' situations. But human judgment would play a big role in the final decisions.

It is in this area of semi-structured decisions that Keen and Morton see the greatest potential for decision support systems.

Unstructured decisions. These decisions rely almost entirely upon human judgment. At the operation control level are the 'artistic' decisions that are made frequently, such as selecting advertising copy. At the management control level, an example is the hiring of a new manager. And at the strategic planning level might be the selection of the research and development project portfolio for an organization.

This has been a very brief summarization of the books by Mintzberg, and Keen and Morton. Let us now step back a bit, to see what clues

these books give as to the aspects of a manager's job that computer technology might assist.

Some general observations

One point should stand out clearly, even with the brief summary of the cited studies. There is just no way that computer technology will 'take over' the work of *any* level of manager. Managers just have too many roles and too many semi-structured and unstructured decisions for there to be 'automated management.'

It may well be the case, of course, that computer support can help managers broaden their span of control so that fewer managers are needed for accomplishing some specified workload. Generally, though, organizations broaden their objectives as they find it feasible to do so. So computer support probably would not cause a decrease in the total number of managers.

This is a non-trivial point, it seems to us. In the early 1960s, office workers saw computers as a threat to their employment and resisted the installation of computer-based systems. It became apparent before long that, while people were displaced, they generally moved quickly into other jobs. Now managers may see themselves in the same situation as the office workers were 15 to 20 years ago. It may take awhile before the 'threat' of computer support for management can be evaluated.

So where might this computer support first appear? We see the most likely areas as (1) collecting, storing, and disseminating information, and (2) supporting the structured and semi-structured decisions, by means of better information presentation.

How much help will managers receive from this computer support? A message that comes through from the two books, that space did not allow us to discuss, is the following. Computer support is not likely to result in large, measurable cost displacements, or radically improved decisions. Improvements may well be hard to quantify. Managers may accept computer support because it gets rid of some annoyances and provides a feeling of more confidence in the decisions they make, not because of cost savings.

And managers and executives *are* aware of these annoyances. Rowan (Reference 3) surveyed over 50 company chairmen, presidents, and vice presidents and asked each of them to rank his ten worst 'time wasters.' The top wasters, starting with the most wasteful, were: telephone, mail, meetings, public relations, paperwork, commuting, and business lunches. Note that the top three are the telephone, mail, and meetings—and that the executives considered these as *wasteful* of their time.

So computer support may be accepted to bolster the main shortcomings of present methods.

Shortcomings of present methods

In their informational roles, managers should be monitoring the organization's total environment. The reason is to identify changes in the environment, to determine where improvement projects are needed, to make sure the organization is carrying out its share of the goals of the enterprise, to look for trouble spots, and so on. This monitoring requires *current* information, obtained mainly by verbal methods.

But to get this information with present methods, managers pay a price.

Big filtering effort. Only a fraction of the information that managers receive via current methods is relevant to their interests. But that fraction cannot be easily defined in advance. So managers accept the deluge of information and filter out that which is relevant.

Many interruptions. Because of their wide variety of interests, managers receive many messages. They want short, pithy messages; if they hear something of interest, they assign subordinates to get more details. The messages come from many sources, so managers must allow frequent interruptions in the course of the work day. Often, the only chance they have to concentrate is in the evening.

Verbal methods are slow. People speak at an average rate of about 100 words a minute. Further, their thoughts are often not well organized, so there may be a lot of repeating and rehashing. Reading speeds are generally at least two to three times faster, and the written material is often better organized. But verbal methods are preferred because they bring current information.

Managers have to filter this information and retain much of the relevant information in their memories. Then some of it is disseminated to subordinates, again by slow verbal methods. Because of the inefficiency of verbal methods, it is impractical for managers to distribute all of the information that really should be disseminated. So no subordinate can really take a manager's place, in the manager's absence.

Big variations in memories. Some executives and managers have exceptional memories. They seem to be able to remember almost everything they see and hear and can retrieve desired information quickly. But the memories of most managers are not of this caliber. They forget a good amount of what they see or hear. To support their memories, they make notes, use tickler files, store memos and correspondence in files, write out their schedules of appointments, and so on.

Hard to retrieve information on paper media. Documents generally are filed under one classification, perhaps by the name of the originator. But quite often it is desired to retrieve information under another context. It is not too unusual for a manager to say, "I remember receiving a letter a month or two ago that mentioned a problem at company A. I'm working on something connected with company A. I wonder where that letter is." Then follows an item by item search of the files.

Also, most of a manager's memory supports are recorded on paper media, with consequent disadvantages. The documents may not be filed properly. Some may be thrown away inadvertently. If a manager is at home and needs information in his or her personal file at the office, it generally means waiting until the next day. And so on.

These shortcomings of the manager's current information retrieval methods pertain to both internally and externally generated information. Information that applies to a problem or a decision that the manager is working on may be known to exist—but where is it located? Or, just as bad, it is known to be in the data processing files, but special retrieval and reporting programs have to be written to get at it, and no programmer time can be spared. In other instances, those special programs are

written, but when the results are delivered, the manager finds that the question was phrased wrong.

Information not sufficiently comprehensible. This shortcoming is particularly true of large volume computer printouts. The manager first has to search through a printout for the data. When it is found, what is seen is a list or table of numbers. From the raw numbers, it is hard to detect trends, or changes in trends, or significant variations, or to make extrapolations. Either the manager does not get a clear picture from the raw data or someone must take the time to put the data into more comprehensible form. For example, consider the 'management chart rooms' used at many companies.

In addition to these shortcomings in information handling methods, there are some evident problems with current decision making methods.

Shortcomings in decision methods. Some of the difficulties in decision making are a direct result of the shortcomings in managers' information handling methods.

'Superficial' decision making. One characteristic of managers' work is that the workload is heavy and is performed at an unrelenting pace. This is partly due to the slowness of verbal information exchange, and also to the need to receive 'raw' information from many sources. The manager usually cannot afford to spend much time on any one decision, and so may consider only a few of the relevant factors—and completely overlook something significant. Hence, says Mintzberg, much of the manager's work is done superficially.

Structure not perceived. As late as the mid-1950s, the inventory reordering decision was considered to be quite judgmental at many companies. Due to the huge mass of data, for the many items in inventory, managers did not see the structure in the decision. But the operations researchers found that structure in the late 1950s, and now the reordering decision is mechanized at many, many companies. The result has been more consistency of decision-making and less waste in inventory reordering.

There probably is structure in many of today's judgmental decisions. Until that structure can be found, however, managers will continue

to use their individual decision-making styles, with consequent variations and (probable) waste.

Incomplete information. When information is hard to retrieve—because it is filed away and cannot be located or because retrieval programs cannot be written in time—a manager may be forced to make a decision based on less information than might be desired. This can lead to poor decisions.

Hard to test 'what if...' conditions. When judgment is required, it helps if the decision maker can test out a number of 'what if...' cases. The sensitivity of the results to the different decisions can then be measured. This may indicate the need for further study before making the final decision, if the penalties for a poor decision are severe enough. But this testing is hard to do with manual methods.

These, then, are some of the shortcomings of the manager's present information handling and decision making methods, as they came through to us from the works of Mintzberg and Keen and Morton.

The next question is: how might computers help to overcome these problems?

How might computers help?

Here, briefly, are the areas where we think computers can provide support for managers.

The informational roles. Managers need the wide variety of information that they are now receiving. So a main objective of computer support is to provide some of these types of information by the computer, in a timely and efficient manner; the remainder of the information would still flow by present methods.

Reduce interruptions. Telephone calls and unscheduled meetings together represent about one-third of managers' activities and take up about one-sixth of their time. Further, these activities often interrupt the managers' thought processes. The activities cannot be eliminated, but they can be reduced. The goal would be to provide current information with fewer interruptions and in a form that it can be assimilated more easily.

Reduce scheduled meeting time. Scheduled meetings represent about one-fifth of managers' activities, on the average, and take up al-

most 60% of their time. Again, meetings cannot be eliminated, but it should be possible to reduce them, both in number and in duration. Technology should be able to provide for pre- and post-meeting information exchange, on a rapid basis, to allow for screening the purpose of the meeting, preparing the meeting materials, and later, for disseminating the meeting results.

Improve dissemination. Between one-third and one-half of managers' time is spent with subordinates, mainly in verbal information exchange. Not all relevant information can be disseminated by the manager, because of the slow verbal method and lapses of memory. Technology can help the manager pass along more of the relevant information.

Aid in 'desk work'. Desk work represents about one-third of the activities and almost one-fourth of managers' time. Part of this work is preparing written material—letters, memos, reports, proposals, etc. Many managers find writing to be almost painful, as they make frequent revisions in phrasing. Technology should help make this task easier, by making it a simple matter to make revisions or to insert material that has already been prepared.

Computer message systems, answer phones, word processing, and so on, are tools for improving these informational roles.

The decisional roles. We do not see operations research models being accepted any more readily in the next five years, say, than they have been in the past 15 to 20 years. Acceptance will continue to grow, but at a slow pace.

What we *do* see happening is the introduction of techniques to support the manager's judgmental decisions.

Aid information retrieval. The manager often knows that information exists but cannot get at it—it is lost or mislaid, someone has borrowed it, or special programs are needed to extract it from computer files. The goal of tech-

nology should be to provide easy access to both personal files (correspondence, memos, tickler files, etc.) and to data processing files. With this facility available, companies also will be more willing to set up files about the external environment, perhaps using data purchased from others.

Aid comprehension. For many people, information that is presented in graphic form is more meaningful than seeing the same information as columns of raw figures. The use of graphics will allow information to be shown in bar chart or line form. Color graphics will allow the computer to flag items for the manager's attention. The better the comprehension, the better the resulting decision is likely to be.

Support the thought processes. Coupled with the use of graphics, analysis routines can be provided for showing trends, changes in trends, ratios, significant variations, and so on. In instances of structured decisions, decision models might be built

These, then, are the areas within managers' jobs where we would expect computer support to appear first.

Next month, we will discuss some user experiences with two methods for determining managers' information needs. One of these methods is IBM's 'business system planning' (BSP), that a number of companies have started to use.

Computer support for managers is not something of the far future. It is already arriving.

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