EXECUTIVE INFORMATION SUPPORT SYSTEMS

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The exact words are always different. They come from diverse people in disparate organizations and are uttered with varying degrees of urgency. But the inquiries are always from the upper echelons of each organization and the inherent question is always the same. Moreover, it is being asked with increasing frequency these days.

The head of information systems of a major consumer goods company phrased it this way, "The President has been reading a lot of articles about executive use of information. He wants a terminal on his desk. What do I do now to turn this into a useful exercise rather than the quickly-discarded or little used electronic sham I see in some top executive terminal use today?"

The President of a machinery manufacturer said, "I know very well that I'm using my staff too much to rework, reanalyze and graph out data which comes directly from our computer system. Either I or my staff should be able to interact directly with the system to provide the information support I need. I have a strong feeling that we ought to get started on this. Where do we start and what should our ultimate aim be?"

But a key administrative staff member in the Office of the President of a large chemical manufacturer, wearing a very amused smile on his face, said it with the most urgency. "The President bought a home computer six months ago. He's been happily working on his own investment portfolio with it and told us last week that he was sure that he ought to be able to use computers directly in the management of the

corporation. We need a plan to make this happen."

These three questions and others with exactly the same intent launched us eighteen months ago into a study of what we now term "Executive Information Support" (EIS), a type of computer usage which we perceive to be growing very quickly, and to have major implications for both the informations systems field and the management of corporations in the 80's. Six major conclusions have arisen from the study thus far. These conclusions are:

I. There is a small, but rapidly growing, number of senior line managers who desire today to make use of computer-based information retrieval and analysis. The underlying objective, in almost all cases, is improved performance in carrying out the basic top management functions of planning and control, that is, the development of deeper and better analyses for monitoring the organization's progress and charting its path into the future.

II. Existing concepts concerning managerial use of computer-based information are helpful but incomplete, both conceptually and pragmatically, in providing guidelines to these executives concerning the development of such systems.

III. A few companies have made significant and successful progress in providing their top management with accessible computer-based information. Some of these systems have been operating for several years.

IV. The emerging field of executive information support can be conceptualized in a managerially meaningful way.

V. Executive information support systems are one significant result of a new, and vastly different era in the use of the computer. A new managerial perspective is necessary for this era. Many techniques which were successfully used to manage the development of computer-based systems in the past are actually counter-productive for these new systems.

VI. There are significant implications for executive action which arise from the emerging trend toward the development of executive information support systems.

To reach these conclusions, we studied the concrete efforts of twenty companies to gain an understanding of how they were using the computer to provide information support to top managers. We did this in the belief that the "inductive approach" (generalizing from observed pragmatic case evidence) would enable us to best comprehend the real role of the computer with regard to executive information support. We chose companies which for several years had been placing major emphasis on the "information" role of the computer as opposed to "paperwork processing". Each company studied had at least one relevant system. Most had been in use for a period of one or more years, were now considered as successful and had become part of the organization's working life. As will be noted later, from these examples, a clear pattern has emerged. The pattern indicates a set of guidelines for

managerial actions in this area. It is currently being used to assist organizations, such as those described in the opening paragraphs of this article, desiring to move into the field of "executive information support".

Let us look at each of our six findings in turn:

I. The Need for Executive Information Support

At the top executive level in most corporations there is very little perceptible impact from three decades of computer technology. What little there has been has quite often degenerated into unused systems and dust-ridden terminals. There are those who feel this "degeneration" is inevitable because top executives "just don't use formal, hard information."[1]

To the contrary, almost all senior executives do use this type of information. We observe top managements making use, in varying ways, of much formal data concerned with the planning and control processes in their organizations. Data is used at least monthly, and often more frequently, to monitor the progress of each subdivision in the company. Sales data is scanned to keep abreast of major trends. Continual track is kept of major new developments and the progress of major change-oriented programs. Long range plans are developed and scrutinized in great detail. And, increasingly today, strategic data is being gathered and analyzed. However, in many companies, very little, if any of the computer resource has been devoted to these very

significant processes.

If one were to take a cross-section of the information systems status in most major multi-divisional organizations today, it might be diagrammed as in Exhibit 1. A host of good paperwork processing systems exist to support the order-processing, manufacturing control and financial accounting aspects of the business. Applications such as order entry, billing, accounts receivable, inventory, payroll, general ledger and so forth abound. They are supported by a set of data bases oriented toward the efficient processing of the necessary transactions and the resulting paperwork which are the lifeblood of the business.

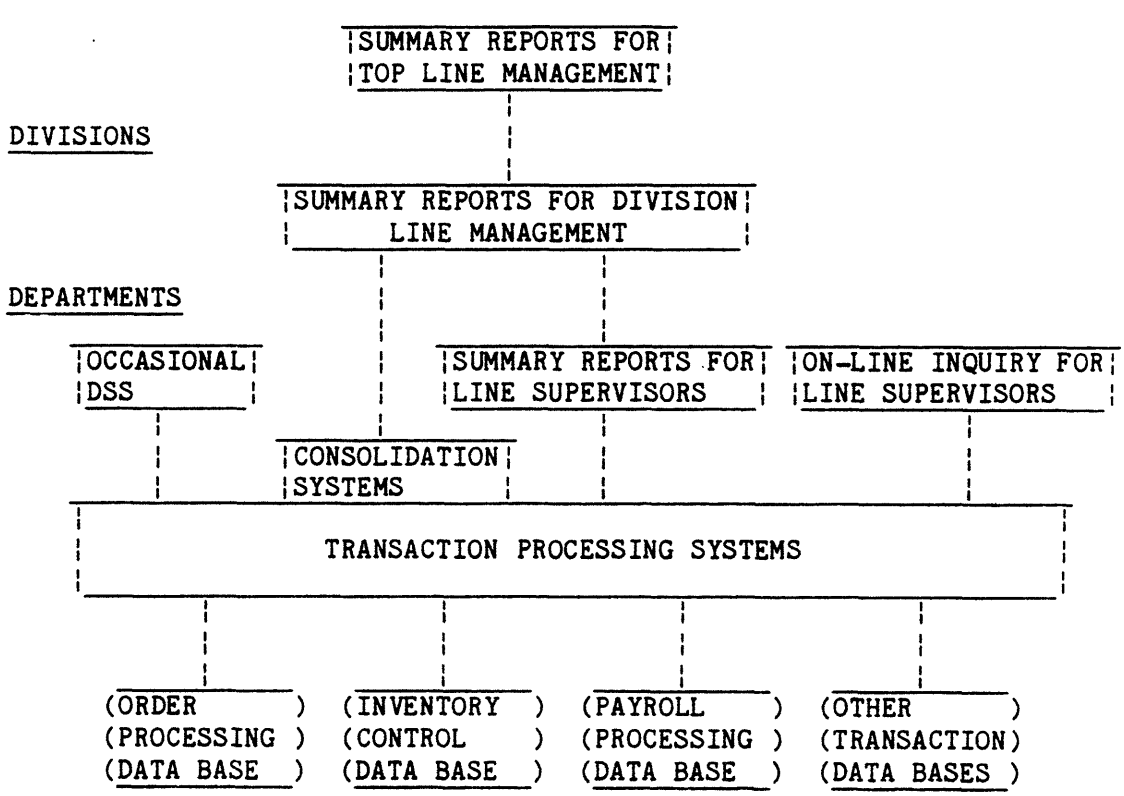

EXHIBIT 1
TRADITIONAL INFORMATION SYSTEMS
IN A MULTI-DIVISIONAL ORGANIZATION

The information in these "operational data bases" is made available either on-line or in standard reports to first-line supervisors to help carry out the day-to-day functions of the firm. Some of this data is forwarded in electronic or paper format, most often in reworked form, to the divisional and, ultimately, to the corporate offices as part of a monthly regular reporting process. In addition, there are quite often today, scattered throughout the lower and middle levels of the organization, a few "decision support systems" aimed at helping a particular manager to effectively zero in on a particular decision.[2]

Given this concentration of computer resources well below the corporate office, most top executives today receive the formal information they desire only through periodic, delayed and most often heavily aggregated paper reports with fixed, unvarying formats, or through oral reports. Desired analyses are either carried out by staff personnel or not done at all.

What many executives are asking for, however, is the ability to have increased visibility into the workings of the corporation and its environment. For this, they feel they need to have access to a broader sweep of current data, often at an increased level of detail. In a number of cases, we find they also desire to manipulate and analyse this data themselves.

II. Existing Conceptualizations of Computer Support for Managers

For those executives wishing to develop systems to satisfy these felt needs, there has to be a clear conceptualization of the purposes of and alternative approaches to such systems. Key design guidelines must be clarified and emphasized. In short, there is a need for a framework for the development of the appropriate system for each particular executive.

The primary conceptual approach to computer-based support of managers currently is that of decision support systems (DSS).[3] This method, originated many years ago by Scott Morton of M.I.T., is aimed at harnessing the computer to support a decision-making process. In this approach, the computer is used to do what it does best. It stores data, manipulates the data, and outputs data in textual, numeric, or graphic form. The manager, working at a terminal, also does what he does best. He determines what data he needs to make the decision, what aggregations or transformations are most pertinent to making the decision, and the way he desires to see the information made available to him. The computer is thus used to handle and transform the data; the manager makes the decisions.

There are many repetitive decisions in almost all organizations. For these decisions, DSS can be built to assist the relevant decision makers. Examples of such repetitive decision processes are the selection of bonds and stocks by a bank trust officer for a client's portfolio, the scheduling of a manufacturing plant, and the choice from

among alternative sales promotion plans by a product manager using a computer model of market response in a consumer goods company.

In general, each of these repetitive decisions is reasonably well defined; Gorry and Scott Morton call them "semi-structured".[4] Given a fair degree of structure, these decisions can be, and are, delegated to middle and lower levels in the company. Each semi-structured decision has specific data needs and specific processing programs can be designed to store and recall data in appropriate formats.

For many top level line managers, however, the concept of decision support fails to equate very well with the way they view their jobs. Decision support is, in effect, a middle management concept.[5] The decisions top executives make, however, are non-repetitive, ever-changing and moment-to-moment. There is no time to build a system for each of their decisions.[6] The DSS orientation is therefore inadequate and even misleading in the conceptualization of top managerial use of computer-based information.

A second recent method of viewing managerial information needs is the Critical Success Factors (CSF) concept.[7] Designed to assist managers in determining the information they need to monitor their organization's progress, the method focuses on selecting the few most significant areas deemed to underly organizational success or failure. Emphasis is thus placed on insuring that information is available to the manager concerning progress in each of these "critical success" areas. Today there are, in fact, many managers who have developed

insight into their own information needs using the CSF process. The method increasingly appears to be a useful and pragmatic way for a manager to determine what information he should have.

Yet the CSF method stops at this point. It is only one part of the answer to the questions presented at the start of this article. The CSF method provides a way for a manager to determine what information is of priority. It provides no insight, however, as to ways to organize the data, methods of gaining access to it, or the appropriate technology to use.

In summary, both the DSS and CSF approaches provide useful concepts. From the DSS field, we get the idea of "supporting" a manager in those activities which involve information processing. The CSF method provides a means by which an executive can focus in on the high priority information to which he should have access. Neither concept, however, is sufficient in itself to answer the questions presented at the start of this article.

III. Some Examples of Successful Executive Information Support

Given the incompleteness of these existing approaches, we sought to develop a new and more robust conceptualization of the process of executive information support. As noted earlier, our efforts have been based primarily on the analysis of "case studies" of relevant systems which have been implemented. A clear pattern and some evident guidelines have emerged from these cases. To illustrate this, we now

turn to describing four leading-edge systems from among these cases.

Weyerhaeuser - At the Weyerhaeuser Corporation, a major forest products company, the controller decided in the mid-1970's that, in his dual role of safeguarding the company's assets and advising top line management of the implications of current and expected financial results, he needed improved and more flexible access to the financial information generated in the company. He felt that the existing batch reporting system which provided, at regular intervals, a number of fixed-format standard reports was less than adequate and that far too much manual re-manipulation of data was taking place. As a result, he asked the information systems group to set up an "on-line" data base which would contain the financial general ledger data (both historical results and future budgetary projections) for each of the twenty-two subsidiary divisions. He also asked that this data base be easily accessible so that all necessary reports, including newly conceived reports with available data elements combined in any desired manner, could be generated upon demand.

As might be expected with financial data, the reports desired, although numerous, are mostly routine and predictable. As a result, in the months following the development of the data base, some 200 different reports were frequently requested and were designated as "standard" reports. Today, each is available with the very latest data to anyone on the controllers' staff upon request. A staff member merely selects from a "menu" on the computer terminal the report number he wishes to see and it is produced for him.

The staff, however, even with 200 standard reports, continually finds new ways to look at the data present in the data base. Thus, new reports are sometimes desired, often with a new analytic twist. Yet no one in the controller's department wishes to "program". Taking this into account, yet still desiring to facilitiate access to the data base, the information systems group has assigned one programmer to the controller's department in a "continuing support" role. Any request for a new report goes to this programmer. Then, using Mark IV, a relatively simple language for report definition, the programmer generates the report which is provided to the staff member within 24 hours.

At Weyerhaeuser, therefore, as Exhibit 2 summarizes, the controller's data base contains "hard" financial data generated within the company by the subsidiary organizations. The primary use of the data is for financial monitoring of the past and extrapolation of the exected performance of the various divisions. Although they do not program, the controller and his staff have access to the arrangements of data they need to support their own analyses and to advise senior line managers at Weyerhaeuser.

IBM - A corporate executive at IBM had a somewhat different problem in the 1970's. At that time, he and others on the business plans staff were faced with the need to answer increasingly difficult strategic questions posed by the chairman and president of IBM. He decided that they needed access to an extensive data base containing information which would facilitate the recognition of IBM's current and future marketing opportunities.

Following much discussion of the data needed, a three-part data base was established. Unlike Weyerhaeuser, where all the data is a by-product of internal divisional operations, only one part of the IBM data base comes from the routine transaction processing systems which support day-to-day operations. This segment of the data base contains current and historical data concerning the equipment installed in each customer location. It originates from the customer record file which is used in the daily operations of the business.

Two other segments of the data base, however, are gathered and stored specifically for this particular application. One part is taken from an annual survey of IBM marketing personnel. It includes data on such matters as the applications being processed by the customer, the manner in which they are processed, and the amounts and types of resources being devoted by the customer to the data processing function. Some portion of this is "soft" data, as is true of all survey-generated data. Rough estimates often substitute for hard facts, and there are undoubtedly some inaccuracies. Yet it is useful data to aid in marketing decision making.

The third part of the data base is made up of "industry data", much of it purchased by IBM from external sources such as Dun and Bradstreet. This type of data describes individual companies, presents economic and financial projections for particular industries, and furnishes trend data concerning the economy in general. This part of the data base thus consists of data series which are felt to be helpful in the projection of the business situation for particular companies and industries.

Through this multi-part data base, IBM analysts and executives have available to them, in a computerized form, the several types of data needed to determine which business segments or particular customers are most apt to expand their use of the company's products. General projections of market growth can be made. More important, specific analyses can be developed to yield insights as to the factors affecting the use of IBM products in different companies and industries.

Unlike the situation at Weyerhaeuser, IBM personnel involved in the system most often desire "to get to the computer" to do their own analyses and projections of trends. Initially, users of the data base were supported by information systems professionals using standard data processing languages to produce batch reports. While this was feasible for a small community of local users, a different approach was required to support a growing number of users in geographically remote headquarters and development laboratories. A terminal-oriented file inquiry facility was designed to provide users simplified access to

large files of planning data. This facility, implemented using APL and called APL-Data Interface, is a simple language, yet one adequate for this particular task. APL-DI is easy to learn and simple to use. It provides the few functions necessary to extract the required data from a major data base and to display it in a manner useful for the vast majority of planners and analysts. This simple language is now in use in IBM by all the analysts and managers who make use of the data base. For those few who wish to make more "sophisticated" analyses, the full power of APL is available.

The system has now been in use at IBM for approximately five years. It is supported by an internal information systems group which acts in an "assisting role", providing technical assistance, language training, and education for the people using the system. The system itself has slowly evolved and continually grown.

XYZ Bank[8] - A few years ago the President of this large bank, felt a need for better reporting to him on the status of various aspects of the bank's far flung operations. He had a desire to be able to quickly "get the numbers" on branch office operations or institutional loans with a minimum of time and effort. He also had a second desire, to instill a more quantitative perspective throughout the top echelons of the bank.

To satisfy the first of these desires, the information systems group placed a computer terminal upon his desk, from which the president could recall numerous preprogrammed reports with the touch of a few buttons. It did not require that he learn to program a computer; in fact, the means for data recall could be learned in a few minutes. The report formats were generated by the I/S group using the RAMIS language, a data management and report design language that offered limited analytic ability, but easy report writing features.

All of the data available on the President's terminal is generated from or used by the bank on a routine basis. There are no external industry databases. There are no "soft" marketing databases. The President's database contains only the data necessary to supply a set of preprogrammed reports.

The terminal has had some impact upon other bank executives. Some have requested a look at his terminal and a few have made arrangements for their own systems, some with increased analytical capabilities. The implementation of an executive information system is facilitating a shift toward more quantitative management at the bank.

The President is presently looking toward some changes in the capabilities of his own EIS. No longer satisfied with only status information, he now wants to be able to perform some quick analyses on his own, or at least to be able to look at the data in other ways. This will soon require an analytic language and an expanded database to provide a richer grazing ground for information.

Northwest Industries - Ben W. Heineman, President and CEO of Northwest Industries, decided in 1976 that he needed an executive information system to aid him in planning, projecting, and monitoring the progress of his nine major divisions. Heineman was, and is, a great believer in the advantages of "not being the captive of any particular source of information". He felt a great need to analyze various aspects of the business himself, but saw little opportunity for this without a computer-based system that would reduce data handling chores.

An experimental support system was at first designed to allow executives to retrieve more than 70 predefined reports and to perform limited analyses such as compound growth calculations, variance analysis and trend projections. In January of 1977, the six top executives were given access to this system. By February, Mr. Heineman had stretched the limits of its analytic capabilities and was demanding more.

The additional capabilities came in the form of a new access and analysis language called EXPRESS. EXPRESS includes not only simple file handling and data aggregation facilities such as are found in Mark IV, RAMIS, and APL-DI, but also much more extensive capabilities which facilitate extensive modelling and statistical analyses of data series.

To complement this access facility, Northwest Industries has continually expanded its "Executive Data Base" to currently include:

1) 350 financial and operational data items of actual, budgeted, forecast, and planned monthly results for each operating company for the past eight years.

2) 45 economic and key ratio time series

3) Several externally subscribed data bases, including Standard and Poors' Compustat and DRI services.

Northwest Industries' system is truly a corporate-level executive support system. It is now used by almost all managers and executives in the corporate office to perform their monitoring and analytical functions. The corporate controller's department, the planning department, and the top line executives all use the data base independently to serve their particular information needs. As a result, the data base is more all-inclusive and extensive than any other we have seen to date. It is constantly growing as new data items and series are added by various managers as they are found to be of use.

The driving force behind the system, and its most significant user, is Heineman. Use of the system is an everyday thing for him, a natural part of the job. He programs using the EXPRESS language and a full ten finger typing approach to the terminal keyboard. He believes that the knowledge he can bring to the analytic process from his viewpoint makes personal analysis preferable, in many situations, to handing assignments to staff personnel. What is more, instant access to the data base, to try out a thought he might have, is very useful. For

this reason, terminals are present at home and available during vacations.

Supporting Heineman and others in their development and use of the data base is an information systems group whose capabilities and tasks are quite unlike those of the data processing personnel found in the operating divisions of most companies. The corporate I/S personnel rarely design or program any reporting systems. Rather they function as "coaches" to the various managers at the corporate level. Their primary function is that of training of the users, not the provision of service. They aid in helping a user determine whether the data he needs is already available, and whether any additional data needed can be obtained. They further assist by getting the data into the data base, coaching the users in access methods, and helping the users to understand what sort of analytic routines are best fitted to the particular types of analyses which are desired. Only for major "modelling" applications do they take part in the system design and programming process.

	WEYERHAEUSER	IBM	XYZ BANK	NORTHWEST INDUSTRIES
Primary User(s)	.Controller's Staff .Business Divisions	.Market Research Staff .Planning Managers	.President	.President .Corporate Staffs
Preliminary Designer(s)	.Controller	.Market Research Managers	.President	.President and I/S Department
Data Bases Utilized	.Financial general ledgers	.Usage equipment histories .Customer surveys .External purchased data	.Financial operating data	.Marketing data and financials .Economic time series .External purchased data
Key Tasks Performed with System	.Financial monitoring & analysis	.Market planning & analysis	.Managerial monitoring	.Divisional performance monitoring & analysis .Resource allocation planning
Language Used For Data Access	.MARK IV	.APL-DI .APL	.RAMIS	.EXPRESS
Continuing I/S Organizational Support	.Programmer for ad hoc reports	.I/S assistance when necessary	.On-going system improvements	.Multi-disciplinary "coaches"

EXHIBIT 2
FOUR EXAMPLES OF
EXECUTIVE INFORMATION SUPPORT

As the cases make evident, and as Exhibit 2 summarizes, the various implementations of executive information support are diverse. All, however, from an information systems design viewpoint, have several elements in common with each other and with other systems we have seen. All of these elements are necessary for successful implementation. The five elements are, (1) the presence of an "information support data

base", (2) user-tailored access methods, (3) organizational support, (4) the user as designer, and (5) system evolution. We now turn to a discussion of each of these.

The presence of an "information support data base" - In each case cited in this article and, indeed, in all the others we have seen, the foundation upon which each system is built is what we have termed an "information support data base". This new type of data base is quite unlike the traditional transaction processing data bases such as those shown at the bottom of Exhibit 1. Those more traditional operational data bases store files of data which are used for order processing, inventory control, payroll, and other applications which are the mainstream of the day-to-day paperwork processing life of an organization. These data bases must be up-to-date, accurate and complete. They must have well-designed sequences of data storage, optimized as far as possible to facilitate efficient processing of the thousands of daily transactions which occur in major organizations. Careful editing procedures and controls must be built in to assure data accuracy. Changes are made in these conventional data base structures only after considerable evaluation of "downstream" effects on other paperwork processing systems and the reporting obligations of the firm.

Information support data bases, on the other hand, are very different in purpose and the type of data they use (see Exhibit 3). They have no role in day-to-day operational paperwork. They are built primarily as data repositories to make information available for recall and analysis. As noted in the cases, they are fed in part, but only in

part, by data from the operational data bases. Where they are fed in this way, only selected data is transferred, and often it comes from multiple operational systems. Moreover, much significant "soft" data from customer surveys, market sampling, and internal planning processes are often also included in the information support data base. So is "externally purchased" data from any of the approximately three thousand machine processable data bases which can be bought from information vendors today.

In technical structure, information support data bases are also different from the conventional data base used primarily for transaction processing. Most information support data bases are designed with very inefficient, yet simple and easily understood file structures. Primarily they exist as a "bucket of variables". This makes them inefficient with regard to computing machine usage but easy for a user to understand, simple to access, and very responsive to change and evolution.

	TRADITIONAL TRANSACTION DATA BASE	INFORMATION SUPPORT DATA BASE
Purpose and use	.support transaction processing systems	.data repository
Data attributes	.up-to-date .accurate .consistent .complete	.timeliness not critical ."hard" and "soft" data .consistent .completeness not always possible
Storage method	.optimized for efficiency of computer resources	.tables of data designed for easy access & change
Ability to change the data base	.difficult .only after much consideration of "downstream" effects	.easy to accomplish .data base designed for change and evolution

EXHIBIT 3
A COMPARISON OF TRADITIONAL AND
INFORMATION SUPPORT DATA BASES

User-tailored access methods - A second key element of successful EIS systems is a well designed means for its users to get to and, when desired, manipulate the data. These access methods, however, can vary tremendously and must be tailored to the tasks, the desires, and the abilities of each user. Fortunately, a wide spectrum of access mechanisms exist. At Weyerhaeuser, where limited interactive ability is desired, the access method is extremely simple. At Northwest Industries, there are rich data access and manipulation facilities. The IBM and Bank systems have intermediate facilities. But all fit the current desires of the user population.

Organizational Support - A third common feature is support for the users by information systems professionals. This is a factor which is in the background and often unnoticed, yet it is essential. At a minimum, the access languages used by all EIS systems, beyond the basic Weyerhaeuser approach, are tools which require some training and some ongoing assistance. Support personnel must provide this training. As is evident in the preceding cases, however, in most instances organizational support goes far beyond mere training in the access langauge. The function of the EIS support 'coach" is emerging as a major factor in these systems today. He furthers system use by providing education, helping establish the data base, and providing assistance to the users in conceptualizing, designing, and improving their EIS.

These coaches must have a consulting-oriented "helping" rather than "doing" approach to their role. Many, in fact, as at Northwest Industries, are former consultants. In order to allow continuing, uninterrupted assistance to EIS users, most organizations are separating out this organizational support group from the regular data processing organization. This appears to be a healthy move, both because EIS consultants are a "different breed" from most conventional systems analysts, and because they need to be shielded from forced involvement in the "emergency" development of an overdue conventional system.

The User as Designer - In each case, the ultimate users of the system must involve themselves in the specification of both the data base they desire and the type of access mechanism they deem appropriate. Only the key users know what data are useful to themselves as status signals or as the raw material for analytic purposes. And only they can provide an indication of the means they are initially willing to use to get to that data. Conventional systems, such as payroll processing systems, are well understood and can be designed almost without management input. However, the type of managerial information processing being noted here is almost "uncharted" ground. The data needed and access methods for a good EIS system are very much a function of the particular managers involved, their analytic propensities, and their view of the critical success factors of the firm. In every case we have seen, there are one or more dominant users who have been extremely active in determining the initial shape of the system.

System Evolution - Each system must be built in a way which facilitates its evolution. Several factors make change and evolution an inherent part of the EIS we have observed. Most important, as the system is used, managers obtain insights into additional data which can be beneficially used. Some data series are also found to have little value and are eliminated. Moreover, as managers gain confidence with the system, they often "upgrade" the access mechanisms they desire. Additionally, the rapidly improving technology today facilitates user evolution to improved computer-based means of analysis and display. Finally, new system users, with different perspectives, often desire

new data and different access mechanisms. For all these reasons, system evolution, and the need to smoothly facilitate it, is the final essential design element for EIS systems.

IV. EIS - A Conceptualization and Design Approach

As just noted, the cases presented and indeed all that we have seen, have the above described five common technical design elements. More important, however, is the fact that they fit, from a managerial viewpoint, into a conceptual pattern which sheds significant light for those wishing to design such systems in their companies. This pattern has three major parts. All executive information support systems:

- share a common purpose and a resulting common design philosophy.

- can be located at the executive office level or the functional staff level, to provide support for the shared activity of information analysis for planning and control.

- utilize one or more of three quite different, yet well defined, modes of access, where the choice between modes is a significant act.

Purpose and Resulting Design Philosophy

All of these systems have as a major purpose, the provision of information to top management for the monitoring of the organization's activities, analysis as to the reasons underlying favorable or adverse trends, and the projection of the future path which the organization plans to pursue. In sum, the systems support the planning and control processes in an organization.

There is, however, no single accepted planning and control process for an organization. A well defined common report set does not exist. Procedures vary from company to company, depending on the company's history, its industry, and its current environment and strategy. Different executives, with different managerial styles, design different management planning and control structures. It is generally recognized that plans must be made and control exercised, but there is no formula for performing these tasks.

Moreover, the process of management planning and control is a large and widespread undertaking. It requires specialists in particular areas, such as strategic planning, accounting, and finance. In addition, it requires the insight, analysis, and guidance which can only be provided by senior line management. Thus it is a shared activity, a point which will be discussed more fully in the next section.

Equally important, just as there is no "normative" approach to planning and control, there is no clear set of decisions which arise in the course of this process. Rather, data concerning both past and current results as well as future plans, are scanned and analyzed, and a set of ad hoc, highly variable decision opportunities occur.

For executive information support, therefore, one cannot build systems to support individual decision processes. Rather, the EIS system design process is oriented toward assembling the necessary relevant planning and control data in an information data base, providing the desired access mechanisms, and establishing the relevant organizational support mechanisms to assist the users. The aim is to provide the basis for deeper and often broader analysis of a company's past results and its future path.

Two Organizational Levels for Executive Information Support

The way in which top line executives develop and use information for planning and control is often obscure. A key to breaking through this obscurity is the realization that these executives have several optional ways of ensuring that the appropriate data is gathered, analyzed, and acted upon to be certain that each of the sub-organizations remains on track (control) and is developing an appropriate future course (planning). The top executive can do most of it himself. He can use his own personal staff to perform the bulk of the work. He can depend on the expertise of subordinate line executives. Or, he can rely heavily on the data gathering and analytic

work of key functional staff personnel.

In most cases, however, these information analysis responsibilities are a shared activity divided among the four participants. Therefore, one must view, as Exhibit 4 notes, these four participants at the corporate level as a unit. This unit is divided into two logical groups, the "executive office", which has line responsibility for the organization as a whole, and the "functional staff groups," which play a support role in information processing for specific functions of the business. Each of the participants has other responsibilities which make demands upon their time, but a joint, shared function is the gathering and analysis of data for the planning and control of the organization.

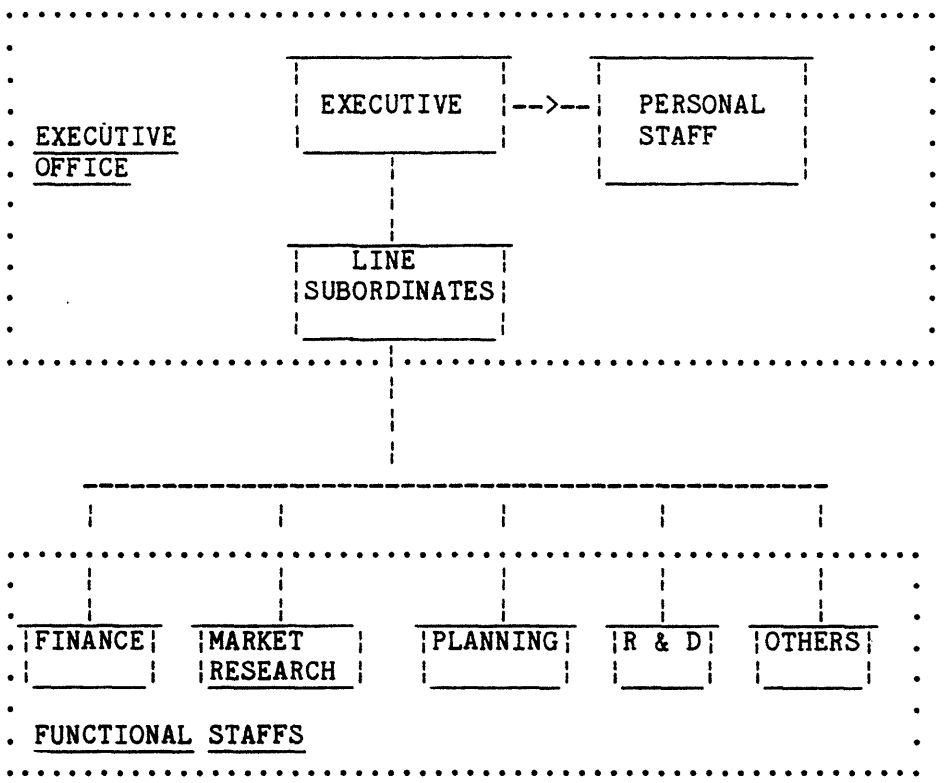

EXHIBIT 4
THE EXECUTIVE INFORMATION ANALYSIS ORGANIZATION

Until recently, data gathering and analysis were time-consuming and tiresome tasks. Thus, they were largely relegated to the functional staffs. However, advances in the technology have alleviated this situation. Data is more readily available and the clerical and mechanical requirements of data analysis are greatly reduced. Deeper, more data-rich analysis is increasingly being performed by functional staffs. Equally important, it is now feasible for line executives in the executive office to be directly involved. Some are, for the first time, exercising this option. Thus, the locus of an increasing amount of information monitoring and analysis is shifting from the bottom segment of Exhibit 4 (the functional staff) to the top (the executive

office).

For many senior executives, given their managerial styles, their view of their roles, and the capabilities of their subordinates, the formulation of information requests to computer-assisted staff groups will be the closest they venture to the analytic potential offered by the computer. The improvement of executive information support, thus, for them and their companies, rests first on the development of information support data bases for their functional staffs. Secondly, it depends on the improvement of the quality and scope of the data, the access mechanisms, and the organizational support available to the functional staff personnel to allow them to best exercise their systems.

For an increasing number of senior executives, however, indirect staff-based information support is only the beginning. It is their belief that direct access to an "executive data base" is feasible and desirable today. This is the case at Northwest Industries and at the Bank.

The composition of an executive data base must be broader than that of staff-oriented data bases. Top line officers are responsible for all areas of the business and must integrate diverse aspects of the organization and its activities in their planning and control processes. They need data drawn from multiple areas of staff responsibility. Thus, each executive office level information support data base we have seen has rapidly developed to reflect this need.

Exhibit 5 diagrams these multiple possible locations for information support data bases. From the viewpoint of the CEO, he can have either indirect, functional staff-based information support (shown by the broken lines in Exhibit 5) or have the ability to directly get to the data through his own executive data base.

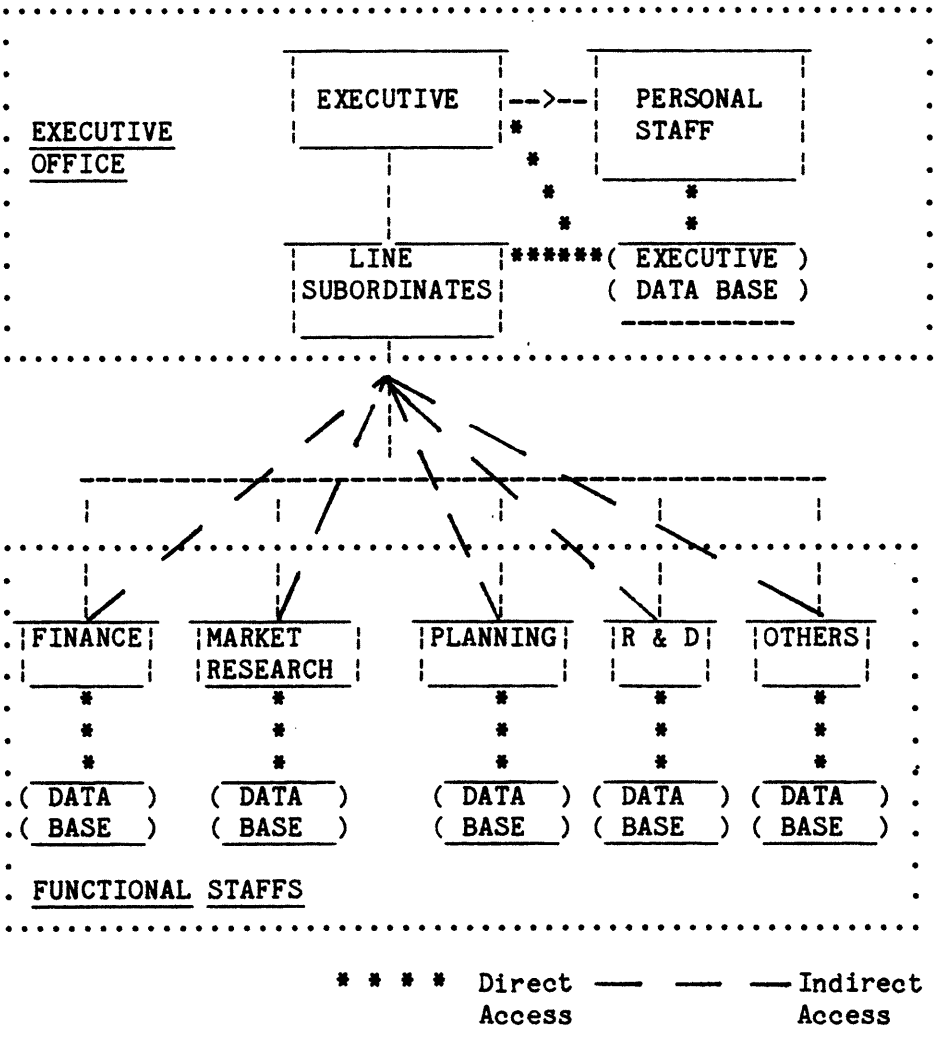

EXHIBIT 5
INFORMATION SUPPORT DATA BASES

Three Modes of Access to Information

The cases noted earlier and the others we have studied indicate three major modes of access to the information in the information support data base. Any one of these modes can be selected as the primary focus for a top executive or his staff. Multiple modes can be employed, and in some cases are. As Exhibit 6 shows, these choices can be termed status access, personal analysis, and model-based analysis. Let us look at each mode.

Status Access - Two of our cases, Weyerhaeuser and the Bank, describe EIS systems that provide a "status access" mode of executive information support. This approach can be envisioned as an "automated set of reports." In this mode, the executive or staff member has "read-only" access to the latest status of particular variables of interest. He can peruse the information he has requested, but can do little else.

For some functional staffs dealing with significant amounts of data, this means of access is undeniably useful. At the upper executive level, however, one must apply this approach with some care. In situations where the data is changing fairly quickly, where there are many facts of possible interest, or where hour-to-hour operational tracking is of use, the "status access" provided by this mode appears to be of real use. In particular, where the CEO is in fact chief operating officer, tracking sales of particular products, day-to-day costs and so forth, this access method is viable and desirable. This

simple approach can also be espoused as a "signal" to the rest of the organization of an increased emphasis in planning and control on quantitative measurements.

The "status access" method of access may also be a useful low cost, low risk means of allowing an executive or staff member to become comfortable with a terminal. However, this mode can also be a high-risk, short-lived mode. Where the user is not involved in operations, where the data he is interested in is a small, limited set, where the data he uses does not change fairly rapidly, and where he is not concerned with inducing organizational change, the utility of this mode is dubious. The terminal will soon be found to provide little added value over traditional paper-based status reporting techniques. The presence of the terminal will soon be seen as an embarrassment, not an aid.

Personal Analysis - In this second mode, the executive or staff member uses the computer as an analytic tool. Northwest Industries and IBM illustrate both the direct and indirect personal analysis mode of access, respectively. The user learns the relevant access language, dictates the contents of the data bases and does a significant share of his analytic programming himself. Instead of merely having access to the data, the user also manipulates the data to assist his analytic process.

To move from the status access mode to the personal analysis approach, or to start in this way requires a significant commitment of time and energy from an executive or staff member. He must believe that he can significantly improve the existing analysis process with the aid of a computer system. He must also be willing to invest time and energy to this process. If both of these conditions hold, then this mode of access can be successful.

Model-Based Analysis - Whereas with status access the user has access to data, and with personal analysis the user manipulates that data for analytic purposes, the third access method, "model-based analysis", provides computer-based models of the key aspects of the company, industry and economy for use by the executive office or the functional staffs.

The models of this sort that exist today for staff groups focus on parts of a particular company. Today, these partial models are exercised primarily by a few analytically-oriented staff personnel. Can the line executive use them? Even the partial ones? The debate can and will be vociferous. There is no clear evidence but, at Northwest Industries and in some other companies, we observe operations researchers who are now building such models to be exercised by the people with the most inherent ability to draw on and act on insights from them, senior line executives. We have seen enough opening forays, to believe that much attention will be paid during the decade of the eighties to this mode of executive information support at executive levels.

	STATUS ACCESS	PERSONAL ANALYSIS	MODEL-BASED ANALYSIS
Database Used	.operating data .mostly internal data	.operating and "soft" data .internal and some external data	.wide ranging data .internal and external as required
Access language	.menu-driven	.very high level .English-like	.programming & modelling languages
Organizational Support	.program new reports .little analytic aid	.gather data .create large analyses .some OR/MS consulting	.OR/MS consulting
Designer	.executive & I/S staff	.executive & I/S staff	.executive & OR/MS staff
Evolution	.more reports .more flexibility	.deeper analyses .more data .more modelling	.better techniques .bigger models .more realism
Principle Advantages	.quick sol'n .easy to use .some benefit from simple analyses	.provides increased analytic capability	.increased org'tional understanding

EXHIBIT 6
THREE MODES OF EXECUTIVE INFORMATION SUPPORT

A Concept of Executive Information Support

We have conceptualized information processing for planning and control purposes at the top of an organization as a shared activity involving several participants. For each, the development of information to further this process is a partial role. Each participant also has other responsibilities.

EIS systems can be developed at one or both of two significantly different levels of the organization, the executive office level or the functional staff level, and by anyone in one of these levels. Wherever developed, they utilize an information support data base and require organizational support. Three quite different means of access can be used at each level. To illustrate this, Exhibit 7 suggests a two-dimensional matrix of six key choices for "where" and "how" to develop EIS systems. A company may choose to utilize any or all of the six approaches noted in the six cells. Any functional staff organization may be selected, and any of the occupants of the executive office can assume EIS design responsibilities. It is not necessary to place a terminal on the President's desk to get started on effective executive information support today. Other useful options exist.

Today, a move into EIS provides two major opportunities for companies. First, it is possible to increase the effectiveness of information analysis for planning and control purposes. This can be done by increasing the scope of the data being utilized. One can also improve the depth of analysis performed through the aid of computer support.

provide information analysis capabilities consonant with the needs and styles of the particular executive, staff members, and the particular organization. Information support can exist anywhere, and in multiple modes, throughout the "information analysis" organization.

V. The New Era in the Use of the Computer

The development of executive information support systems has been enabled by, and is part of, the advent of a new era in the use of computers in organizations. From the viewpoint of the types of systems being built (in information systems jargon, the "applications,") this is the third era. Each era has spawned a significantly different set of computer applications. Each therefore requires different hardware, software, and managerial processes to allow its particular set of applications to be successfully implemented. The eras and some of their differences are summarized in Exhibit 8.

The emergence of an era - A host of factors have converged in the last two to three years to facilitate the emergence of the latest era. We mention here only four of the most significant elements. Most important, the cost of computer hardware has dropped precipitously. Today one can perform a given computation on a computer for less than one percent of the cost of the same computation two decades ago. In addition, vastly improved software "languages" (such as those cited in the cases) have made managerial communication with the computer and its associated databases a far simpler task than even a few years ago. Many other technical advances have been made, but, in sum, changes in

the technology have made it both easier and cheaper for a manager to use computer support.

	ERA I: ACCOUNTING	ERA II: OPERATIONS	ERA III: MANAGERIAL INFORMATION SUPPORT
Sample Applications	.payroll .general ledger .accounts payable	.on-line order entry .factory scheduling	.executive information support .decision support
Justification	.clerical replacement	.clerical replacement .asset reduction .service	.better analysis, planning, and control
Line Management Information Provided	.of little use	.supervisory status reports	.extensive
Management Involvement In Systems Design	.minimal	.supervisory level only	.significant managerial involvement necessary
Expected Change From Initial System Design	.none	.minimal	.extensive evolution
Primary Systems Technology	.batch .centralized large computer	.on-line .local & central computers	.on-line .local or central computers
Primary Languages	.FORTRAN .COBOL	.FORTRAN .COBOL	.EXPRESS .English-like with graphics
Data Structures	.separate files files for each application	.data base optimized for efficiency of machine use	.data base optimized for ease of use and evolution
Required Data Accuracy	.high	.high	.estimates and approximations are acceptable

EXHIBIT 8
A COMPARISON OF THE THREE ERAS OF COMPUTER USAGE

Many other factors also contribute today to the increased feasibility of computer-based information support for managers whether at executive or lower levels. Significantly, a majority of the paper handling processes of most large organizations are now computerized. Thus, major databases exist today containing much of the company's internal marketing, production, and financial data. This data is now available in machine-transferable form to managers seeking to build information support data bases.

Additionally, the computer is no longer a fearsome object. A generation of younger managers have come out of universities with significant exposure to the advantages and increasing ease of using the computer. Many older line managers have been exposed through personal home computers and the actions of their subordinates to the ability of the computer to aid them in information gathering and analysis. Acceptance of the computer as a useful tool is now widespread.

Finally, external environmental factors, such as domestic and international competition, inflation, and the increasing cost of capital have provided a growing impetus for more effective use of available information by corporate leaders. Each of these forces has emphasized the need for improved planning and control of each organization's activities and assets.

Different Application and Different Eras - All of these factors have led to a "third era" of computer usage, the era of "information support". As Exhibit 8 shows, from an application perspective, this is

the third major wave of computer utilization. The first era, begun in the early 50's, was devoted to accounting-oriented applications such as payroll and general ledger. Overlapping with this initial application set, and growing rapidly in the sixties and seventies, were a host of "second era" applications aimed at improving various aspects of the firms' operations. On-line order entry systems and manufacturing control systems were typical of this era. Finally, in recent years, we have entered the third era, an era no longer concerned with processing the paperwork of the organization, but rather with providing information support to managers at all levels. Keen has called this the age of "support systems".[9] Decision support systems, discussed earlier, are one category of applications in this era. Executive Information Support systems are another. To deal effectively with EIS a manager must understand the characteristics of the third era in general and the characteristics of executive information support systems in particular.

In the first era, as Exhibit 8 notes, well-understood, well-documented accounting applications were automated. Working on applications with well-defined inputs and outputs, systems analysts sought little input from operating management in system design, and received less. The primary justification and objectives of these systems were sheer clerical savings. Little change from the system design was expected and the information provided was essentially for the controller in both his stewardship and budgetary roles. Except for the latter purpose, line management saw little of the information produced, and used little of it.

Although some things remained the same from Era I to Era II, the latter differed from its "accounting" predecessor in many major respects. Most important, the operational nature of the systems in Era II demanded readily accessible up-to-date information. This led to the development of on-line systems most of which functioned more effectively on small decentralized local computers. For the first time, because the systems hugely affected their areas of responsibility, first-line supervisory managers became actively involved in system design and in using the status information generated from these systems. Additionally, although system justifications were still based in part on the "hard cost savings" of clerical replacement and asset reduction (e.g., inventories, receivables), a large percentage of Era II's systems were designed primarily for (and justified heavily by) improved service to customers. All-in-all, in Era II, the focus swung from processing the passive historical accounting paperwork of Era I to working with the vital day-to-day (often minute-to-minute) operational activities of the lower levels of the line organization. With this profound shift in the type of application processed, hardware type and location, managerial involvement, and justification procedures all changed dramatically.

The changes from the previous two eras to the third are even more extreme. The hardware technology has not changed much, with the possible exception of the addition of color graphic capability, but everything else has. The access "languages" are different. The data bases must no longer be designed for "efficient" processing, but rather for fast response to the terminal and for ease of change as managers'

views of the types of data they need change (as they observably do). Required data accuracy is also different. For accounting, or operational purposes, accurate data is required. However, as "soft" survey data and estimates of the future are well accepted by managers involved in planning and control. Most important, however, in this era managers must be directly involved in specifying the types of data they need as well as the "languages" or access mechanisms they are prepared to use. In short, they must "design" the system and continually "redesign" it to allow it to evolve as their perceived information needs evolve.

Finally, and importantly, system justification for Era III applications is also different. EIS and DSS systems designed for improved analysis, planning and control or improved decision making can not be justified primarily by hard cost savings. Rather the "value" of potential improvements in these functions must be estimated and the systems justified in this manner.

Today, applications from all three eras are being developed concurrently in most companies. To successfully implement Era III system, however, top management must utilize a set of principles which are different from those used for Era I and II applications. All processes from initial system justification to post-implementation support are different.

VI. Implications For Executive Action

Given the above, there are six major action-oriented implications for management. These are:

1. The process of executive information support requires attention by top management today. The knowledge and technology needed to build these systems is available. The economic and competitive environments are such that improved information support for top management planning and control appears desirable. A rapidly increasing number of companies is taking advantage of this potential today. However, it will not "just happen" in an organization. The technology, techniques, and managerial processes utilized are different enough that a conscious effort to initiate development and to establish suitable management procedures for this new breed of systems is necessary.

2. Top management can take advantage of executive information support without "direct" access to the computer. EIS does not require a terminal on the President's desk. For many organizations, the most beneficial approach will be the indirect provision of information to the executive office through functional staff-centered information support.

3. Since executive information support systems are designed to evolve, the entry price can be relatively modest. For Era I and II processing systems, a commitment of several million dollars was

often necessary for a single major system before any results were obtained. For most EIS systems, however, an initial hundred thousand dollars has allowed the organization to build its first prototype system, thereby enabling management to gain access to limited but useful data bases and to gain insights into the benefits of EIS systems before going on with further investments.

4. To take full advantage of this potential, top management must get involved in systems design. Responsibility for the design and development for Era I and II systems could be delegated. EIS systems, however, are intimately dependent upon both the data that top management feels they need and the access mechanisms that they desire. Careful thought must be given to both by top management if the system is to be successful. For the former, the critical success factor approach can be distinctly useful. For the latter, executives must clarify for themselves the exact mode of access which best serves their managerial style.

5. A new information support organization must be established to aid line executives and key staff to use the system. A coaching, consulting group of people with a set of skills far different from traditional data processing skills must be established and dedicated to supporting the system if it is to be successfully developed and used.

6. The organizational implications of executive information support systems must be given careful thought. A shift in the availability of information or the site where information analysis is performed can have significant impacts on the distribution of power in an organization and the types of people needed.[10] The potential for organizational impact must be given some consideration before installation of these systems.

FOOTNOTES

[1] This is the sense of several authors. See, for instance, Henry Mintzberg, "Planning on the Left Side and Managing on the Right," Harvard Business Review, July-August 1976, p. 54.

[2] See Steven L. Alter, "How Effective Managers use Information Systems," Harvard Business Review, November-December 1976, p.97.

[3] See Peter G.W. Keen and Michael S. Scott Morton, Decision Support Systems: An Organizational Perspective, (Reading, MA: Addison-Wesley, 1978).

[4] See G. Anthony Gorry and Michael S. Scott Morton, "A Framework for Management Information Systems," Sloan Management Review, Fall 1971, p. 55.

[5] See Peter G.W. Keen, "'Interactive' Computer Systems for Managers: A Modest Proposal," Sloan Management Review, Fall 1976, p. 1.

[6] See C. Jackson Grayson Jr., "Management Science and Business Practice," Harvard Business Review, July-August 1973, p. 41.

[7] See John F. Rockart, "Chief Executives Define their own Data Needs," Harvard Business Review, March-April 1979, p. 81.

[8] The bank wishes to remain anonymous.

[9] See Peter G.W. Keen, "Decision Support Systems: A Research Perspective," Center for Information Systems Research Working Paper Series, CISR No. 54.

[10] See Martin L. Bariff and Jay R. Galbraith, "Interorganizational Power Considerations for Designing Information Systems," Accounting, Organizations, and Society, Vol. 3 (1978), No. 1, p. 15.