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Summaries and New Directions**

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Abstract:

Forecast of the impact of new information technologies on management in the period 1971-1990. Summarizes and extends three studies commissioned by the Conference Board in 1970.

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PREFACE

In 1970, the Conference Board began a series of studies on the implications for society, in general, and for managers, in particular, of the impacts of developments in information technology in the period 1971-1990. As a result of our participation in this project, with the support of The Conference Board and the Graduate School of Business of The University of Texas at Austin, three research studies were produced. The first of these studies, "Business: Newer Concepts of Management, Profits, and Profitability," appeared in Information Technology: Some Critical Implications for Decision Makers (The Conference Board, New York, 1972). The results of this study are summarized in the second section of this paper. The second study, Information Technology and Its Impacts (Graduate School of Business, The University of Texas at Austin, 1971), contained not only a context for structuring the problems presented by information technology but went beyond this to present a long-range program of actions for managing the impacts of information technology. A short-range set of initiatives for managing information technology comprised the third study and was published as Information Technology: Initiatives for Today — Decisions That Cannot Wait (The Conference

Board, New York, 1972). The highlights of these two latter studies are presented in summary form in section three of this paper.

Since the completion of the above-mentioned studies, we have continued our research into the implications and impacts of information technology on decision makers. In this process we have focused on delineating the new styles of management that are arising as a result of the impacts of information technology. The fourth section of this paper summarizes the results to date of these ongoing research efforts. Our tentative conclusions and assessments conclude the paper.

At this point we should note that the material contained in the original documents that these summaries represent has benefited from contributions and criticisms from many of our friends and colleagues. We would like to acknowledge their contributions while at the same time reserve to ourselves full responsibility for the content of this paper.

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V. SUMMARY AND FIRST CONCLUSIONS

I. Introduction

"We are in the Western world and even beyond its boundaries, passing through an historical watershed which we little understand, and which may be ultimately of more importance than the Renaissance, the Reformation, or the Industrial Revolution," states the Rev. Theodore Hesburgh, President of Notre Dame.

How have we reached this watershed? Society has been led to it by major advances in information technology. These are changing the nature of information, our modes of perception, the bases of political and economic power, and the range of choices open to society. Furthermore, the changes in information technology are extremely rapid.

The ruler of Renaissance and Reformation societies, and the entrepreneurs and political leaders of the Industrial Revolution did not have to cope with changes of the same kind and magnitude. Change in those periods was, by comparison with today, of glacial speed; the bases of power were transformed at a pace that allowed most men to comprehend and prepare.

As Rinehard Bendix has observed, during the 19th century authority based on ownership of property was transformed gradually into authority based on control of property through the hierarchy known as the corporation. In our own

century, authority has passed gradually to management. Its power is based on possession of information that is not readily available to others.

The nature of information is now changing rapidly: more of it is available to management, but it is no longer their exclusive possession because it reaches them after extensive selection and manipulation by others. In government as in business, the executive branch is increasingly dependent on the new information technology and on those who are expert in it. Yet management, in both the corporate and governmental sense, is still organized as though its power rested largely on its monopolistic control and manipulation of exclusive information. "It is the power that derives from expertise, but it is the use of a special expertise in an especially expert manner"(the Lowi Panel on the Conference Board study). That definition of power will still be true in the new information age; what will change, and change dramatically, is the nature of the expertise.

The key to power in the information age will be information technology.

What is information technology? For the purposes of this paper --

- a. Information technology is a body of knowledge. It is what we know about the collection, measurement, storage, manipulation, transmission, and use of data and information. In this form, it is found in reports and books, on film, on video and magnetic tape, and in people's heads.
- b. Information technology also includes the hardware for information generation, flow, organization, and use. Examples include computers, television sets, telephones, movie cameras, printing presses, typewriters, and even pencil and paper.

- c. Information technology includes software -- computer programs, written and spoken language, and mathematical theories and models, among other things.
- d. Information technology includes behavioral, organizational and social methods and practices -- group processes, social dynamics, instructional techniques, planning and control capabilities, decisions and evaluation methods, and system logic and design.

Most aspects of the new information technology are of hopeful importance. For the first time, society has the means to reassess itself and to choose its destiny instead of drifting into the future on a tide of myths. For the first time, society has a technology at its disposal which will allow it to allocate resources for a maximum efficiency directed towards a planned purpose. For the first time, society has the ability to reshape its institutions coherently and realistically.

The information technology that is now emerging makes all this possible -- and more.

The question is whether society has the desire and flexibility to use these new opportunities. Already those opportunities have placed unprecedented burdens on government, on education and on corporate management. That burden has been imposed because information technology has increased by several orders of magnitude the strategic choices available to society. Information technology will not automatically provide the men who must make those choices with a clear perception of the challenges and opportunities, or with the framework within which they can view the problems, the criteria by which to assess the choices,

and the methods to judge the long- and short-term consequences of specific decisions.

To obtain those new perceptions and criteria, government and business must desire them, and then plan for them. Until they do, many of today's leaders will feel frustrated and confused by change — and some will see information technology as more of a threat than an opportunity.

Society is confronted, in fact, by two sets of related problems. Many date from well before the advent of today's information technology. Among them are poverty, racial discrimination, international conflict, urban overcrowding, and overpopulation. A relatively recent manifestation of information technology, radio and television broadcasting, has helped to thrust those problems into the forefront; at the same time, a combination of political promises and economic prediction has raised people's hopes and aspirations.

One facet of information technology, the mass media, has thus helped to bring society to a point where it demands and expects quick solutions to enduring problems. Another more sophisticated facet of that technology, the whole cluster of applications built round the computer, has brought society the tools for identifying the causes of those problems providing solutions, and mobilizing resources.

Unfortunately society does not know how to use those tools.

There is a critical need for those who make decisions in government, education and in business to regain the lost initiative. Only when they do will they be able to analyze effectively the broad social and technical patterns; identify and modify their own and their institutions' roles and relationships; and fashion the frameworks within which they may view goals and choices.

Information technology potentially allows men to move effectively and surely in a world of changing reality. In that future, the authority of management will rest, as it does now, on a special kind of knowledge. But that knowledge will have a new legitimacy, because it will enable managers to see their role in its social, cultural and economic perspective, and to predict the consequences of their actions with greater certainty than is possible today.

II. Summary of Information Technology's Impacts on Business Institutions

A. Introduction

Looking ahead to the next twenty years and beyond, a variety of changes in information technology are likely to occur that will significantly affect business institutions. It is possible to make predictions about the nature and timing of a reasonably large number of developments in information technology that might occur. The important point to be made here is that any developments in information technology that are predicted can only come about as a result of the actions of specific managers of various institutions. If one regards a policy as an intention to affect or direct the future in a specified manner, and if one identifies policy-making centers as those institutions or organizations that have the ability to affect the future, developments in information technology then become the results of policy setting and subsequent action on the part of the policy-making institutions.

Presently one can clearly see that businesses and businessmen are associated with and members of varying organizations such as trade associations, chambers of commerce, other business-social clubs, etc. In no formal way are such associations policy-making centers in the sense that they set policy for the nation or a segment of its industries. Yet in many respects they are still viable and influential organizations within our current theory of political democracy.

On the other hand, the current events and continuing pressures for re-examining our social, institutional and individual values will be sufficient causes for business managers to re-examine the need for newer policy centers within and between business institutions as well as among other institutions; for example, government and business and business and education. Business policy-centers as we envision them are not centralized formal policy-setting organizations traditionally associated with industrial activities. In the light of information technology developments there is no need for such centralization or formalization. A policy-center then becomes a nexus of decisions taken on a given issue. It is an informational construct and not a physical organization; it is a new form of organization not found or conceived of in traditional business practices. In this respect, policy-making centers are not static but dynamic and one needs to be able to assemble information that identifies the policy-making locus over time. At best, information technology may serve to identify and link series of centers that somehow combine to make policy decisions that affect society.

To date, the growth of policy centers such as the military-industrial complex has generally originated from the need of society to meet a single objective at a time and has had a government bureau or agency as a focus. Examples of this include the Manhattan Project, landing man on the moon and returning him safely to earth, etc. More often, these complexes arose from crises that involved national defense or national prestige and were given top

national priorities. Furthermore, they had definite end goals which could be equally perceived by the program managers as well as by the public, regardless of which policy centers they were in.

The skyrocketing demand by society to solve today's critical problems (such as environment, urbanization, education, and their interrelationships) has obsoleted the single-objective program approach. Multi-objective programs are required. There is no well-developed technology or sets of technologies to solve today's national domestic or international crises. It is clear that the effective management of society's demands will require newer relationships between policy centers as well as newer complexes for meeting society's inter-related demands. Moreover no single policy center as constituted today has the resource or responsibility or opportunity to solve these problems in its own "center". What is worse is that as one examines any one policy-making segment such as government, there is no one place which is responsible for establishing the initiation and coordination of the planning or ordering of the solution.

Current problems generated by social demands are no longer self-contained but are highly interrelated. This situation would seem to be tailor-made for a "systems analysis," but it might be noted that in order to carry out a systems analysis you first need a system to analyze. Neither business policy centers nor society's problems have been systematized. While a partial solution includes the need for the newer complexes, yet to be clearly defined or structured, we must be aware that many of today's societal problems are recurring. This

requires retaining many of today's institutions and their interrelationships. The newer policy centers are, therefore, an added layer over today's existing institutions and they thereby create the need for management abilities of an order of magnitude not required heretofore. Furthermore the flow and distribution of information between and among business institutions and others are often of an order that has not been required heretofore.

B. Implications of Information Technology Trends for Business

It is now appropriate to examine the more critical aspects of the utilization of the trends in information technology. Utilization of technology is not necessarily a business policy-center decision but rather one to be made on a company-to-company basis. In other words, each company and its entities by function, products, or services must make a decision of what, how, and when to utilize or retard the advances. Today's business management cannot send its staff or experts to any one place to inform themselves about the detailed and multifaceted aspects of information technology. The knowledge is dispersed among many departments and agencies within the Defense Department, NASA, AEC, and other federal departments and agencies, universities, and corporations both within and outside the U.S. In this situation, reading periodicals, books, patents, etc., is an insurmountable task. To keep up with developments is equally insurmountable. The only resort is to either specialize in selected segments of information technology or to actively participate in the broader developments of information technology and thus use technology to overcome the problems of technology.

If management is to direct the necessary developments of information technology, it must look at the information process not only within its own institutions but also within other institutions. Nor can management postpone understanding information technology, as well as advances during the past two decades in the closely allied behavioral and social sciences. It is no longer sufficient to plead lack of understanding or to rely wholly on staff or consultants.

One rule that seems to be evident in the new ball game brought about by information technology is that the relevant technology is more often in selected people rather than in the literature. That is, there is an informal network of "experts" [theoretical and practical] who reside in a variety of policy-making institutions.

The advent, growth, and expansion of information technology in business to date have generally been in those corporations associated with primary activities regarding national crises. On the other hand, some regulated industries such as communications and transportation have also been in the forefront in the use of information technology. Other companies associated with mass production industries, health care, services to consumers, and education have tended to lag. As a result, we see an uneven understanding as well as application of information technology in our business institutions. By the same token, in the past two decades there has been a general overselling if not over-optimism in the applicability of information technology in U.S. business. Nor has there been, in our opinion, the required attention to a quasi-orderly applica-

tion of information technology to business either as a service industry or in our education of business management. Until very recently few companies thought of themselves as being in the information industry. Instead, they thought of themselves as being specifically in broadcasting, or electronic data processing, or newspaper publishing, and so on. Even today, the fact that there is an information technology industry is not generally recognized.

What is lacking is a perception of the common denominator that links these apparently discrete elements: all, in one way or another, are processing the same resource — information. Once that common denominator is recognized, the disorganization of the information industry becomes a subject for study, description, and concern. Quite clearly, the fragmentation of the information industry does bring with it the virtues of competition, and makes it difficult for any group to exercise undue control. On the other hand, the fact that industries which are really intimately related continue to make unrelated and frequently contradictory decisions could have deleterious results for society.

Another rule to successfully utilize information technology at a company level is that it must be made specific to the firm's needs. In this respect, management must have more precise knowledge of its markets and evolving demands from its markets than it has previously required in the past to operate successfully. This implies that information technology makes possible and is necessary for the employment of even more complex information technology due to increased demands, markets, or competitive action — domestic or

foreign. The least that any firm can do is to keep up with information technology in its industry.

What are some of the consequences in not keeping up with information technology? One effect is that the competitors within the industry can capture large segments of the "brain power" and, in time, provide the newer goods and services to thereby capture the market. Competitors could also operate their firms more efficiently and thereby secure more of the limited capital and expand their market influence. Another effect is that another industry or competitor within an industry could bring about standardizations of the information technology and thereby impose them on other firms.

By the same token, many of the advances in American information technology have already been assimilated by business leaders in other nations into their own firms. Many of these firms have become or can become very serious competitors for world markets as well as for the American domestic markets. The seriousness of the problem is pronounced with the realization that foreign utilization of information technology has been in nonmilitary markets.

C. Information Technology's Impacts on Profits

Information technology is likely to affect both the measurement and the concept of business profits. It can be expected to have this impact through

- (1) information technology as a management tool, and
- (2) information technology as a product and a national resource.

As a management tool, information technology will affect the measurement of profits by extending management's perception of both costs and benefits.

This can be accomplished through management's use of decision models that incorporate management goals, technological relationships, environmental constraints, and risks in an explicit manner with a base in a data bank that incorporates near real-time information. Profits will then extend beyond direct costs and benefits measured by immediate dollar inflows and outflows to include secondary and tertiary effects of a firm's action. The point to this is that information technology to date has given many business managers and experts on their staff confidence that proven existing practical decisions can and will be extended to include the secondary and tertiary effects of a firm's actions. These models will incorporate not only the current measures of business revenues and costs but also simultaneously provide a secondary measure of the effectiveness of the government regulations relative to their intended purposes. For example, the actual state of our pollution within a given region is a secondary effect of production; a tertiary effect will be found in the responses of the environmentalist to the firm's actions vis-a-vis adhering to the government regulations and required actions. Thus while the definition of profits (benefits minus costs) may remain the same, the measurement and concept of both costs and benefits can be expected to change.

The perception of information technology as a national resource may introduce a new dimension to the notion of a company's profits. As a national resource some information technology can be a property of society and a way of achieving national goals. In this sense, profitability may have the characteristic (among other things) of viewing the generated information as knowledge that has wealth when both possessed and transferred in an assessed manner. Knowledge in the sense of "technical know-how" is wealth when it is applied to other societal needs as contrasted to when it is merely stored in files. In short, profits are likely to be those net benefits derived by a company. Profitability then will account for that measure of benefits to society beyond a company's profits. Profits alone do not convey the benefits that society has received from the goods and services provided by a company. Profitability in 1971-1990 will not necessarily require companies to reduce profits or take lower rates of returns on investments.

In short, a company can, through its actions, add to society's benefits which can be measured outside the company's accounting measures of profits. This added portion is what we mean by profitability. For example, a company that has developed an effective internal education system to train its own personnel; e.g., computer programmers or managers skilled in information technology who, through attrition, go to other firms or government agencies and utilize such skills represent a contribution to profitability. There are also secondary and tertiary effects to profitability. In the above example, a secondary effect is to reduce the need for educational institutions because of such corporate

actions. A tertiary effect is that such corporate programs can provide materials, examples, as well as instructors for educational institutions.

A key point is that there exists the ability to transfer technology (information process) developed for one purpose to meet other needs. In other words, the notions of corporate profits must be extended to profitability which includes societal demands. The notion of profitability allows formulating decisions on where it is best to produce goods and services for society under changing internal and external environments, ranging from war to prolonged peace.

D. Information Technology and Societal Demands

If our society keeps moving toward newer policy centers derived from societal demands for human-based systems (e.g., health, welfare, education, etc.), it is highly likely that the consequences of failure or success will be traumatic. The consequent success or failure of a system has a much more drastic implication than the success or failure of a product or service. Lose a product, you can lose a company. Lose a system and you can lose a nation, just to oversimplify the point. It is clear, visible and understandable, therefore, that research effort of a magnitude to provide the means for society to appropriately determine its goals and desires (timely, relevant, nontension building) be required. It must be a continuing effort. The form with which society provides itself with this capability has not yet been conceived by any of our existing institutions.

This capability is likely to emerge first from the innovators in information technology. It must come from human beings, not from machines or institutions. In the U.S. (or the world) today, not more than a handful of people exists who perceive this need in our society and might be able to initiate the beginnings of a deliberate effort to design programs to develop such capability. When limitations of capability become severe enough, they act as "triggers"; i.e., they cause the sudden spurt of technology that will both overcome this particular limitation and produce unexpected additional capabilities.

Growing population and rising expectations make the efficient management of scarce natural resources crucial in the future. This is a primary "trigger" for the development of information technology between 1971 and 1990. Another important "trigger" will be the world's pressing need for intellectual expertise. The demand for expertise already outruns the supply. There is no chance for demand and supply to come into equilibrium unless we change our methods of supplying that expertise — in short, improve the educational process.

Who will provide the impetus for development? There will be two supremely important groups: those we may call the generators and those we may call the transformers. Generators are the highly creative scientists, engineers, artists, and sociologists. They are the driving force of technological and cultural progress. Transformers are just as vital. They provide the interface with society which generators often find difficult; their role is to take the output of the creative intellect and to match it to the needs of society. The role of the transformer has long been the function of the business manager.

At the same time, if information technology fulfills the role expected of it, all segments of industry may depend increasingly on the labor which will likely be of a higher average skill and educational level than presently prevails in business. The demand for these labor skills may well outstrip the ability of our existent educational systems. Currently such skills are largely provided through in-house training by business institutions; but since these skills are general and easily transferred from one firm to another (thus forming more of a social resource than a specific organizational resource), a demand may arise from business for society to develop these skills at its own expense as a national resource.

As the variety of products and services increases due to increasing production ability and market segmentation, information about the products and services will become a more important part of a firm's output. Requirements on this information will stem from consumer demand and, if not satisfied by the firm or industry, will likely be embodied in consumer protection legislation. It is also possible that besides product and service information as a basis for making their purchasing decision, consumers will demand information about the activities of the producing firm with regard to societal demands; e.g., pollution.

In short, information technology may not only provide new products and services to the customer but may also provide him with a way of evaluating those and other products and services so as to make more rational consumption decisions.

Moreover, it cannot be expected that consumers will continue to play as passive a role as they have in the past; and, most likely, it will be through information technology that consumer activism will be realized and will result in more effective feedback of information to business institutions.

In some respects then, when one views the older business infrastructure, the questions that will be raised in the next two decades are: where will the goods and services be produced and for whom will employment be made available? The advances in technology are transferable not only between individuals or firms within a nation and its various regions but also between nations. Accessibility to a mass market is not enough to ensure that a company will have the market. In addition to costs, designs and changing consumer habits also play an important role. The mobility of technology has shifted the components of unit costs of goods and services; for example, manufacturing costs, distribution costs, and marketing costs.

If business is to provide the major source of employment for our society during the next two decades, then it is important to examine the total requirements for our business institutions and their ability to meet both the domestic needs and societal needs. In other words, there is a growing need for coordination between government, industry, and education in the transference of relevant and reliable planning information.

The business infrastructure is under a number of discernible impacts, some of them technology-based in terms of newer materials and processes, and

some of them in terms of newer managerial technological advances covering production, marketing, financing, planning, and distribution methods. The impacts of material and process technology are not limited to those derived within a firm or by other companies or even within industries in the U.S. or from our government-sponsored research and development; they extend to the technology developed in other nations. In this respect, technological developments in other nations have impacts on the business infrastructure in our nation.

If current trends persist, multinational firms will form an increasingly important part of the business community. In a world characterized by aggressive international economic competition, multinational enterprises become the practical elements in a dollar-diplomacy strategy. But whether multinational business is a factor in government policy and the beneficiary of government subsidy or if it develops from perception of new market opportunities, new problems involving international operations are of a higher order of complexity than those faced by purely domestic firms. Structural alternatives such as domestic fabrication and testing coupled with foreign marketing, or fabrication in one foreign country, assembly and testing of assemblies in another foreign country together with domestic marketing, present complications involving foreign trade restrictions, foreign labor, currency exchange ratios, etc. These problems and choices are in addition to most of the problems encountered by domestic firms. New types of competition also face multinational firms. For example, in Japan, firms are linked financially through the Bank of Japan to a large part of

the capital resources of the nation. Competition of this type does not occur in the domestic market.

These differences as well as others imply that multinational firms will require different types of information and the information technology to manipulate it than that utilized by domestic firms. To cite but a few examples of differences that occur in multinational enterprises, data banks are multinational in structure and in content; decision models involve many sets of national legal frameworks; and communication channels will cross international boundaries. It is also possible that the focus of decision making for international planning and operations will also shift under the shifting information requirements and bases for policy-making. For domestic firms, commencing multinational operations often means establishing an international division. Even though the corporate headquarters originally established the international segment, the expertise required for decisions involving foreign capital and labor markets, etc., often means that the international division becomes a policy center in its own right. And if the international segment becomes larger than the domestic area, it becomes a case of the tail wagging the dog. Nominal policy-making power resides at corporate headquarters but the de facto power is in the division. A new order of decision-making models, data banks, and communications networks (e.g., satellites) are required for corporate headquarters to carry out its obligations to its employees, customers, stockholders, and society.

E. Managerial Assessment for a Business Institution Through Information Technology

1. Managerial Styles.

Management styles will change under the impact of information technology. The traditional manager regards his skills in dealing with people as his primary asset. He tends to use static concepts in his thinking. The traditional manager depends on training and experience in making decisions and does well in general but suffers when faced with radically different or shifting situations on a large scale.

Because of the impacts of information technology, a new businessman is being developed. He is likely to be viewed, and to view himself, as an information processor; i.e., an employer of information technology. Realizing that his institution and its environment can be viewed through a variety of informational structures, he knows that rigid frameworks are not necessary for decision making because information technology can provide him with a dynamic picture of his firm's activities. The new businessman sees institutions as something that can be designed to fit people. He does not rely on a formal position in a hierarchy of power to give him authority; he relies on his expertise as a professional manager and his superior ability to command information to get his decisions accepted.

This contrast between the traditional manager and the new businessman is just one instance of a communication gap within the

firm as well as between other firms and between industry and education that is being created by information technology. Further instances of this gap can be found in the misunderstanding between managers and specialists in information technology, between newly educated MBAs and their employers, and between managers and educators. This gap, resulting from changes in information technology, can only be resolved by employing and directing information technology itself. Research and development efforts directed toward improved and continuing education, increased access to and usability of hardware and software, and improved decision-making techniques would be a first step toward reducing these gaps.

2. Managerial Assessment.

It is not too early to establish that management assessment is required to determine the direction desired in regard to information technology. Most of the computer technology developed for management to date has been for computer centers at the operating levels. These centers are generally service-oriented in nature and are far removed from the key individuals involved in the business policy-making functions of corporations. It is not too difficult to see that continued development of such information technology could well lead to establishing a mode of organizational structure based on the underlying mode of highly structured operations.

The managerial assessment process requires more than either an adequate understanding of the information technology or an appreciation of the need for the utilization of the information technology. For example, it is not enough to know that a department store needs the ability to collect and maintain data for credit authorization. Nor is it enough to know that information technology makes such collections and maintenance of data feasible. One needs to know what human errors have been prevalent in human-based systems or in computer-based systems and what human links have been provided to counteract these errors.

The traditional manager's role of making a trade-off analysis between human-based system and information technology-based system will not have disappeared. The trade-off just gets harder. For, in fact, the manager may have little choice but to proceed even with the observable imperfections in the information technology-based system. The assessment is one of which consequences are least desirable for the company and/or society in terms of newer profitability as discussed earlier.

The task of the manager in the assessment of a business institution through information technology will require him to ensure that the long-range goals and objectives of the institution are in harmony with and adaptable to the dynamic forces in the external environment. Yet these longer-run goal formulations must be related to the company's day-to-day detailed operations involving employees, unions, finances, production

efficiency, marketing, and competitive actions. Managerial assessment through information technology means that management must be concerned with factors over which it may have either direct control, indirect control, or often no control at all. Assessment through information technology implies that management will accommodate change in the company to perceived and unanticipated changes external to the firm and thereby adapt the firm's short-run and long-run operations to realizing greater profits.

F. Conclusions

At the outset, this section stated that business institutions were in a position to design and/or modify new or existing firms. To this point, discussed were the various relationships that will fashion the environment in which change will take place. This brings the point of specifying what role management is expected to play in the future. The first observation is that change can and will be managed: Some will manage it through neglect — they will have to be unknowingly lucky or they will find themselves in positions far removed from the forefront of the business policy making of the future. Some will manage it through the brute force of their current human resources and research dollar; and they may find themselves to be trend-setters in the business area but at a price that impairs their ability to do business in the new or even their old markets, and in a manner that does not enable them to adequately specify reasonable policies for the future. Finally, there are those

who will attempt to manage change through a managerial assessment of technology — they will find the new ways to do new business and will be the policy-setters of the future.

The transformational aspects between the longer-range plans and the shorter-run objectives of the firm take on a new dimension which seldom before had to be faced. These assessments involve more than opening plants or closing plants; the markets (national and international) in which it wishes to participate; the reassessment of which industry the company will participate in the long and short run; the means of financing for the company in the long- and short-run; the ability to provide employment for all relevant segments of the population; and satisfying and providing for human wants and needs. The assessment will more often than not require an interface between other policy centers such as government, education, and other policy-making institutions which had not been required heretofore. The requirements from information technology will become more staggering for managerial assessment.

What is required on the part of today's managers is primarily a fuller utilization of the current information technology. Existing markets, products, policies and images must be examined to see if they have any validity in light of the information that technology can provide. Secondly, managers must provide solutions to his own firm as such research is in progress. The process is then one from facts to research to test of experience. Of course, a broader base than an individual firm is required to establish the fundamental principles

so that they can be used to transfer the knowledge to other institutions that comprise the policy centers. In many respects, the centers' managerial assessment problems coincide with that of the business manager. Finally, information technology methodology must be evolved so that the restructuring of our policy centers will not result in malfunctioning or conflicting with the goals of our society.

The transition towards managerial assessment through information technology will not be a simple process. A body of knowledge does not yet exist; the specialists are, at best, in short world supply; and our educational institutions have barely perceived the problems and have as yet to formulate an educational-institution's approach to managerial assessment through information technology. On the other hand, the need is discernible to all our policy institutions. The transference of informational technology and its transformation problem are areas for research with a high pay-off to all policy-making institutions. These opportunities transcend all our institutions and have a deep impact on the forward thrust of our society. Nevertheless the initiative lies with today's managers of the policy-making centers of society to specify the alternatives and make a choice in a rational manner. In the next section of this paper, we will present a multi-alternative action program in summary form.

III. Summary of Management of Information Technology
Policy Initiatives for Today's Senior Executives:
A Multi-Alternative Action Program -- 1971-1990

A. Introduction

There are two compelling reasons why today's senior executives should undertake policy initiatives for interinstitutional programs that relate to the management of information technology for the period 1971-1990. These reasons are:

First, the various current problem areas facing our senior executives have not resulted from the actions and decisions of any single institution. Neither is their solution the responsibility of any single institution.

Second, if the "triggers" for change are to be diverted from various pressure mechanisms to more rational management for change, the more dependent the executives of all our institutions become on the need for quick and effective processing of information.

The leadership for formulating multi-alternative programs for the management of information technology for 1971-1990 must be initiated by the senior executives of our major business institutions. They occupy a vantage point for initiating, directing, and receiving the brunt of many past and future changes. Their experience and training in their own institutions have prepared many of them to plan successful multi-action programs for the short-, mid-, and long-term periods. Together with the senior executives from other institutions such

as government, education, unions, and foundations, they are in an enviable position to determine priorities of multi-alternative action programs.

This study does not endorse any specific multi-alternative program; nor was this our intent. Simple alternatives for the executive's selection will not be found here. Instead he will have guidelines for his own review and selection of programs that will result in policy initiatives for a multi-alternative program that encompasses more than one institution.

The attributes of a multi-alternative program can be established on the basis of what we should not expect of them as well as what we think can be expected of them.

What Not To Expect	What Can Be Expected
1. Provide simple solutions to complex problems	1. Provide information and analysis so that decision makers might have a better idea of the direction and pace of events as well as suggesting policies to provide alternatives to those events
2. Usurp or replace decision making of current institutions	2. Incorporate mechanisms for assessments of program activity on-stream as well as relate them to the longer-term goals
3. Be a single, well-defined system	3. Require participation and constructive collaboration by more than one institution or group of institutions
4. Always produce predicted results	4. Possess a high degree of uncertainty about requirements, aims, and operational results
5. Always yield the predicted quantity, quality, and type of data	5. Involve a degree of unknowns — new technology, new resources, new regulations, new structures and new styles of management
6. Establish national goals by themselves	6. Require a high degree of cooperation and coordination and activism on the part of the senior executives if the programs are to be successful

B. Formulating of Issues/Questions for Multi-Alternative Action Programs re: Management of Information Technology

1. Introduction.

As part of the Conference Board study, more than fifty senior executives and educators representing leading U.S. corporations and universities formulated what, for them, were the leading issues regarding the impacts of information technology. A review of the five reports of the Information Technology Panel resulted in the formulation of ten major issues/questions regarding the impact of information technology on society in general. These are listed below.

- | | |
|---|---|
| 1. Wants versus Needs | 6. Personalization versus Depersonalization |
| 2. Public versus Private Communication Systems | 7. Real versus Information Environments |
| 3. Centralization versus Decentralization | 8. Management Styles: Old versus New |
| 4. Distribution of Information as Wealth: Private versus Public | 9. Organizational Form: Open versus Closed |
| 5. Individual Privacy versus Public Knowledge | 10. Keeping Up versus Falling Behind in Information Technology (I.T.) * |

* "I.T." as used throughout this summary refers to "Information Technology".

2. Significant Consideration for Generation of Multi-Action Programs

Further study of the five panel reports resulted in the following observations:

1. Each institution within our society perceives and values I.T. differently.
2. Regardless of the uncertainties due to changes in values, the primary initiatives for managing change are still in the hands of the leaders of our existing institutions.
3. Apparent limitations have always acted as a spur to technology.
4. There is need to perceive and formulate national policies in a way that link them loosely to individual institution actions that bring about dynamic evolutionary changes in a desired time.
5. There is a dichotomy in problem generation, action taking, and assessment. Those who formulate problems often do so with little reference to present realities. Problem solvers working on current problems often do not consider adequately their actions' impacts on the future.

3. Objective for and Characteristics of Multi-Alternative Action Programs

The objective for a multi-alternative action program becomes the problem for assessing and selecting those problems that enable each institution to achieve their goals within a wider context of social objectives. In this regard, the process is to form prediction and/or choice of programs. In summary, the characteristics of multi-alternative action programs can be stated in six phases:

Characteristics of Multi-Alternative Action Programs	
Phase I - Goal Setting -- 1971-1990	Phase IV - Choices of Time Phase Impacts of I.T.
Phase II - Time Phasing - Major Master	Phase V - Choice of Planned Spinoffs
Phase III - I.T. Developments - Major Predictions	Phase VI - Assessment Cycles

4. Summary of Results of Special Study to Formulate Issues and Initiatives

The major conclusion from the study of submissions by the nine panelists and eighteen corporate representatives follow:

- a. The study on Issues and Initiatives indicates that issues around I.T. were not ready for policy initiative selection by senior executives
- b. They did, however, expose two urgent cluster areas:
 - (1) those that arise from the developments of I.T. itself; and
 - (2) those concerned with the impact of I.T. on institutions and individuals
- c. The cluster areas in turn required an evaluation of establishing appropriate policy centers or information networks made up of various institutional components
- d. It was abundantly clear that current institutional structures are not adequate to take the required initiatives to utilize I.T. in the partial solution of what may be considered as major issues by the senior executives of business, education, government, foundations, unions, and other institutions.

C. Formulation and Discussion of Major Problem Areas Required to Generate Multi-Alternative Action Programs re: Management of Information Technology

1. Criteria for Selection of Problem Areas.

To provide a focus

for the senior executives to select interinstitutional policy initiatives, the

following criteria for the selection of problem areas worthy of consideration were used:

- | | |
|--|--|
| 1. Information technology is central or plays a significant role in formulating the major policy issues in the problem areas. | 3. They are amenable to being structured into action programs for selection and immediate implementation by today's management. |
| 2. The force and impact of I.T. affects more than one institution (e.g., business, government, education, unions, or foundations) and thus requires their joint cooperation. | 4. The derived programs and projects if implemented, will have a likelihood of success that is acceptable to senior executives in terms of direct bearing on the problem area as well as provide significant spinoffs for each member institution. |

2. Selected Problem Areas.

Using the above selection criteria, the following problem areas were selected:

- Problem Area 1. Formulate comprehensive research policies that foster the efficient development of research and I.T.
- Problem Area 2. Promote I.T. for the management of change.
- Problem Area 3. Develop and employ the "educated intellectual elite" manpower adaptable to I.T.
- Problem Area 4. Foster I.T.'s use to develop and allocate the nation's human, physical, and technological resources.
- Problem Area 5. Establish the required principles and mechanisms for the gathering, processing, communicating, and transmitting of data and information in terms of accuracy, reliability, consistency, timeliness, flexibility, secrecy, and privacy so that they will enhance a process of assessment other than advocacy or adversary.

Problem Area 6. Promote I.T. developments for social and cultural developments.

3. Conclusion.

The six problem areas are complex. There is no one institution in our society that is responsible for creating these problem areas. This situation is partially a result of the fact that no one institution was responsible for the decisions and actions that created these problem areas. They are all "somebody else's problems."

The six problem areas do not come equipped with ready-made solutions. They do act as "triggers" for a number of criteria, requirements, and multiple institutional action programs. First, these problems trigger a need for interinstitutional policy centers concerned with multi-alternative programs. The objects for concern should be multi-alternative because the need is for policy initiatives. Programs are required because, in the short run, resources are allocated to programs and not to policies.

D. A Multi-Alternative Action Program re: Management of I.T.

1. Criteria for Selection of Priorities.

The following criteria have been established for the selection of priorities in the formulation of the multi-alternative programs:

- | | |
|---|--|
| 1. The multi-alternative program has a high probability of meeting aims set for 1990. | 4. The programs provide for an orderly development of research in I.T. that meets the aims of the multi-alternative action programs. |
| 2. The need for programs or projects currently exists and are generated by current social and economic needs of our nation. | 5. The multi-alternative programs are functions of better utilization of existing and to be allocated resources and the reassessment of the priorities rather than the injection of large quantities of new funds. |
| 3. There must be an observable short-term payoff by the generation of the programs for the existing institutions that participate in their formation and recommendations. | |

2. A Multi-Alternative Action Program — Six Phases.

A multi-alternative action program is presented in six phases as listed in the objectives in section B-3.

Phase I. A Long-Range Satisfactory Goal. The long-range satisfactory goal for the recommended multi-alternative program is as follows:

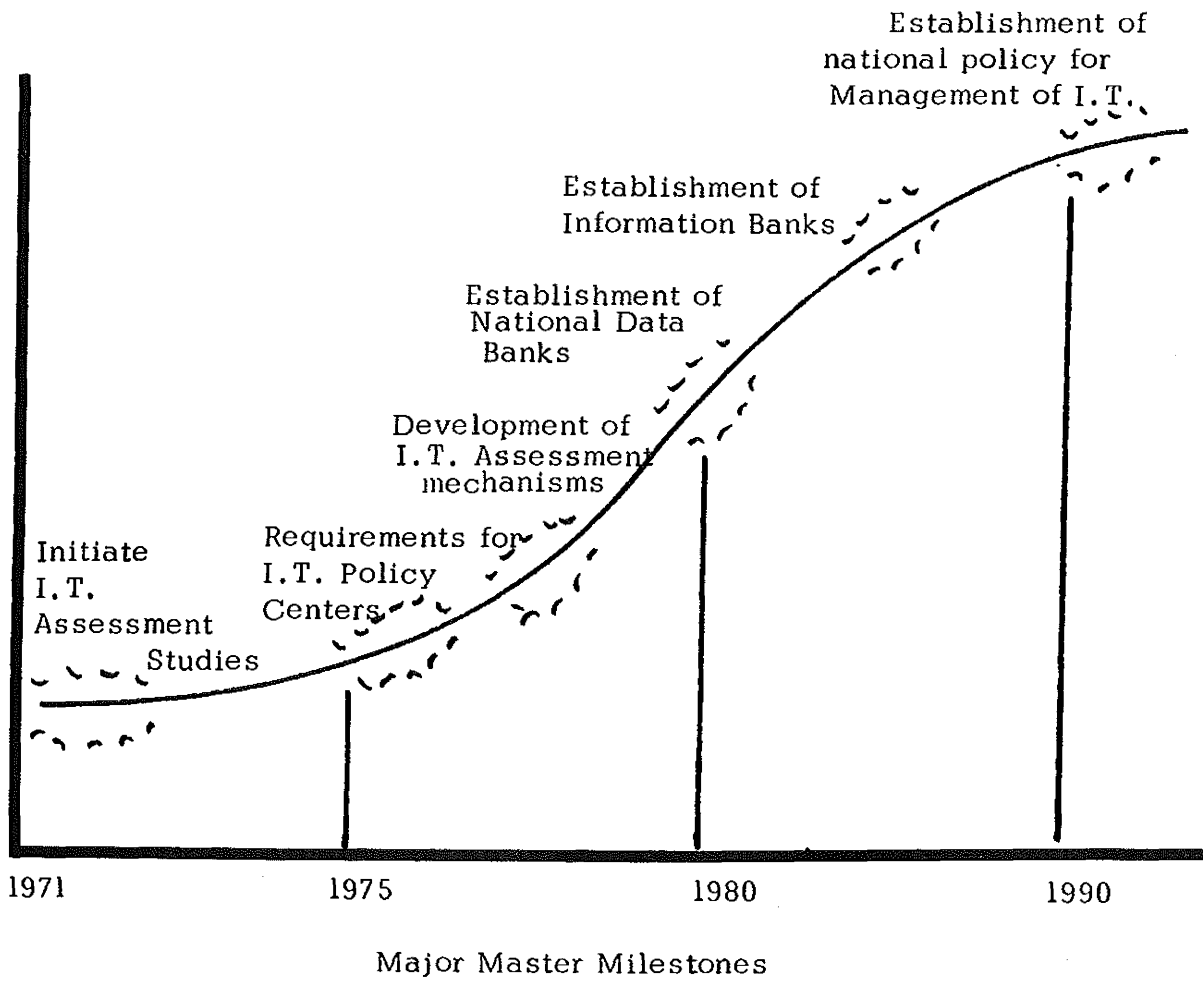
There be established by 1990 an integrated national policy for the Management of Information Technology which takes into account the requirements of major sections of business, education, government, unions, foundations, and other institutions (e.g., individual and families).

Based on the above goal, Table I lists the objectives for the other five phases.

Phases of Multi-Programs	Near-Term Program Milestones - 1971-1975	Mid-Term Program Milestones - 1976 -1980	Long-Term Program Milestones - 1980-1990
Phase II -- Major Master Milestones	<ul style="list-style-type: none"> * Reassessment of Status of Information Technology * Establish Requirements for I.T. Goals * Identification and Formulation of Required Policy Centers for I.T. 	<ul style="list-style-type: none"> * Validate Requirements * Establish Selected Data Banks 	<ul style="list-style-type: none"> * Establish Integrated National Policy for Management of I.T. * Establish Integrated Information Banks and Required Communication Networks
Phase III - I.T. R&D — Major Predictions and Major Bottlenecks	<ul style="list-style-type: none"> * Information Technology R & D Programs for Short-Term Goals 	<ul style="list-style-type: none"> * Information Technology R & D Programs for Mid-Term Goals 	<ul style="list-style-type: none"> * Information Technology R & D Programs for Long-Term Goals
Phase IV - Choice of Time Phased Impacts of I.T.: A Master Operational Schedule	<ul style="list-style-type: none"> * Select priority programs wherein I.T. has significant impact on near-term social & economic problems 	<ul style="list-style-type: none"> * Select priority programs wherein I.T. has significant impact on mid-term social & economic problems 	<ul style="list-style-type: none"> * Select priority programs wherein I.T. has significant impact on long-term social & economic problems
Phase V _ Choice of Planned Spinoffs for I.T. and Its Impacts	<ul style="list-style-type: none"> * Select priority of spinoff near-term programs that can result from Phase IV programs 	<ul style="list-style-type: none"> * Select priority of spinoff mid-term programs that can result from Phase IV programs 	<ul style="list-style-type: none"> * Select priority of spinoff long-term programs that can result from Phase IV programs
Phase VI - Assessment Cycles	<ul style="list-style-type: none"> * Establish and initiate required research for assessment methodology 	<ul style="list-style-type: none"> * Validate the assessment methodology through selected interinstitutional programs 	<ul style="list-style-type: none"> * Implement an on-going assessment program in coordination with the national policies re the Management of I.T.

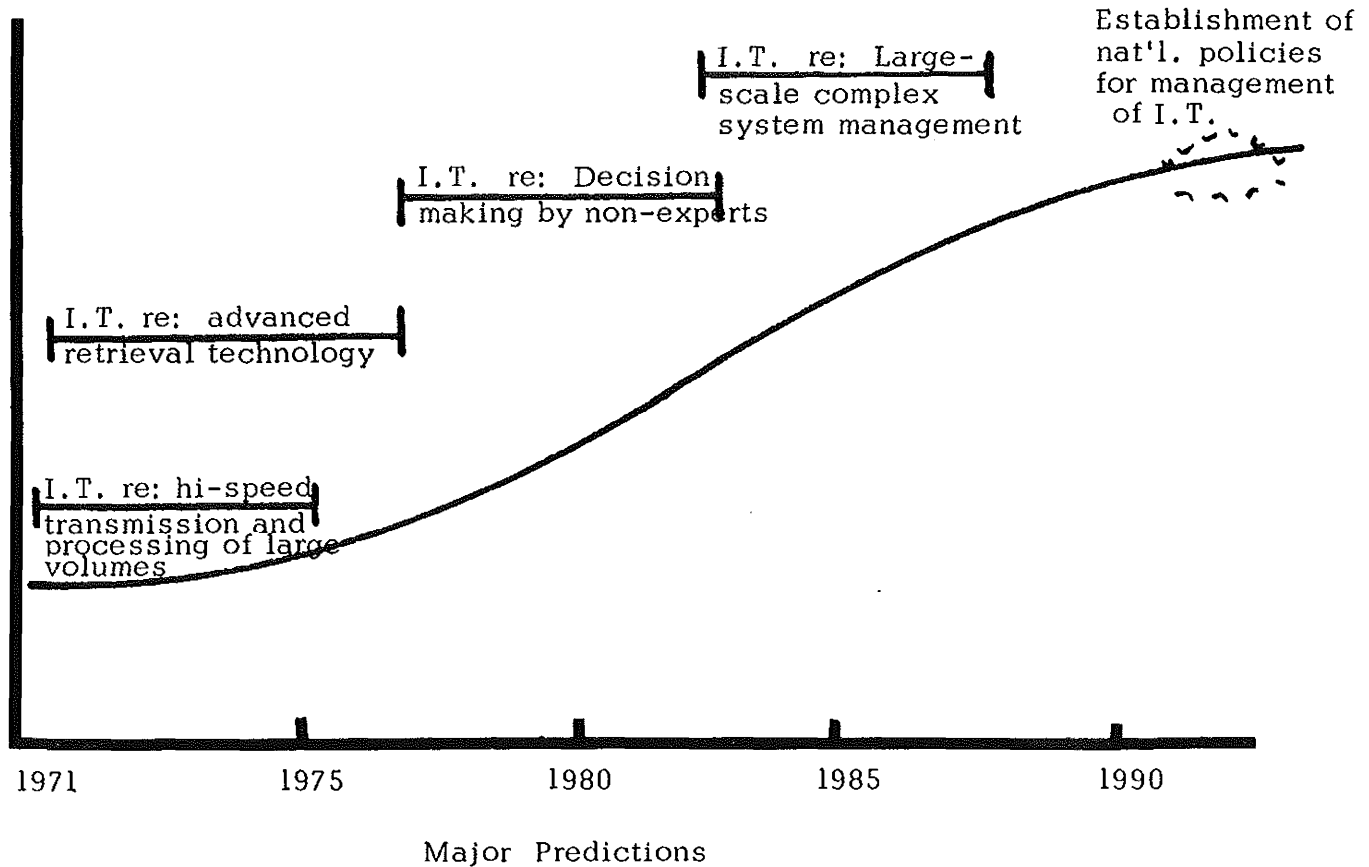
TABLE I OBJECTIVES FOR MULTI-ALTERNATIVE ACTION PROGRAMS

Phase II. Major Master Milestones. In order to accomplish the long-term goal, a series of major master milestones were chosen and a summary of some of the major master milestones is as follows:



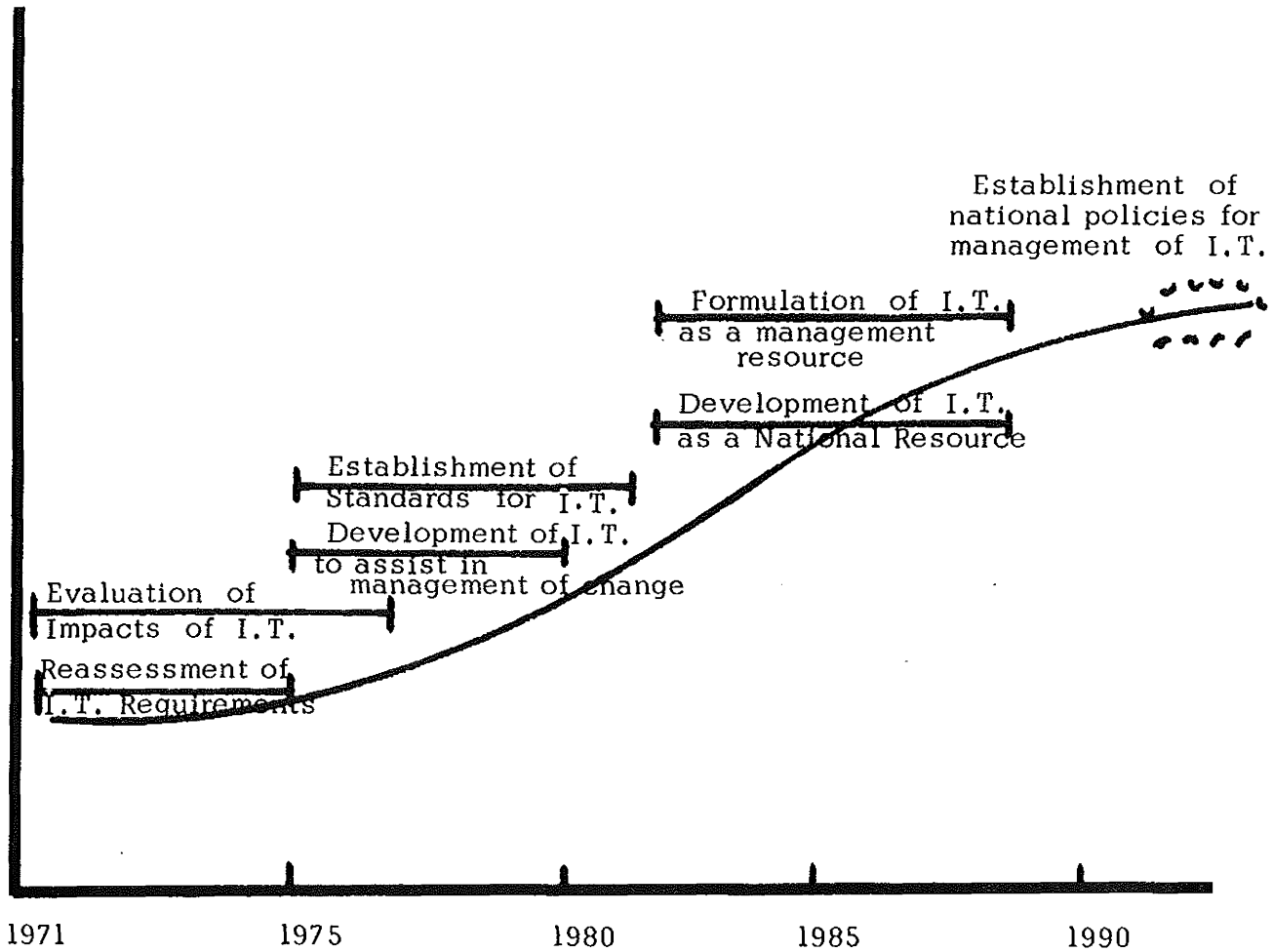
Phase III. Information Technology R & D — Major Predictions

and Major Bottlenecks. The attainment of major master milestones requires R & D re: information technology. These predictions have been based on the assumption that there be no limitations of required funds, facilities, and scientific and technical manpower. Furthermore that there would be no active world-wide war or other major national crises to divert such resources. A graphic summary of selected major events is shown as follows:



Phase IV. Choice of Time-Phased Impact of Information

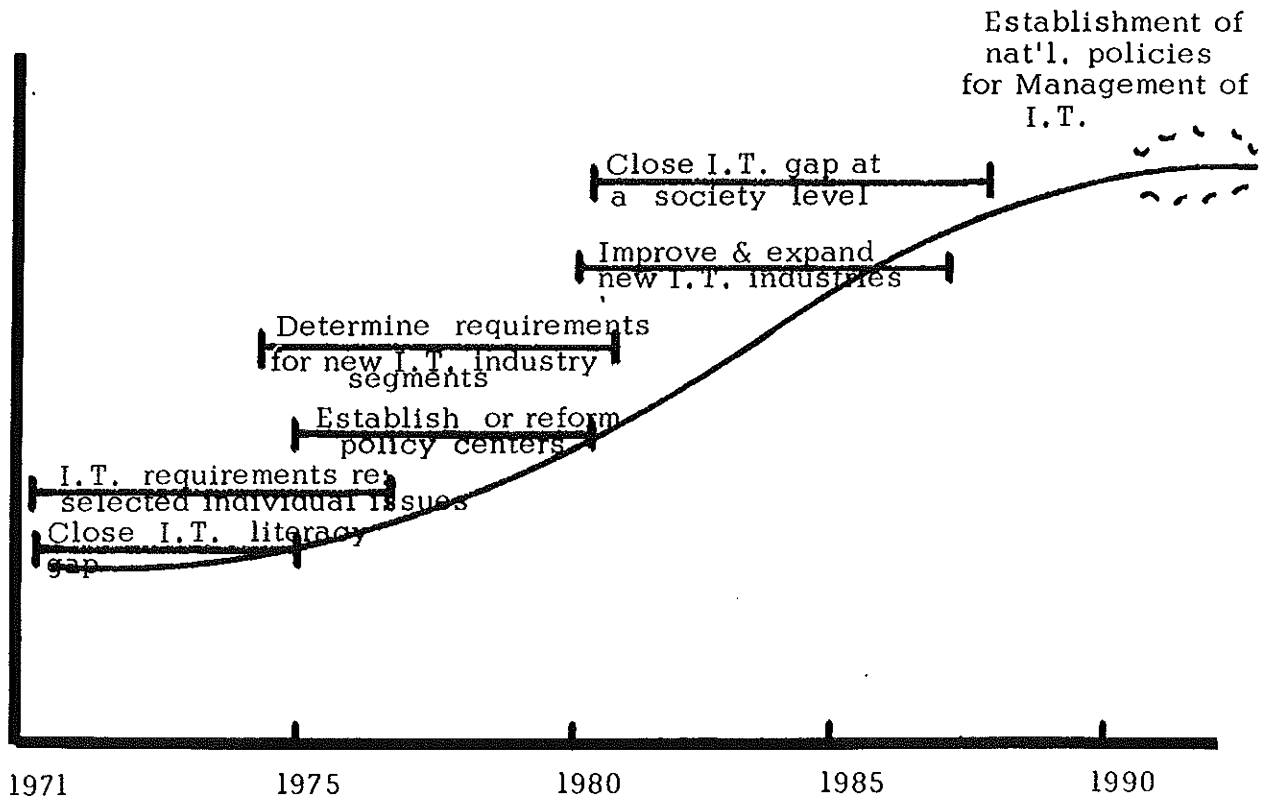
Technology: A Master Operational Schedule. One of the criteria for establishing priorities in the formulation of multi-alternative action programs for policy initiatives by today's senior executives is the need for programs or projects currently existing as generated by the current social and economic needs. The chart below shows some of the selected time-phased projects.



A Master Operational Schedule

Phase V. Choice of Planned Spinoffs of I.T. and Its Impacts.

The projects undertaken in Phase IV can be utilized to provide the means to determine spinoffs. The following chart shows selected choices of planned spinoffs.



Choices of Planned Spinoffs

Phase VI. Assessment Cycles. The assessment of I.T. and its impact is still an uncharted area. There is need to develop I.T. for assessment methodologies that assist executives in all of our institutions to evaluate the consequences of various programs and policies on a more rational basis rather than unduly emphasizing advocacy or adversary mechanisms. The programs for the development and validation of newer assessment methodologies follow.

Short-Term 1971-1975	Mid-Term 1976-1980	Long-Term 1981-1990
* Program to foster research and development of information technology for assessment cycles	* Program for the validation of I.T. methodology assessment by institutional segments that provide for assessment of 1) Industrial Policies 2) Social Policies 3) Cultural Policies 4) Government Policies 5) Science & Technology Policies * Program for improvement of R&D of I.T. methodology for assessment cycles	* Program for the validation of inf. tech. methodology assessment by inter-institutional segments that provide for national agenda assessment * Program for continued improvement of R & D information technology methodology for assessment cycles

E. Policy Initiation for Today's Senior Executives

Given the framework just presented, it is necessary for senior executives of our institutions to review and indicate the programs of their choice for implementation. The recommendation of selecting one program element over another can be decided by using the straight-forward criteria: Would the senior executive (1) reallocate existing resources he controls from one program or project to the one selected, and/or (2) support the allocation of new resource commitments to the information technology project selected.

The focus and catalytic choices to trigger the reaction to formulate an action program must be provided by senior executives. Hopefully the six-phased outlined program is broad enough on the one hand to give senior executives a variety of choices from which to select their priorities and still specific enough on the other hand to avoid the necessity for adding to or altering the program outline to more fully meet the objectives.

IV. New Styles of Management

A. Managerial Styles

It is no secret that informational mechanisms are often designed, purchased, and operated in ignorance of management behavior. Further, attempts are made to operate in various managerial styles regardless of the underlying information systems. It is evident that both information technologists and managers must somehow take into consideration the characteristics of each other's behavior and techniques. As a step in this direction, we propose that management styles be identified and characterized and then related to informational mechanisms that facilitate them. With this in mind, let us briefly describe three styles of management we have identified and then link them to the information bases they require. At the outset it should be noted that the managerial styles we describe are characterizations of management activity. There have been many theoretical discussions of management which purport to tell managers what they should be doing. Our purpose, however, is to relate, in stereotypes, observed management behaviors and to relate them to information products and services.

1. The Professional Style.

The professional style is characterized, in part by an emphasis on factors internal to the organization. If an organization

is to grow, the professional style is biased towards basing this growth on opportunities found within the current product/service/market scope. Growth is achieved then by more of the same or similar activities. The organization structure most conducive to the professional mode is the centralized hierarchy. This structure gives the best internal picture of the organization and is well suited to an emphasis on control of operations. The time horizon implied by the professional style of management tends toward the short run. This complements both the emphasis on growth internally and on control.

In the private sectors, the professional style is further characterized by the use of return on investment as the prime criterion for selection among alternatives, and profit as the measure of success. To finance growth the capital sources selected are usually the traditional ones: investment bankers, private placements, market placements, etc. Firms dominated by professional style management tend to emphasize domestic production and markets with foreign operations limited to marketing. The limiting factor on the exercise of the professional mode of management has been antitrust. Continued internal growth has led many firms to market positions that invite Justice Department investigation. The solution to this problem, at least during the 1960s in the United States, was a shift to the entrepreneurial style.

In the public sector, the professional style of management manifests itself through an emphasis on GNP or GNP-type measures. Progress and growth are measured in terms of a single primary

economic dimension. The professional style tends towards domestic resource exploitation as a primary means of supplying the demands of society. The limiting factors on perpetuation of the professional style in the public sector has usually been seen in terms of limited domestic resources. Faced with this limitation, the professional style usually gives way to an entrepreneurial style of management.

The professional style of management needs and is supported by a corresponding set of information products, structures, and services. The primary information system for the professional style is the internal system. For reasons of both economics of scale and managerial control this information system is most likely to be centrally organized and managed. The information structures are usually hierarchical in nature and broken down along the functional lines of the organization. The information structures are closed and regarded as self-contained. Data for these structures are largely historical and accounting-oriented. Information flows are chiefly along vertical lines.

The decision models used in the professional style of management are closed in nature and are limited to descriptive or single dimensional optimization. In the public sector, input-output models are representative of this type of model. In the private sector, inventory control models, production scheduling models, etc., predominate.

While internal standardization on hardware, software, and information structures characterizes this management style, little attention is paid to standardization on a broader basis. The types of products and services demanded and used by other organizations and institutions are not seen as relevant. For this reason the professional style of management is susceptible to having standards imposed upon it by others.

2. The Entrepreneurial Style.

A second type of management is the entrepreneurial style. Institutional factors limiting growth from within lead to a style of management that focuses on the immediate external environment as a source of growth. The entrepreneurial style emphasizes planning over control. As a consequence, a decentralized hierarchy is the preferred form of organization. This has the effect of decentralizing control into the hands of subordinate managers operating in the professional mode and retains planning as the primary top management function. The entrepreneurial style operates within a medium range time horizon.

In this style of management, in the private sector the key measure for selection among alternatives is expected earnings per share and the criterion of success is growth in earnings per share and price per share. For the entrepreneurial style, growth is financed through the same traditional sources used in the professional style and through private institutional sources (e.g., venture capitalists) as well as by financial leverage

obtained in mergers and acquisitions. Firms dominated by the entrepreneurial style tend to engage in international operations in both production and marketing but with a strong national base. Liquidity represents the prime limiting factor on the entrepreneurial style. Coupled with redefined institutional rules (e.g., antitrust) limiting growth per se there is a tendency for the entrepreneurial style to be replaced by an adaptive style of management.

The entrepreneurial style of management in the public sector is characterized by an interagency orientation as opposed to an internal focus. Measures of performance are dominated by balance-of-payments type considerations rather than the GNP orientation of the professional style. To operate along these dimensions, management looks beyond domestic resources to international resource exploitation. In this process a limitation in the form of scarce world resources is eventually encountered. Thus as in the private sector, the tendency is towards the adaptive style of management.

The information systems implied by and facilitating the entrepreneurial style of management are largely institutional in scope. That is, in the private sector they extend beyond a firm and an industry to include other industries, their suppliers, and their customers. In the public sector the information systems are interagency in scope and encompass several levels (e.g., federal, state, local) of organization. This usually implies an organizational arrangement of a number of weakly-linked

decentralized information systems. Management of the information system is possible through loose standards that are operable within the limits of the institution. Standardized data formats and report configurations among banking institutions are examples of such standardization. Information structures are quasi-open and divided along organizational lines. Information flows are primarily vertical with integration at the common point of top management, but commonalities provided by standards allow for some limited horizontal flows. Data are financial or aggregated operational in nature and are current in timing. Some short-range data projections are used.

The entrepreneurial style is conducive to quasi-open models, often involving multiple goals. Game theoretic models, multi-goal programming models, decision theoretic, and batch mode simulations are representative. In the public sector econometric and world simulation models are part of the entrepreneurial style.

3. The Adaptive Style.

Pushed by liquidity problems and sheer bigness in the private sector and by world resource scarcities in the public sector, the early 1970s has seen the emergence to a dominant position of a new management style. What we shall call the "adaptive style" of management has become influential but not in all organizations. In the case of this style, we are for the most part referring only to corporations like those on the Fortune 500 or to leading federal and state agencies in the public sector. And

even in these corporations when we speak of the adaptive style we are referring to the behavior of only the top management.

The adaptive style of management is systems oriented; that is, it involves both internal and external factors on an interinstitutional business, government, education, etc., basis. Managerial emphasis is on design (or adaptive planning) of total systems. Organizational structures are perceived as being fluid and nonhierarchical. Authority and responsibility are results of superior information and not of pre-structured relationships. The time horizon in the adaptive mode is the long run.

Private exercise of the adaptive style emphasizes asset (human, physical and technological) position rather than earnings per share or return on investment. Profitability is the measure of success. Capital sources are broadened to include on a global basis both private and public sources such as pension funds and joint business/education/government ventures for financial capital, foreign and domestic educational and governmental organizations for human resources, and international interest institutions for technology. Concerns dominated by the adaptive approach are likely to be true multinational corporations.

Public sector adaptive management is characterized by its interinstitutional approach and its emphasis on quality of life type measures. Progress is measured along a number of dimensions

according to a set satisficing criteria. Resources tend to be viewed as a world system of assets complementary to a world system of demands and possible uses (including conservation). In the adaptive style, resource utilization is determined not by physical possession nor by economics but by the value of the end product over a time horizon.

The adaptive style of management requires an open information system. The scope of the system must be interinstitutional, actively linked to business, government, education, foundations, etc. The management of such an information system can only be achieved by widespread standards on informational products, services, and structures. The information structures themselves must be flexible enough to meet a wide range of unanticipated demands. Flows of information are both horizontal and vertical, implying a flexible communication net. Data are future oriented on an inter-institutional basis.

Model types used in adaptive management are open and interactive in nature. They involve not just man-machine configurations but man-machine-man networks. They also go beyond multiple goal structures to incorporate multiple policy functions. As outputs they produce satisficing functions that can serve as inputs to lower level models.

Figure 1 summarizes the characteristics of the three managerial styles just discussed and Figure 2 relates these styles to information products

Type Sector	PROFESSIONAL STYLE	ENTREPRENEURIAL STYLE	ADAPTIVE STYLE	CATEGORY
P R I V A T E	1. R O I 2. Internal 3. Control 4. Centralized Hierarchy 5. Short Run 6. Profit 7. Traditional Capital Sources 8. Domestic Prod./ Foreign Marketing 9. Antitrust	1. E/S 2. External 3. Planning 4. Decentralized Hierarchy 5. Medium Run 6. Growth 7. Private Institutional Sources & Financial Manipulation 8. International 9. Liquidity	1. Asset Liquidity 2. Systems 3. Design (Adaptive Planning) 4. Fluid Non-Hierarchical 5. Long Run 6. Profitability 7. Public/Private Sources 8. True Multinational 9. ?	Measure Emphasized Managerial Focus Orientation Organization Structure Time Horizon Goal Capital Sources Market Scope Limiting Problem
P U B L I C	1. GNP 2. Internal 3. Domestic Resources Exploitive 4. Limited Domestic Resources	1. Balance of Payments 2. Interagency 3. International Resource Exploitive 4. Limited World Resources	1. Quality of Life 2. Interinstitutional 3. World Resource System 4. ?	Measure Emphasized Organizational Focus Resource Scope Problem
Common w/Private	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	

FIGURE 1 CHARACTERISTICS OF MANAGEMENT STYLES

Style Sector	PROFESSIONAL STYLE	ENTREPRENEURIAL STYLE	ADAPTIVE STYLE	CATEGORY
P R I V A T E	*Internal	*Institutional	*Interinstitutional	1. Orientation
	*Hierarchical	*Decentralized Hierarchy	*Fluid	2. Info Structure
	*Accounting	*Financial	*Asset	3. Data
	*Internal Standards	*Institutional Stds.	*Interinstitutional Std.	4. Standards
	*Monolithic	*Decentralized Hierarchy	*Non-Hierarchical	5. Model Structure
	*Optimizing	*Multi-goal Satisficing	*Multipolicy Satisficing	6. Model Type
	*Vertical	*Vertical, some Horizontal	*Multi-directional	7. Information Flow
	*Closed	*Quasi-Open	*Open	8. System Structure
	*Linear Program Production Scheduling	*Goal Programming Corporate Simulation	*N-Person Cooperative Games, Interactive Simulation	9. Model Examples
P U B L I C	*Agency	*Inter-Agency	*Interinstitutional	1. Scope
	*Input-Output	*Econometric Models	*Interactive World Simulations	2. Model Example

FIGURE 2 MANAGEMENT STYLES AND INFORMATION SERVICES

and services. We should emphasize here that in presenting these descriptions of management styles no pretense of being exhaustive with respect to possible modes of management behavior is made. Nor do we maintain that a single managerial style is sufficient to identify a particular manager. A given manager will exhibit different styles on different occasions and, hence, will require different information systems to facilitate his different modes of decision-making. We do feel, however, that for a period of time the behavior of a significant segment of management can be broadly characterized by a particular management style. For example, U.S. management during the 1960s had a noticeable entrepreneurial style. Given this, we maintain there are definite implications for information technology developments. The rest of this section will more fully explore this proposition with respect to some recent information technology developments.

B. Data Base Management

A common myth holds that information technology products and services represent solutions to management's problems. In the 1960s these so-called solutions were packaged in the form of computers. Hardware was sold as the aspirin to cure the corporate headache. But as management found out and as the McKinsey Report ^{1/} documented, computers often became a

^{1/} The 1968 McKinsey Report on Computer Utilization, McKinsey & Co., Inc., 1968, pp. 1-38.

corporate pain in the neck. Shiny computers, sitting in airconditioned rooms did not represent solutions. Nor did piles of computer-generated reports. Management's disenchantment was revealed in a slow-down of computer purchases and a reorganization of technical personnel and systems. By the early 1970s there was evidence that management had begun to learn to use the computer effectively, if not always efficiently.

Now, in the 1970s, we see the producers offering a new information technology development as a panacea for management's problems. The new "solution" is in the form of data bases and data management systems. Producers advertise "Not just data-reality" or "Computer solutions — not just computers". Managers are expected to believe that because the new "solutions" are in the form of software that they are "closer" to management's way of doing things. After all, you can interact directly with a data-base whereas it was a bit difficult to establish a rapport with a computer. Data bases are "user oriented." However, if we examine the salesman's idea of a "user" we find that he is more often referring to the corporate computer technologist than he is to a manager. This finding is reinforced by an examination of materials and seminars explaining data bases and their uses. What we find here is a new technical jargon that speaks powerfully to the technician but says little to the manager. This does not mean that the manager does not perceive the need for some way of managing his data base. He perceived the need as soon as he began to bring the computer under control.

But a managerial concept of the need for data bases and the technologist's concept of the need for data bases seem to differ significantly. The technologist often sees data bases as an end (i.e., solution) in and of themselves. Problems are perceived as being fragmented and data bases are seen as a way of achieving organizational integration. Thus we see, for example, a number of international organizations proposing data bases as solutions to a variety of problems. In the area of agriculture and computer technology OECD proposes data base establishment; and in the area of industrial technology the UN proposes the same; just to cite two cases. Similar cases can be found at almost every level of organization. The results of this course of action can be seen in the example of the Detroit social action data bases. ^{2/} The data base was structured and built and then within a short time allowed to degenerate through neglect. Numerous other tales from both public and private sectors can be cited.

The problem is that while data bases do serve an integrating function, they will only continue to do so if they are useful to managers. Managers see data bases as alternative generators. If these alternatives are not practicable (i.e., if the data bank does not lead to an information bank) the data base is likely to be viewed as expendable. Data bases are not only costly to establish but costly to maintain. You can often make do with an

^{2/} Social Reporting in Michigan: Problems and Issues. Center for Urban Studies, Wayne State University, January 1970, pp. 19-22.

outdated computer; but an outdated data base is useless to a decision maker.

The technologist's view is not incorrect except insofar as it is incomplete. And it is incomplete because it is based on another myth. The myth is that technology is neutral. Computers, communications devices, terminals, compilers, computer languages, and data base are all supposed to be unbiased with respect to the management using them. But, as we attempted to illustrate in the previous section, information structures and management styles are interdependent. The structure of the data base, even down to the manner in which key parameters are identified, has an influence on management behavior.

Data base management systems then must be successful alternative generators if they are to be maintained. They are not solutions themselves; they can, however, generate alternatives that might become parts of solutions to some managerial or societal problems. To do this the data bases and systems (and other information technology devices and services) must be linked to a theory or style of management. If this is not done a priori, managers will do it a posteriori by altering or replacing the data base management **system**.

To date solutions to the problems of successfully integrating data bases into a managerial context have been limited to technical and operational factors. The combining of a number of functionally-oriented data bases into an integrated data base (or the accessing of a common data base by a number of

functional area managers) has led to a number of problems. Different managers have different requirements as to data base structure, access and maintenance. The solution usually proposed is for the organization to create the position of a data-base administrator. This individual's task is to facilitate management's access to the integrated data base and to work out any resulting conflicts. As the position is usually created vis-a-vis an existing or planned data base, the data administrator's style of management is professional in nature and his intent seems to be more one of getting management to adapt to using the data base rather than working out a mutual accommodation between the manager and the data base. This approach again is an illustration of the myth of the data base management system as a solution. It remains anchored to the technical and operational features of both data bases and their administrative systems and does not usually extend to the wider managerial implications.

All this is not to gainsay the usefulness of data administrators. They fulfill a needed role vis-a-vis data systems and can be expected to play an increasingly important role in future organizations. But data base administration is currently limited in its concept and approach, not really being relevant to an entrepreneurial style of management and certainly not relevant to an adaptive style of management, for example. If those dealing with data bases do not adopt an output orientation directed at producing viable alternatives for decision makers, then at the end of this decade we can expect a report

detailing the lack of success of data bases and data-base management systems in solving management problems.

C. Information Management

To complicate matters further, at the same time management is struggling to incorporate data base systems into their organizations, we can perceive the emergence of a new level of structure overlying data bases and data administrators. This new level is that of the information bank. An information bank is that mechanism that has as inputs the alternatives generated by the data base and for outputs has alternative action plans. And whereas a data base has files as its basic structure, an information bank has models and algorithms as its basis. Corresponding to the data administrator of data bases, information banks have information managers ^{3/} to superintend their use. The overall structure of this new system is depicted in Figure 3.

If the question of management style and theory is important in data base management, it is crucial in information management. In establishing an information bank, management should first ask "What is the management theory or style on which the bank is to be based?" Information banks can serve

^{3/} It should be noted that some organizations use the title of "Information Manager" or "Information Middleman" when referring to what is in fact a data-base administrator. We distinguish between them.

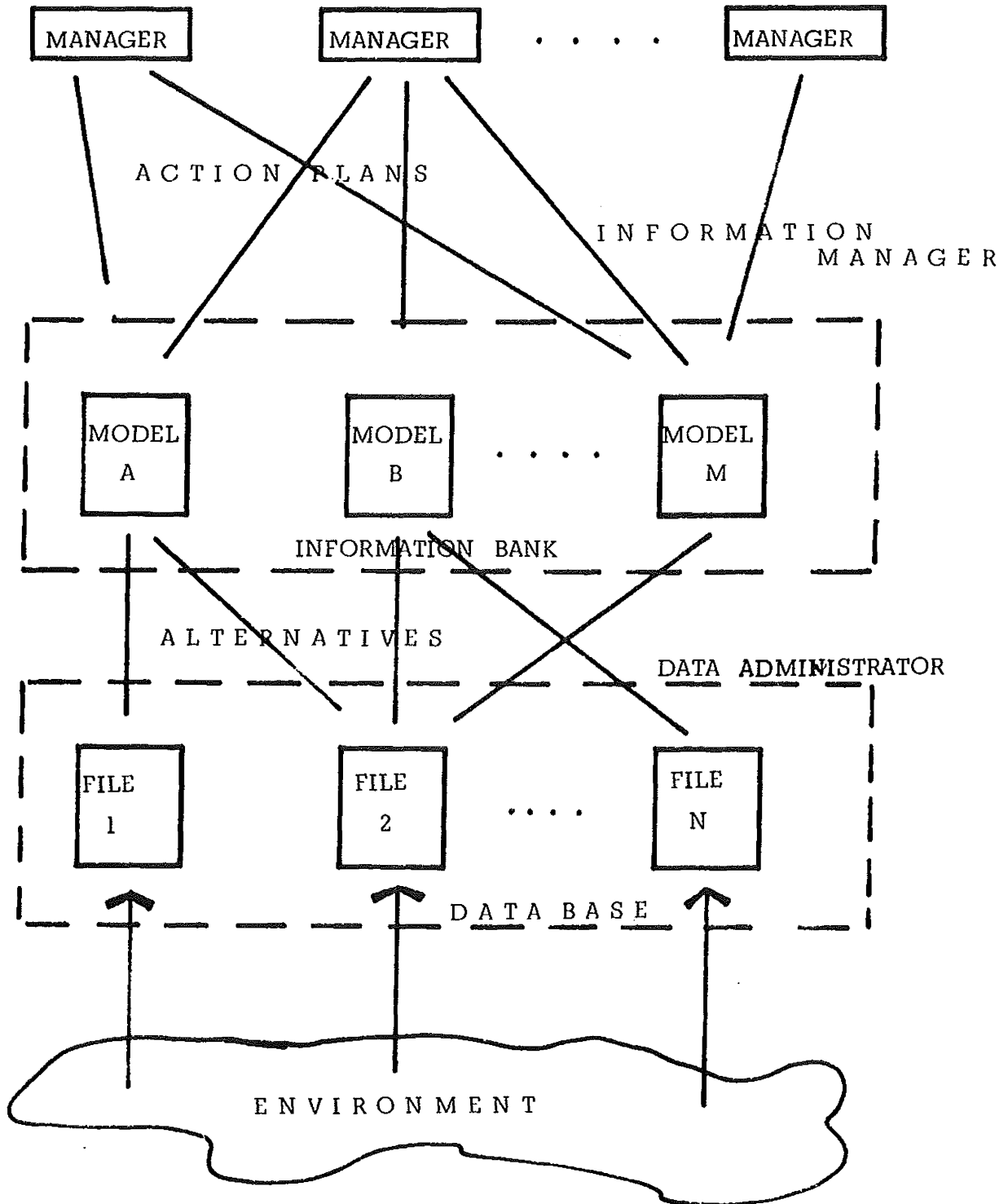


FIGURE 3
Structure of the Information Environment

a wide variety of management styles including the three mentioned in the previous section. In fact it is the information bank which makes it possible to link data bases to the entrepreneurial and adaptive styles of management. Thus the key role of theory.

The next series of questions regarding information become more and more technical, thus, if answered, forming the needed link between theory and operations. They are:

- * What are the managerial implications of the mathematical theory upon which the various segments of the information bank depend?
- * What is the mathematical theory?
- * What is the algorithm upon which the computations are based?
- * What is the code that does the computation?
- * What are the performance characteristics of the code in terms of time, cost, and performance?
- * What are the operational outputs of the code?

Most of the building blocks of an information bank are implemented in the form of computer codes. Thus it is all too easy to begin or continue the construction of an information bank by purchasing or developing computer codes without considering their managerial consideration.

Although information banks are currently in operation in only a few highly information-dependent organizations it is not too early to begin to perceive some of their impacts on management and managerial styles. The one impact of considerable interest to both managers and students of management that we will mention here is that information management may well be the way to the top in many organizations. Let us take a case in point; airlines. It used to be that the common route to the presidency of an airline was to become a pilot and work your way up. More recently, given the financial problems of airlines, the financial function produced a number of nonpilot presidents. Currently with information systems for passenger reservations, flight schedules, repairs, personnel, and other airline functions becoming increasingly important, presidents for airlines are being drawn from the managers of airline information systems.

This trend is duplicated in banks where the legal department is being replaced by the information system as the source of presidents. Insurance companies are also following suit and we can expect the service industry and government in general to do the same. Such a trend, if followed, will represent an important development for management in the last part of this century.

D. Conclusion

In this section we have addressed ourselves to the problems of relating managerial styles and information technology developments. These

latter developments have moved from the computer (which is quite removed from management), to data base systems (which are closer to management), to information banks (which directly interface with decision making). As information technology devices and services increase their overlap with management activity a corresponding need is developed for a middle ground upon which managers and information technologists can successfully intersect. It is likely that information banks coupled with an adaptive style of management will fulfill this function. The developments in these two areas will be of critical importance to the development of the information society over the next twenty years.

V. Summary and First Conclusions

A. Summary: From the Future to the Present

Having identified trends and developments that are likely to take place in the future we can now summarize some of the impacts of information technology in terms of resources, institutions, and choices to the present.

1. Resource - Information Technology. Information, via the new technologies, becomes a new type of resource whose unique characteristics are such that they challenge many of the core concepts, institutional values and functional allocations in society.

- * It is not "used up" in use but gains — hence, unlike other resources, the more it is shared the more it multiplies.
- * It changes core concepts of "wealth" and "power". Older forms of these concepts are based on physical materials, invested energies, etc., tend to be obsoleted. Information creates new "property"; i.e., organized information with transfer and transformative capacities far greater than before.
- * It creates a "new property class" — those possessing skills with regard to access to, manipulation of knowledge and information.
- * It shifts policy decision-making and control functions in society — which now come to be associated in due ratio with the new wealth and power.

- * Information technology forces a higher order range of choices and options in the management of change. It amplifies not only ranges of choice but also the possibility of strongly "negative" options. By its nature, the increased range and variety of information about both the physical and social environ, and individual human dynamics suggests that there may be no one optimum way in the monolithic sense — emphasis here is not either/or but both/and. Choices, options, and policies must be viewed as optimal only for a given time for different groups, specified areas, etc. -- and will require a greater trust in the choosing ability of each individual than ever before.

There is no conceived means for allocating technology as a resource.

Consequently we cannot tell whether the allocation function is efficient or inefficient; or even if it is working and meeting the needs of society.

2. Structure of Society — Institutions. Most of our current institutions were established at a time when our information technology was limited. Therefore, institutions are used to having people, responsibilities, and resource allocation adapted to their existing structures.

Information industries are a predictable outcome. In various combinations, they will afford the development of newer uses of man's intellectual capacities through the exploitation of the emerging informational resources. Our society has yet to recognize and begin to determine its opportunities and controls in the public interest.

3. Choices. Choice making is critical in the management of change in a period of transition. The problem for managers of all policy-making centers in general becomes the problem of assessing and selecting those elements of information technology that will enable their institution to achieve their goals within a wider context of societal objectives.

What are the choices? What are the questions to be asked about these choices?

a. Wants versus Needs

What are wants and needs in respect to information technology? Whose wants? How do you identify need groups? How do you provide a balance? How do you establish priorities?

b. Public versus Private Communication System

Who should establish them? What technology should be employed? Who should control access to them? How should access be controlled? How do you make sure that current communication systems can be extended to provide for future society's various information processing needs?

c. Centralization versus Decentralization

What dimensions are relevant? What are the effects of information technology on these dimensions? How do various other systems (e.g., transportation) complement or compete with communication systems?

d. Distribution of Information as Wealth -- Private versus Public

How should information wealth be measured? How should it be distributed? What mechanisms can be established?

e. Individual Privacy versus Public Knowledge

What information is privileged? How can access be controlled? When will we be able to develop an experimental system to "debug" the required technology for either private or public knowledge?

f. Personalization versus Depersonalization

How does information technology affect individual personalities? What is a "whole" person? How can they be developed? How can they be maintained?

g. Real versus Information Environments

What is "real" experience? How does it compare with informational experience? How can experience be fostered?

h. Management Style: New versus Old

What are the requirements for managers of the period 1973-1990? How can they be identified? How can today's problem-solvers be educated in the new relevant information technology?

i. Organizational Form: Open versus Closed

What are the appropriate organizational forms for the future? How do they relate to information technology? to managerial style?

j. Keeping Up versus Falling Behind in Information Technology

What is information technology? How can it be transferred? What are the costs of falling behind?

B. First Conclusions: From the Past to the Present or
The Way to the Future

"We now make many clear distinctions, and have come to separate science from philosophy utterly, but what remains at the core is still the old myth of eternal invariance, ever more remotely and subtly articulated, and what lies beyond it is a multitude of procedures and technologies, great enough to have changed the face of the world and to have posed terrible questions. But they have not answered a single philosophical question, which is what myth once used to do." 4/

"To begin with, there is no system that can be presented in modern analytical terms. There is no key, and there are no principles from which a presentation can be deduced. The structure comes from a time when there is no such thing as a system in our sense" 5/

4/ Giorgi de Santillana and Hertha von Dechend, Hamlet's Mill (Boston: Gambit Incorporated, 1969), p. viii.

5/ Ibid., p. 56.