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INTEGRATED INFORMATION SYSTEMS MANAGEMENT:

A COORDINATED AND COOPERATIVE APPROACH

by

Paul J. Knudsen

B.A., Gordon College, 1970

and

Steven N. Strominger

B.A., Bowling Green State University, 1966

A research project submitted to the Faculty

of the Program in Telecommunications

of the University of Colorado in partial

fulfillment of the requirements for the degree of

Master of Science

Program in Telecommunications

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This Project for the Degree of

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by

Paul J. Knudsen

and

Steven N. Strominger

has been approved by

Fred Chernow

Frank S. Barnes

Robert J. Williams

Date August 13, 1979

Knudsen, Paul Jeremy (M.S., Telecommunications)
Strominger, Steven Ned (M.S., Telecommunications)

Integrated Information Systems Management: A Coordinated and Cooperative Approach

Project directed by Professor Fred Chernow

Integrated Information Systems Management: A Coordinated and Cooperative Approach offers a new way of evaluating information systems management. The converging data processing and telecommunications technologies that are making concepts of the past inadequate for using both information and information systems to achieve organizational objectives are evaluated. The impact the converging technologies can and will have upon the traditional organizational and managerial structures designed around and for information systems is discussed. It is shown that as information systems become more technologically complex and interdependent, the need for more effective information systems planning and management escalates.

This project considers the nature of information, the forces leading to integrated management, and the interaction of integrated information systems and the management environment. The relationship between Integrated Information Systems Management and effective and efficient interfacing of the diverse information systems that exist in organizations today is explored.

A requirement for cooperation and coordination between managers of separate information technologies is established in light of the evidence that new information technologies transcend traditional organizational boundaries. Integrated Information

Systems Management is offered as a tool to evaluate management practice and to develop a fully coordinated and cooperative approach to information systems management.

This abstract is approved as to form and content.

Signed Fred Chenow
Faculty member in charge of project

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We thank also Professor Frank S. Barnes and Professor Robert J. Williams for consenting to be members of the review committee.

To our wives, Vicki Strominger and Joanne Knudsen, we owe a special debt of gratitude. They suffered our frustrations and shared our joys. They spent long hours typing draft after draft and editing, but most importantly, we are grateful for their encouragement and patience.

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Finally, we must thank the faculty of the Program in Telecommunications who have given us a deeper appreciation of the interdisciplinary nature of our chosen field.

Paul J. Knudsen
Steven N. Strominger

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CHAPTER I

INTRODUCTION

> . . . Modern business runs in large measure on information and communications. Swift, versatile communications play a crucial role in the efficiency and profitability of business large and small.[1]
>
> AT&T 1978 Annual Report

While communications has always played an important role in the conduct of a successful business, a technological revolution in communications is now occurring that makes it possible for communications to play an increasingly pivotal role in the success or failure of a business enterprise. This revolution began many years ago with the railroad and the telephone. However, from an historical perspective, it is the convergence of data processing and telecommunications in the past fifteen years which has precipitated a new and more accelerated stage in the communications revolution.

The issue of converging technologies has received a great deal of attention. It has been exhaustively analyzed from a regulatory standpoint in two Federal Communications Commission (FCC) inquiries. In addition, many magazines, books, *et al.*, have addressed and speculated upon the significance of this convergence. Unfortunately, a great deal of this attention has been devoted to the technical aspects of this convergence and to the potentials of the new information technologies which can be derived while management approaches for handling the existing and emerging information technologies have been almost totally ignored.

Purpose

Integrated Information Systems Management: A Coordinated and Cooperative Approach offers a new way of evaluating information systems. It is based upon the fact that the converging data-processing and telecommunications technologies are making the organizational concepts of the past inadequate for using both information and information systems to achieve organizational objectives. The converging technologies can and will have a tremendous impact upon the traditional organizational and managerial structures designed around and for information systems. They present organizations large and small with new and challenging management options for these systems. As information systems become more technologically complex and interdependent, the need for more effective information-systems planning and management escalates.

The convergence of information systems, an outflow of the converging technologies, presents management with a dilemma. Should organizational information systems continue to be treated as distinct entities (e.g., mail department, computer department, telephone department, etc.)? Or should new management structures be adopted that recognize and stress the commonalities of their functions, rather than stress the dissimilarities between these traditionally distinct entities?

This project is based on the thesis that Integrated Information Systems Management (I^2SM) is essential to an effective and efficient interfacing of the diverse information systems that exist in business today. Effective management of information systems requires maximum cooperation and coordination between the managers of the separate information systems because the new information technologies transcend traditional organizational boundaries. This cooperation and coordination cannot be maximized without the support, encouragement and attention of top corporate management, as well as the end users of corporate information systems.

Intended Audience

Integrated Information Systems Management: A Coordinated and Cooperative Approach is written for top management and users of information systems. Because the topic is management and the primary intended audience is management, information systems will be discussed from a management, rather than a technical, perspective. The intent is to present a kaleidoscopic view of what the new information technologies, in an integrated-information system structure, can offer in the way of reduced operating costs, improved productivity, and, most importantly, improved information flow and accessibility.

In this regard, it is written for the information nonprofessional, rather than for telecommunications or data-processing managers. This does not mean, however, that information technology managers cannot derive benefits from this project. An appreciation of how I^2SM can enhance operations from economic, productivity, and information flow points-of-view can help these service-oriented managers to recommend, design, acquire, and operate information systems that support organizational goals. An adversary relationship often exists between departments handling separate information-systems technologies. This work will provide individual information-systems managers with a universal, rather than a parochial, view of how information systems technologies are becoming inextricably intertwined.

Structure

This project is structured to give managers and information users a basic understanding of information, information systems, and management approaches for handling information resources. Chapter II addresses the value of information. The concept of information as both a resource and a source of power or competitive advantage is discussed.

The evolution of the many distinct and separate information systems is treated in Chapter III. Historical perspective is germaine because it gives managers insight into the evolution of the variety of distinct information systems. Emphasis is placed upon the forces motivating organizations to adopt or incorporate the new information systems which emerged as a result of the Industrial Revolution.

Chapter IV explores the forces propelling business toward an integrated-information resource, and away from the distinct information systems discussed in Chapter III. It is shown that reduced operating costs, improved employee productivity, and improved flow and accessibility of information are the primary benefits that can be expected from an integrated-information system.

The relationship of integrated-information systems and organizational management is the focus of Chapter V. The impact of advanced systems on the management process and structure is explored, and the effects of traditional management thinking on the development of integrated-information systems is critiqued.

Chapter VI offers an analysis of integrated-information systems management. Management theory is compared with actual practice as derived from responses to a questionnaire. The analysis examines four interacting organizational variables in the context of I^2SM.

Approach

The topic of management, by its very nature, predicates the use of an interdisciplinary approach. Nevertheless, the range of disciplines applicable to the topic is surprising. Particularly in the primary source area (books), material was derived from the following disciplines: Engineering; Economics; Sociology; Organizational Communications; History; Management; and Business.

To augment the primary and secondary source material, a questionnaire (Appendix A) was sent to 99 companies randomly selected from Standard and Poor's "500" price index. The 99 companies are identified at Appendix A. Of the 97 questionnaires delivered, 46 responses were generated (47 percent). Of the 46 responses, 42 were actually completed, while the other four were returned uncompleted due to company policy.

Conclusions derived from the reponses to the questionnaire are discussed in Chapters V and VI. However, there are some important inferences which can be drawn from the fact that so many of the questionnaires were completed and returned.

Robert A. Peterson[2] reported in the Journal of Business Research that the average number of respondees to a questionnaire similar to ours is 26.7 percent. The questionnaire was mailed from a university source (i.e., using university letterhead), with stamped (vice-metered) outgoing envelopes, no follow-up letter was transmitted, and a labelled (vice-typed) address was used.

Despite its complexity, the better than average response to the questionnaire, and the obvious care with which the majority of the respondees answered the questions, suggest that they considered the subject important. This implies that corporate management (from vice-presidents to information technology managers) are open to viable suggestions and approaches for managing integrated information resources. While the responses to questions 27 through 33 all support this implication, question 30 is particularly meaningful (Table 1-1).

TABLE 1-1

RESPONSES TO QUESTION 30 (APPENDIX A)

Question 30:

A study which will propose a management approach to facilitate maximum coordination and exploitation of Telecommunications and Data Processing will be beneficial to you.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4	5	5	21	6

Thus, disregarding the neutrals, interest in a new management approach to information systems is positive by a three-to-one margin.

Scope

A majority of the evidence cited in support of I^2SM is derived from large corporations such as those listed in the Fortune 1000 and Standard and Poor's "500" price index. Large organizations with decentralized operations (geographically dispersed divisions, subsidiaries, etc.) may appear to have a more pressing and immediate need to better manage their extensive information networks. However, the long-range impact of new information service offerings such as Advanced Communications Service (ACS) (see Appendix D) and the immediate applicability of integrated-information technologies to improve employee productivity and information flow and accessibility means that I^2SM is applicable to any organization, large or small.

CHAPTER I

FOOTNOTES

[1] American Telephone and Telegraph Company, 1978 Annual Report (New York: American Telephone and Telegraph Company, 1979), p. 9.

[2] Robert A. Peterson, "An Experimental Investigation of Mail-Survey Responses," Journal of Business Research 3 (July 1975):204.

CHAPTER II

INFORMATION: THE RESOURCE AND THE POWER

The purpose of communications is to transmit information from one place to another. It may be as simple a transaction as face-to-face oral communication or as complex as transmitting voice, video, and telemetry information between a ground station and astronauts circling the moon. Developments in telecommunications technology have provided the means for ever increasing rates and volumes of information transfer, and at the same time, have made the goal of universal communications a virtual reality. The ability to communicate almost instantaneously to any part of the world has had enormous impact on all facets of modern life including organizational management.

During the past three decades, there have also been revolutionary advances in the ability to gather, store and process information. It is natural to immediately think of the advances in computer technology in this regard since the computer has had perhaps the most profound effect on this ability. Other developments include microfische, micrographics, xerography, word processors, and videotape.

Today, prodigious amounts of information are gathered, stored, retrieved, processed, and transmitted around the world to make decisions, close sales, control activities, conduct diplomacy, and save lives. It is sometimes argued that controlling the information required for any end application is tantamount to controlling the outcome.

This chapter will consider first the concept of information as a resource. Various aspects of information and their importance to managers will be discussed. Second, the relationship between information and power will be explored.

Information: A Non-Depleting Resource

Information may be considered a resource. It fits the definitions proffered by dictionaries for resources, i.e., it is an asset, a source of supply or of wealth. Unlike physical resources, however, it is not consumed through use. Information may be stored or held in reserve, as any other resource, to be accessed and used as necessary, but the storage medium retains the information in its original form to be used again and may, in fact, obtain additional information in the process (Figure 2-1). Some types of information, though not all, may be consumed not by the user, but by time.[1] Such data as the current selling price of stock varies from moment to moment, while the information contained in the works of Plato has remained valuable through the ages.

Although the current selling price of stock demonstrates the fleeting value of some types of information, the example is not complete. Actually, it is of transient value only to one who is interested in that singular piece of data, i.e., what is the price of stock XYZ at this moment. To one who is interested in trends of stock XYZ, it may have value for an exceedingly long period of time.

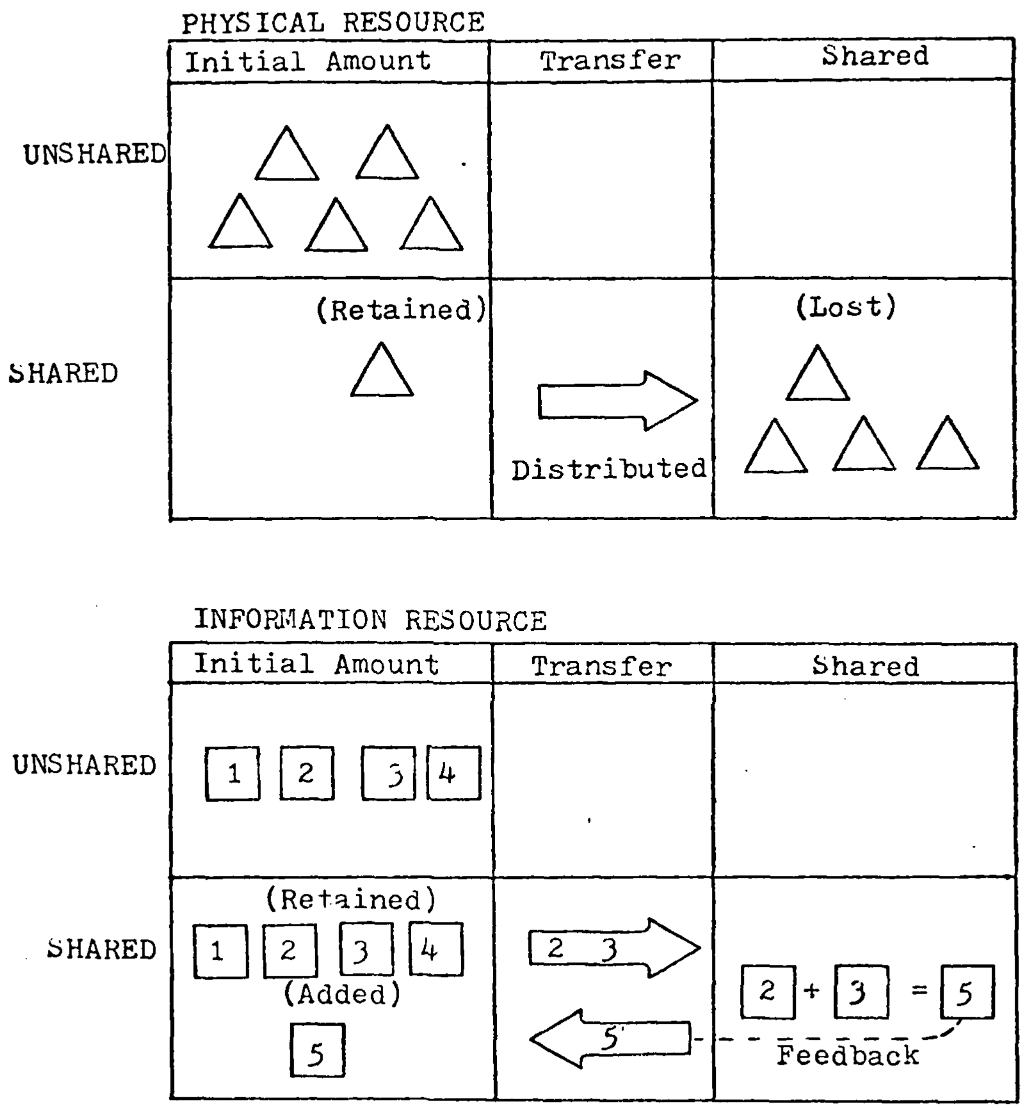


Figure 2-1. Depletion of Resources

Source: John McHale, "The Changing Information Environment," in Information Technology, Some Critical Implications for Decision Makers (New York: The Conference Board, 1972), p. 195, Figure 10.

Note: This figure has been adapted to show the concept of feedback more clearly.

Thus, the value of information must not be measured on the basis of one specific application. Information invaluable in one application may be irrelevant, and thus worthless in another:

> . . . Its value is plainly the worth and the usefulness to the individual user in the right form at the right time. That value would be imputed from his behavior with respect to it.[2]

Thus far, the terms "information" and "data" have been used such that the reader may have concluded that they are synonomous. Edward Glaser[3] suggests there is a basic distinction. He proposes that data are elements of information, but are rarely information in their own right. Information is data organized in some way; processed or structured. Data, then, may be viewed as analogous to elementary subatomic particles. It is the organized assemblage of these particles which establishes the relative value of the end sum.

The functions of management are exceedingly dependent on information. These functions--planning, organizing, staffing, directing, and controlling--involve decision making, and success depends on how well these decisions are made.[4] Good decisions can only be made when accurate, timely information is available in the right form for the decision maker. This immediately suggests four important aspects of information to managers; form, timeliness, accuracy, and accessibility. Other aspects of importance have been suggested such as conciseness, reliability, control, etc., but it appears that these generally fall within one of the four categories listed. It is important to discuss each of these key elements, but it should not be inferred that the order of discussion is the order of importance. Rather, these elements form a synergistic whole which establishes the information's value to the manager.

Form. If information is organized data, it must be accepted that it has form. The importance of form to the manager manifests itself in at least four ways: relevance, conciseness, completeness, and format. Perhaps the most important of these is relevance. Donald H. Sanders states that ". . .[r]elevant information is 'need-to-know' information which leads to action. . . ."[5] That is, it is the information managers must have to make decisions. Background information, methods used to acquire or validate the information, or similar items may be "nice-to-know," but are often extraneous and may cloud the issue or confuse the decision maker. Roman R. Andrus[6] observes that rather than too little information being available, as many system designers argue, ". . . [t]he problem is that frequently too much undigested information reaches the decision maker. . . ." This leads naturally to the second aspect of form--conciseness.

Conciseness is closely tied to relevance as the preceeding discussion has shown. The "shotgun" approach to getting information to the manager is inefficient and often counter-productive. While it is important to provide *all* the information the manager needs, it is usually profitable to spend some time to provide *only* the information he needs. This, of course, can present some problems since, in a *de facto* way, it casts the information supplier in the role of decision maker. By selecting what information the manager has with which to make his decision, the information supplier may affect the outcome of that decision. A compromise approach may be to provide all information which pertains to a decision as attachments to a concise summary. In this way, the manager can decide how much of the added information he really needs for his decision.

As suggested by the above discussions of relevancy and conciseness, the manager must have complete information. Decisions based on relevant, concise information may be bad ones if all information pertinent to the decision is not available. Sanders[7] reports a classic example of incomplete information in the Japanese attack on Pearl Harbor. He notes that ". . . data available, in bits and pieces and at scattered points, if integrated, would have signaled the danger of a Japanese attack."

Finally, the format of information is important to the manager. The language or jargon used in providing the information, the organization of the information, and the manner in which it is presented, all contribute to the value of information. The manager himself, when requesting information, must specify the what, how, and how much. It must be presented to him in such a way that he finds it understandable and useful. Andrus[8] states that ". . . [a]s the form of information more closely matches the requirements of the decision maker, its value (or utility) increases."

Timeliness. Information must be available in a timely manner. It does little good if complete, concise, relevant information in the right format is available if it is not available when needed. Information must be available in time to make a decision. There are tradeoffs involved in this aspect of information. Most notably, information should be available rapidly enough to maintain its immediacy or "freshness," but the response time to the request should be long enough to gather sufficient information to be of use. "Real time" information is important, but so also are trends that may fall out of a series of real time responses.[9] Additionally, too rapid information flow to the manager may inundate him with more information than he can handle. This can confuse decisions as easily as insufficient information.

The problem of timeliness is the first of the aspects of information in which telecommunications plays an important role. Telecommunications provides the means to gather information from widely dispersed locations into one place very rapidly. When used in conjunction with data-processing technologies, the manager has at his disposal the means to make decisions affecting nationally or multinationally diversified operations.

In many decisions a manager makes, time is of the essence. The less time available to make a decision, the less information is likely to be available to make it. The less information available, the greater the risk involved in the decision. As more information is gathered, the degree of uncertainty decreases. Enough information is that amount which enables the manager to decide that the risk has been reduced to a sufficient level to proceed.[10] The marriage of telecommunications and data processing has had a profound effect on making more information available to managers in a shorter time.

Accuracy. Accuracy and its corollary--reliability--are of extreme importance to the decision maker. Andrus[11] describes the value of perfect information:

> If a manager were able to perfectly predict the behavior of uncontrollable factors which influence his success, he would then be able to manipulate controllable factors to achieve optimal results. The value of perfect information is the value of the optimal strategies which would result from perfect understanding and prediction of the behavior of uncontrollable elements. This information would result in minimized losses and maximized gains, regardless of the behavior of competitors, government, or the whims of consumers. It represents the maximum dollar saved or earned by a perfect strategy.

This value can obviously be extended beyond the business world to governments or individuals. Knowing exactly the capabilities of a potential enemy, for instance, would allow a country to defend against or negate those capabilities to the fullest technical possibility while not squandering effort and resources elsewhere.

Accurate information is, by definition, reliable. Reliable information, however, may not be accurate. Reliability, as applied to information, is a value judgment usually reflecting the quality of the source. A source that has consistently proven to have been accurate in the past will be considered reliable. Additional information from this source will be regarded as accurate and so acted upon based upon the source's past history of accuracy. If it is later determined that some information from this source was, in fact, inaccurate, the status of accurate information is unaffected, but the reliability of the source may be diminished.

Once again, communications can play a vital role in the accuracy/reliability problem. Its role is not one of *establishing* accuracy or reliability, but rather of *maintaining* it as information is transferred from one point to another. A bad communications system can ruin perfectly accurate information. Continued use of the same system can render accurate information totally unreliable despite the reliability of the original source.

The degree of accuracy required once again involves a tradeoff. Decisions involving routine, relatively unimportant activities may tolerate a higher degree of inaccuracy than those of a cataclysmic nature. A 95 percent accounting accuracy on inexpensive parts in inventory may be quite acceptable for deciding when to re-order, but the same accuracy percentage is useless when balancing the company's books of account. In the latter case, *accuracy* must be improved, while in the former, accuracy *could* be improved but the increased costs of obtaining that accuracy may be unwarranted.[12]

Accessibility. The fourth parameter of information is that of accessibility. Like accuracy, accessibility has a corollary--control. As we have seen, the manager must have accurate, timely information in an appropriate form to make decisions. The important factor here is that *he must have it*. Unless he can access information, it is useless to him. Earlier, it was suggested that an information supplier may become a *de facto* decision maker when attempting to place information in a concise form. It was also suggested that control of information may be tantamount to control of the outcome of the application for which the information is required. In his discussion of "information utilities," Andrus[13] observes:

> Control of information is an important facilitator or inhibitor of managerial performance. The platitude *knowledge is power* has meaning for information management. Internal structure and external effectiveness are functions of the location of information within the firm. Possession is a significant information utility for which men have maneuvered since society's beginnings.

The late Hubert H. Humphrey[14] characterized the problem of accessibility in this way:

> . . . Are management and operating personnel . . . getting the information which they need and want, when they want it, in the way that they want it?

Modern developments in information technology are providing the means for managers to get the information they need and want. A current advertising campaign for the Bell System's Dataphone® Digital Service features a photograph of a pirate in a law office with one lawyer requesting of the other: "Quick! Get me every decision you can find on 'buried treasure'!"[15] The advertisement makes the point that access to information is no longer restricted to that which is physically within reach, but rather it can extend to the limits of the available telecommunications system. The access exists *as long as* the information seeker has control, or can obtain control, over the information source. Such control need not be of a long-term nature, but may only exist for the duration of the request.

Information, then, is a nondepleting resource which has the parameters of form, timelinness, accuracy, and accessibility. In describing the process of using this resource for decision making, Morton F. Meltzer[16] uses a concept he calls the "Information Gap." Basically, the Information Gap is the difference between the information needed for a decision and that which is accessible by the decision maker. Because of the factors of time or control, available information, that is, information which exists, may not always be accessible. The Information Gap is a function of time (Figure 2-2). At a certain point, the manager must decide that he has enough information to proceed, and at that point, the Information Gap, by definition, is "closed" (Figure 2-3). Telecommunications can significantly alleviate the problem of time, but the control limit still exists.

Theodore Lowi[17] says that ". . . [i]nformation is a resource that can be used, developed, controlled, and sold." Thus, the concept of information as a resource also indicates that information has a price. Information may be purchased outright (such as a book, a manufacturing license or patent, etc.), it may be purchased through the salary of an employee hired for his expertise, or it may be "leased" as in paying a fee to access a specialized data bank. The price to be paid is set by the marketplace:

> . . . The price may have little relation to what a user thinks is the value of the information. Price is what the seller can get for the information in a competitive market. This price, it is hoped, the small independent user can afford. . . . Dangers, specifically of monopolistic pricing practices, multiply if a few giant [information] systems are allowed to prevail.[18]

<u>Information: A Power Influence</u>

There is an even more insidious effect that can result from the concentration of information in a few giant information systems. As suggested earlier, control of information or of its flow can have significant impact on the outcome of decisions. For an example of the power associated with the control of a vitally needed resource, one need look no further than the headlines of current newspapers. The oil producing nations (OPEC), predominantly developing countries, are able to control oil prices, thereby affecting the economics of the industrialized nations dependent on

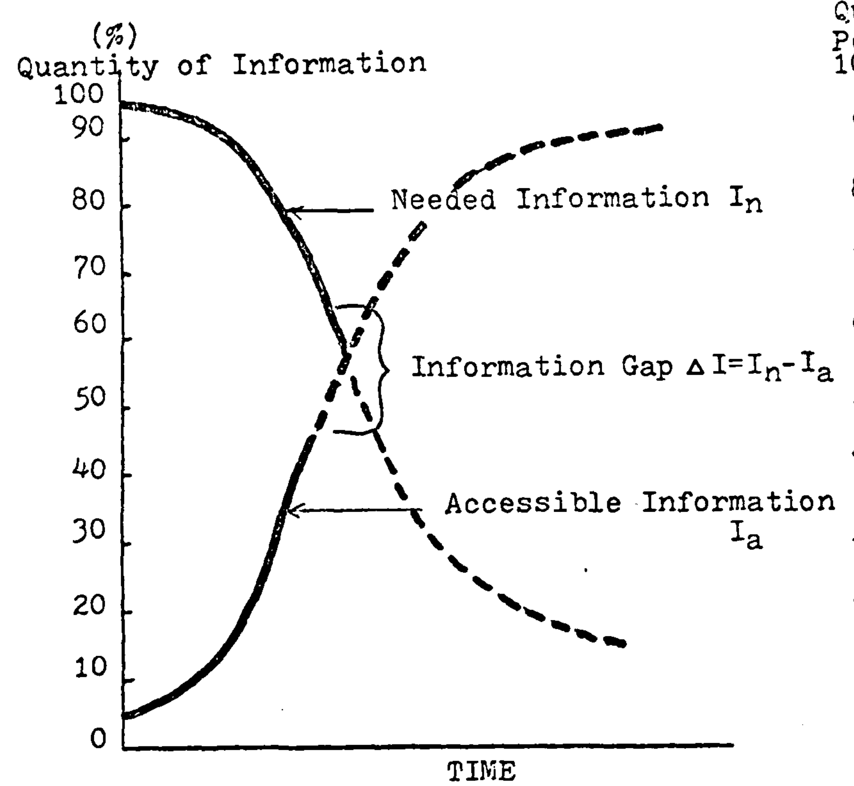


Figure 2-2. Information Gap

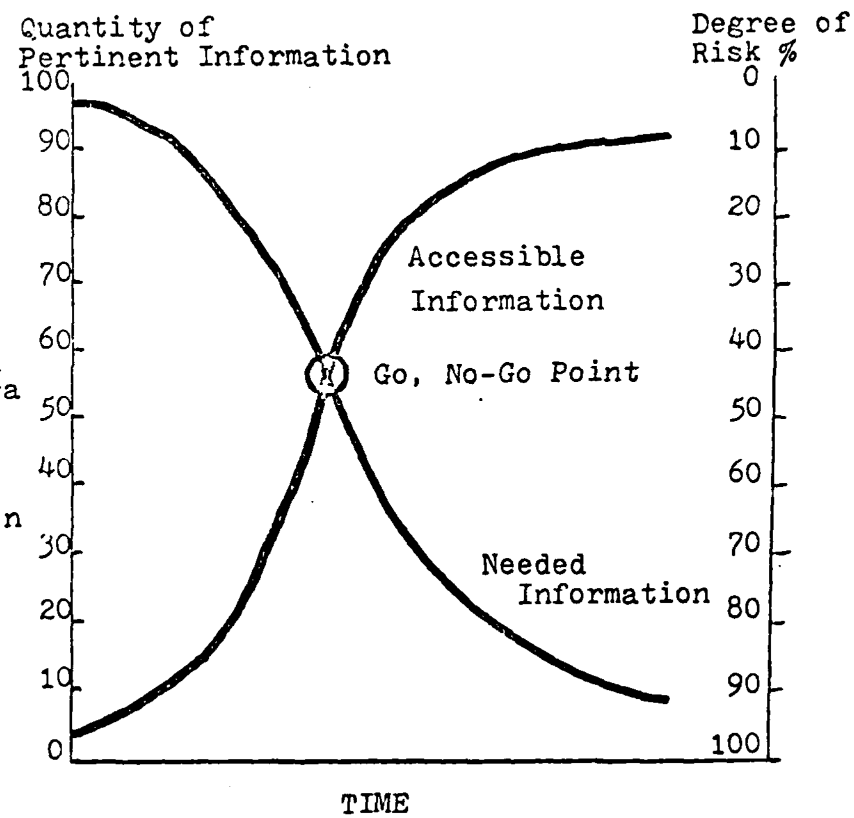


Figure 2-3. Information Gap (closed)

Source: Morton F. Meltzer, The Information Center (New York: American Management Association, 1967), pp. 32, 35.

their oil, and in some cases even the political direction of those countries.

A case-in-point involves the situation in the European Economic Community (EEC) in 1973. During the so-called Yom Kipper war in the Mid-East, the Netherlands came out very strongly in favor of the Israelis. The Arab states reacted to all pro-Israeli countries with an oil embargo until Arab goals could be achieved. The Netherlands refused to back down from its stance, and while the embargo against most nations was modified, the boycott against the Netherlands remained total. The actions of the rest of the EEC were a careful balancing act, an attempt not to appear too friendly to the Netherlands and yet maintain the integrity of the EEC.[19] How much more powerful, then, would be the control of information? Glaser[20] asserts that it is ". . . the most valuable of all resources since it can control physical resources of every kind."

At a 1977 meeting of the Organization of Economic Cooperation and Development, Louis Joinet[21] said:

> . . . Information is power . . . the ability to store and process certain types of data may well give one country political and technological advantages over other countries. This, in turn, may lead to loss of national sovereignty through supra-national data flows.

Until about two hundred years ago, power was inextricably associated with the ownership of land. The wealth, esteem, military position and authority over populations that was associated with the landed gentry insured them a position of community and state power.[22] Societies were primarily agrarian, and success, even survival, was based on the possession of "materially visible assets" such as land and materials, buildings, equipment and livestock, and control of resources and people.[23] Possession of capital had not yet become the dominant power factor in society. John K. Galbraith[24] notes that although capital was in rather short supply, so also was the opportunity for its use. Great sums of money were not required to work land and there was enough for those who possessed land to meet their needs. Possession of capital, on the other hand, was not a guarantee that land would be available for its use.

The source of power began to shift as the scarcity of land challenged men to find new supplies. The Americas, South Africa and Australia all promised an abundant supply of land provided that the capital necessary to obtain passage for "seed, livestock and equipment" could be found.[25] Just as the discovery of a new, cheap, plentiful energy source would substantially decrease the power the OPEC countries now hold over industrialized nations, so did the availability of land outside of Europe decrease the power associated with land ownership. Capital had become the scarce commodity and those in control of capital ". . . could now command the needed labor and land. Control of labor or land accorded no reciprocal power to command capital."[26]

During the last few decades, a new shift in power may be discerned. This shift has been in the direction of knowledge, or "organized intelligence." This shift, says Galbraith,[27] has been:

> . . . disguised because, as was once true of land, the position of capital is imagined to be immutable. That power should be elsewhere seems unnatural and those who so argue seem to be in search of frivolous novelty. . . .

Galbraith adds that the disguise in this shift is also attributable to the fact that power has not passed to ". . . another of the established factors . . ." of production. It has not passed to labor or to the classical entrepeneur. Rather, it has passed to what may be called a new factor of production. "This is the association of men of diverse technical knowledge, experience, or other talent which modern industrial technology and planning require."[28]

Daniel Bell[29] discusses the evolution of society as passing through three stages: pre-industrial, industrial, and post-industrial (these stages will be discussed more thoroughly in the next chapter). He states that ". . .[i]n the post-industrial society, technical skill becomes the base of and education the mode of access to power. . . ." It will be seen that the advent of post-industrial society, in the United States at least, roughly equates in time to Galbraith's power shift to knowledge. Table 2-1 is a schematic representation of the power shift as proposed by Bell.

The power shift, obviously, is not complete, even in the United States. Property and capital based power continues to be exceedingly influential and will probably continue to be for some time. What is striking is the rapid emergence of information as a very viable source of influence on power, if not power itself. In terms of political power, John McHale[30] notes that ". . .[i]n an information-dependent society, power tends to be associated with knowledge." He says that increased availability of information will cause greater stress on those who make policies in the form of

TABLE 2-1

STRATIFICATION AND POWER

	Pre-Industrial	Industrial	Post-Industrial
Resource	Land	Machinery *Capital	Knowledge
Social Locus	Farm Plantation	Business Firm	University Research Institute *Corporate Technostructure
Dominant of Power	Landowner Military	Businessmen	Scientists Research Men *Technical Specialists
Means of Power	Direct Control of Force	Indirect Influences on Politics	Balance of Technical-Political Forces Franchises and Rights *Control (possession) of Critical Information
Class	Property	Property *Capitalist	Technical Skill
Base	Military Force	Political Organization Technical Skill	Political Organization *Corporate Organization
Access	Inheritance Seizure by Armies	Inheritance Patronage Education	Education Mobilization Co-Optation

Source: Daniel Bell, The Coming of Post-Industrial Society (New York: Basic Books, Inc., Publishers, 1973), p. 359.

Note*: These terms have been added to show the parallel between Bell and Galbraith. Note that these additions do not alter the substance of the stratification of power.

questioning, intervention, and leverage:

> We have noted, particularly in the past two or three years, that due to increasingly swift diffusion of information, the 'time cushion' between the occurrence of perceived problems and issues and their entry into the public dialogue has dramatically decreased. Consequently, policy makers are increasingly placed in postures of day to day crisis-management with specific regard to issues in public view.

Extending this power influence beyond the political arena to business, George Kozmetsky and Timothy Ruefli[31] note that consumer attitudes will have increased effects on corporate decisions:

> Consumers, utilizing developments in information technology [sic] will have increasingly instant and effective means for anticipating or reacting to corporate policies, decisions, products, and services, and will make their influence be felt on a continuous rather than *ad hoc* basis.

Galbraith[32] suggests that in organizations themselves, the real power resides not in the stockholders, or owners, but in the directors and their staffs and that the staffs ultimately control the direction of the organization based on their knowledge or access to knowledge:

> Thus decision in the modern business enterprise is the product not of individuals but of groups. The groups are numerous, as often informal as formal, and subject to constant change in composition. Each contains the men possessed of the information, or with access to the information, that bears on the particular decision together with those whose skill consists in extracting and testing this information and obtaining a conclusion. This is how men act successfully on matters where no single one, however exalted or intelligent, has more than a fraction of the necessary knowledge. It is what makes modern business possible, and in other contexts it is what makes modern government possible. . . .

Information, then, in the past several decades, has come to be recognized not only as an invaluable asset, but also as an increasingly important source of power or influence on power. Max Ways[33] sums up the importance of information to all facets of society:

> . . . It was well understood 50 years ago that universal schooling, mass newspapers, telephones, the telegraph, etc., were more than luxuries that the society bought because it could afford to do so; the flow of information through these new or expanded channels was regarded as the lifeblood of the society, indispensable to political as well as economic health. In other words, policy-making--whether personal, political or business--had come to depend on organized information flows.

In succeeding chapters, the evolution of information technology will be traced and the marriage of telecommunications and information-processing technology will be explored. The impact of these developments on corporate management will be addressed and an approach will be offered to manage these technologies in such a way that they will be fully coordinated and exploited to achieve organizational goals.

CHAPTER II

FOOTNOTES

[1] Edward Glaser, "Information Technology, Power Without Design. Thrust Without Direction," in The Conference Board, *Information Technology: Some Critical Implications for Decision Makers* (New York: The Conference Board, 1972), p. 27.

[2] Ibid.

[3] Ibid., p. 23.

[4] Donald H. Sanders, *Computers and Management in a Changing Society*, 2nd Ed. (New York: McGraw-Hill Book Co., 1970), p. 10.

[5] Ibid., p. 17.

[6] Roman R. Andrus, "Approaches to Information Evaluation," in Sanders, p. 41.

[7] Sanders, p. 16.

[8] Andrus, in Sanders, p. 41.

[9] Sanders, pp. 15, 16.

[10] Morton F. Meltzer, *The Information Center* (New York: American Management Association, 1967), pp. 34-47.

[11] Andrus, in Sanders, p. 40.

[12] Sanders, p. 15.

[13] Andrus, in Sanders, p. 42.

[14] Meltzer, p. 29.

[15] See, for example, *Telecommunications*, May 1979, pp. 14, 15.

[16] Meltzer, pp. 32-37.

[17] Theodore Lowi, "Government and Politics: Blurring of Sector Lines. Rise of New Elites--From One Vantage Point," in *Information Technology*, p. 132.

[18] Glaser, in *Information Technology*, pp. 27, 28.

[19] For a more detailed account, see the following issues of The Economist, October 20, 1973; November 3, 1973; November 24, 1973.

[20] Glaser, in *Information Technology*, p. 22.

[21]Dr. Gabriel G. F. Bach, "International Data Flow and Protection Regulations," Telecommunications, May 1979, p. 89.

[22]John Kenneth Galbraith, The New Industrial State (New York: New American Library, 1967), p. 62.

[23]John McHale, "The Changing Information Environment: A Selective Topography," in Information Technology, p. 197.

[24]Galbraith, p. 63.

[25]Ibid., p. 65.

[26]Ibid., p. 66.

[27]Ibid., pp. 68, 69.

[28]Ibid., p. 69.

[29]Daniel Bell, The Coming of Post-Industrial Society (New York: Basic Books, Inc., 1973), p. 358.

[30]McHale, in Information Technology, p. 221.

[31]George Kozmetsky and Timothy W. Ruefli, "Business: Newer Concepts of Management, Profits, Profitability," in Information Technology, p. 62.

[32]Galbraith, p. 76.

[33]Max Ways, "The Question: Can Information Technology Be Managed?," in Information Technology, pp. 12, 13.

CHAPTER III

THE EVOLUTION OF INFORMATION SYSTEMS

> . . . intelligence should never travel faster than the mails because 'news was golden to anyone who could get it ahead of the mails that gave it to everyone.'[1]

Postmaster General Cave Johnson used the above rationale when he recommended to President Polk in 1845 the government assume ownership of the telegraph. Johnson's comments revealed that even in 1845, the value of rapid information delivery was recognized as a key factor in the success of both governmental and commercial enterprises. More importantly, Johnson's comment signaled the beginning of the transformation of information systems from a manual, transportation-bound process to an electronic process.

In this chapter the evolution of information systems will be traced with particular attention to business applications. The primary focus will be upon the impact of the two major technological components of a modern business system--telecommunications and computers.

The expository framework for this chapter was derived from Daniel Bell's The Coming of Post Industrial Society, wherein he postulates that there are three identifiable stages in the development of a society: the pre-industrial, industrial, and post-industrial stages. His central thesis is that a society can be characterized by its predominant technology. In a pre-industrial society the majority of the workers are engaged in a contest with nature; occupations such as farming predominate. The majority of the work force in an industrial society is engaged in contests against machines; in effect, they are engaged in the production of goods. In a post-industrial society the majority of the workers are engaged in contests against man; they are engaged in providing services. The technology which Bell sees driving the post-industrial society is "information." As a result, the post-industrial society is frequently described in current literature as an information society, and the historical era is described as the "Information Age."[2] Table 3-1 briefly summarizes the key characteristics of each of these stages and identifies their dominant industrial sectors.

In 1977 the Department of Commerce's Office of Telecommunications did an exhaustive analysis (nine volumes) of the information economy which has developed in the United States. They found that the United States has indeed entered the Information Age. By 1967, 46 percent of the Gross National Product (GNP) was derived from information activities and almost 50 percent of the United States labor force hold ". . . some sort of an 'informational' job, earning 53% of labor income. . . ."[3] Figure 3-1 depicts the dramatic change in the nature of the United States work force and strongly supports the conclusions of Daniel Bell.

Because the Industrial Revolution precipitated the inventions (telegraph, telephone, typewriter, computer, etc.) which propelled our society from a predominantly pre-industrial to a post-industrial one in the brief period of only fifty years,

TABLE 3-1

GENERAL SCHEMA OF SOCIAL CHANGE

	PRE-INDUSTRIAL	INDUSTRIAL	POST-INDUSTRIAL
Regions:	Asia Africa Latin America	Western Europe Soviet Union Japan	United States
Economic sector:	Primary Extractive: Agriculture Mining Fishing Timber	Secondary Goods producing: Manufacturing Processing	Tertiary: Transportation, Utilities Quaternary: Trade, Finance, Insurance, Real estate Quinary: Health, Education, Research, Government, Recreation
Occupational slope:	Farmer Miner Fisherman Unskilled worker	Semi-skilled worker Engineer	Professional and technical Scientists
Technology:	Raw materials	Energy	Information
Design:	Game against nature	Game against fabricated nature	Game between persons
Methodology:	Common sense experience	Empiricism Experimentation	Abstract theory: models, simulation, decision theory, systems analysis
Time perspective:	Orientation to the past Ad hoc responses	Ad hoc adaptiveness Projections	Future orientation Forecasting
Axial principle:	Traditionalism: Land/resource limitation	Economic growth: State or private control of investment decisions	Centrality of and codification of theoretical knowledge

Source: Daniel Bell, The Coming of Post-Industrial Society (New York: Basic Books, Inc., 1973), p. 117, Table 1-1.

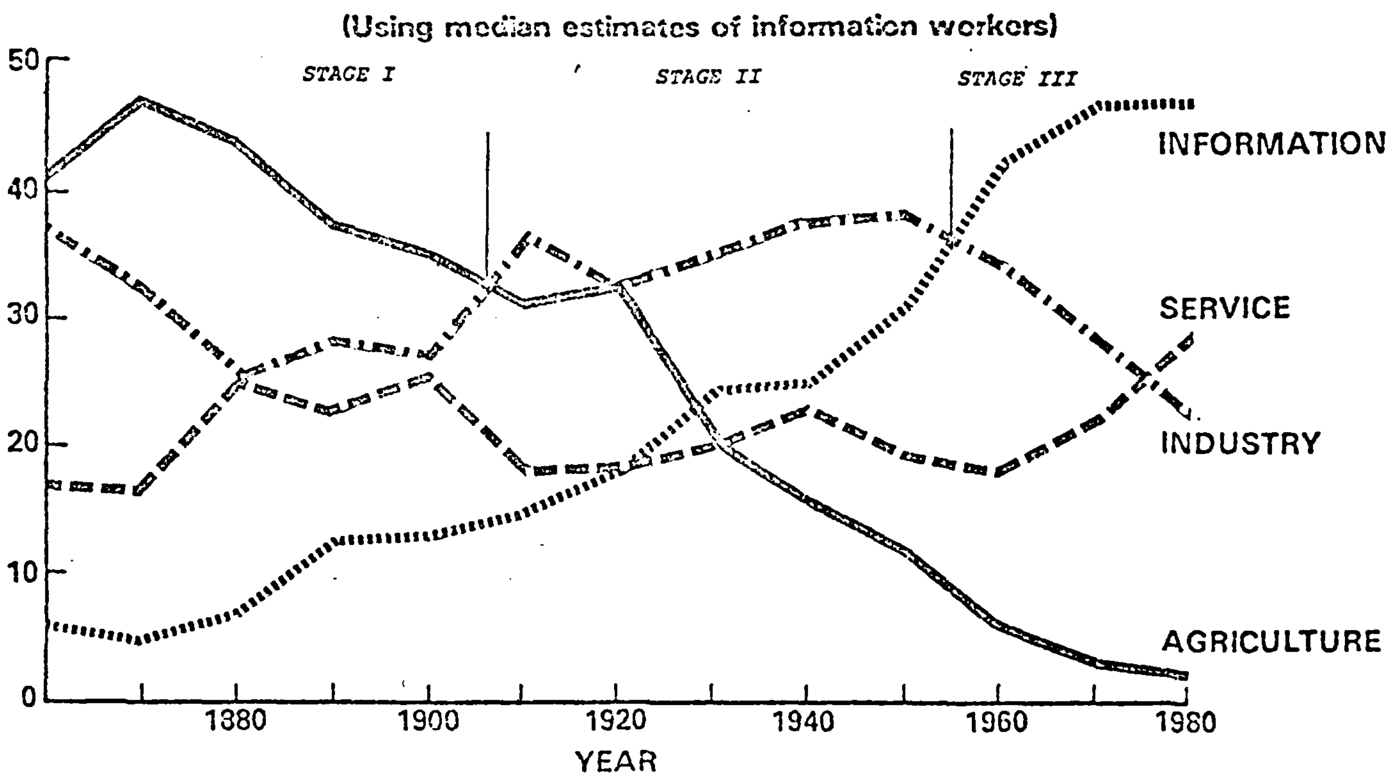


Figure 3-1. Four Sector Aggregation of U.S. Work Force by Percent 1860-1980

Source: *U.S. Department of Commerce*, Office of Telecommunications, The Information Economy: Definition and Measurement, by Marc Uri Porat. Special Publication No. 77-12(1) (Washington, D.C.: Government Printing Office, 1977), p. 121, Figure 7-2.

the Industrial Revolution is an ideal starting point for tracing in broad concepts the development of business information systems. As Alfred D. Chandler, Jr.[4] observes in The Visible Hand: The Managerial Revolution in American Business:

> . . . Any detailed analysis of the history of modern business enterprise in the United States must . . . pay particular attention to the 1850's. . . . Not until the 1850's . . . did the process of production and distribution start to respond in strength to the swift expansion of the new forms of transportation and communication. . . . During the 1850's, railroad and telegraph enterprises began to devise the organizational structures and accounting procedures so central to the operation of the modern firm.

Business information systems became increasingly complex because of the following developments which were precipitated by the Industrial Revolution: division of labor (specialization), automation (mechanization), capitalism, transportation, and communications. Transportation and communications, in particular, "were closely allied in causing increased complexity of business information systems."[5]

The effects of these developments were both direct and indirect. The new machines invented during the revolution were themselves generating information such as production/productivity statistics. Secondly, man was increasingly freed from manual labor as mechanization was substituted, and was able to devote time to devising methods to secure a competitive edge. Information became vital to securing this advantage, and as more information was generated to exploit the advantage, more information was required to maintain position.

The impact of the new machines and mans' insatiable appetite for knowledge and information is reflected in the phenomenal growth of information since the beginning of the Industrial Revolution. In 1800, it was estimated that the amount of information in the world was doubling every fifty years. By 1950, it was doubling every ten years, and it was estimated that by 1970 it would be doubling every five years.[6]

Information systems prior to the Industrial Revolution were essentially transportation dependent and had remained that way for thousands of years. While smoke signals, fires, semaphore, *et al.*, were used, the vast majority of communications was limited to face-to-face conversations or written correspondence. Prior to the widespread use of the railroad and telegraph, communication was slow:

a. In 1832 it took three weeks to send a letter from Washington, D.C. to Boston and to receive an answer.[7]

b. In 1840 more than 90 percent of the United States Post Office routes were still dependent on the horse.[8]

c. In 1850 it took sixty days to travel by overland stage from Washington, D.C. to California and 150 days to travel by sailing vessel from New York City to San Francisco.[9]

d. In 1860 the Pony Express could deliver mail across half the continent in ten days.[10]

It is obvious from the above figures that communications which involved distance were neither swift nor flexible. However, information needs in the offices and enterprises characteristic of United States society prior to 1850 did not demand either swiftness or flexibility to the degree it is required today:

> . . . The office was generally small, reflecting the scale of production in most firms in the years before the last decades of the nineteenth century. Specialization of labor was slight because functions were few: The boss or partners made the decisions, the bookkeeper kept the financial records, the clerk handled the correspondence and maintained the files, and the office boy was the system of communications. The office remained so until the "white collar girl entered the labor force in significant numbers in the 1890's.[11]

While the functions of the small, simple offices may not have changed drastically, their appetite for information was growing phenomenally.

Statistics for the early United States Post Office are indicative of the growing use of communications by business during the first half of the eighteenth century. In 1790 the United States population was approaching four million, but the post office only handled 265,545 letters, or less than seven letters per each one hundred citizens. By 1854 the postal service was handling 119,634,418 letters, which equates to approximately seven letters for each member of the United States population at that time. This forty-five fold increase in letters handled by the postal service in a period of sixty-four years was largely attributed to the increasing reliance of the business community ". . . upon the postal service to handle business affairs that were continually spreading beyond the local communities."[12] The significant aspect of this era was that transportation and communications were inseparable since both used the same channels or networks for the delivery of goods or letters.

The newspaper is another interesting example of the businessman's increasing appetite for information. Prior to 1815, newspapers were essentially a political instrument, but after 1815 the ". . . mercantile demand for quicker, cheaper information was reflected in the nature of American newspapers," which became increasingly commercial and were delivered by the postal service.[13] As can be seen, the business community was having a profound effect on the volume and nature of the information being created and transmitted by the 1850's.

The Railroad and the Telegraph

The advent of the railroad and the telegraph significantly altered the time frame required for transportation and communications. In 1832 it had taken three weeks to send a letter from Washington, D.C. to Boston and to receive a reply: the appearance of the steam-powered railroad suddenly made it possible to physically deliver mail between the same two points to about thirty-nine hours.[14] Figure 3-2 graphically shows the impact the railroad had upon the movement of freight, passengers, and mail over the span of just fifty-seven years.

In 1847 commercial use of the telegraph began and railroad management ". . . quickly found it an invaluable aid in assuring the safe and efficient operation of trains." By 1854, one railroad was using the telegraph not only as a means of making train movements safe, but also ". . . as a device to assure more effective coordination and evaluation of the operating units. . . ."[15]

> . . . The hourly reports, primarily operational and sent by telegraph, gave the location of trains and reasons for any delays or mishaps. 'The information being edited as fast as received, on convenient tabular forms, shows, at a glance, the position and progress of trains, in both directions on every Division of the Road'. Just as important, the information generated on these tabular forms was filed away to provide an excellent source of information which, among other things, was useful in determining and eliminating 'causes of delay.'[16]

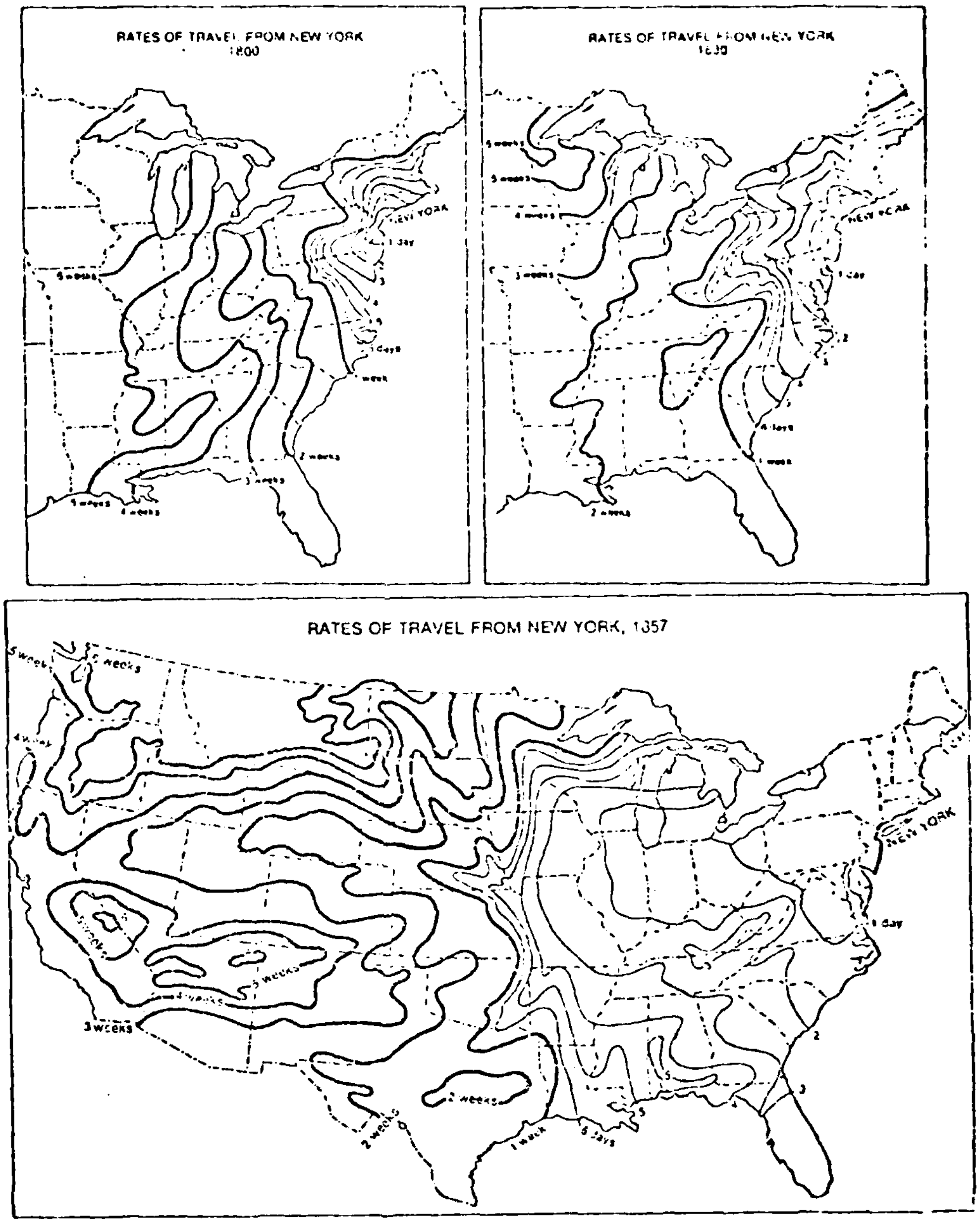


Figure 3-2. Rates of Travel, 1800, 1830, 1857

Source: Alfred D. Chandler, Jr., The Visible Hand: The Managerial Revolution in American Business (Cambridge, Mass.: Belknap Press, 1977), pp. 84, 85.

This quote is interesting not only because it is a good illustration of early business exploitation of communications to extend managerial span of control, but also because it reveals management's already growing need for more and more information of a time-sensitive nature in order to effectively and efficiently run an enterprise.

By 1853 telegraphy transmitted almost the same amount of messages over its lines as the mail handled in the form of letters.[17] And by 1855 the telegraph was being described as the nervous system of business, speeding up commerce, and increasing the tempo of industrial production.[18] To appreciate the impact the telegraph had upon business as a result of its ability to deliver information quickly, it is worthwhile to read what Robert Luther Thompson regarded as telegraph's impact by 1866:

> . . . Men from all walks of life and for a variety of reasons employed the new means of communication. . . . The farmer and the businessman used it to check the market prices for their produce or manufactures, in order to decide when and where to sell. As a result, local trade was increasingly affected by regional, national, and even international factors. The businessman, the banker, the broker, and the capitalist were enabled to operate upon a constantly broadening basis, as it became possible to reach out over hundreds or even thousands of miles and obtain intelligence within a matter of minutes. The increased scope of the operations which the telegraph made possible was a significant factor in the development of big business and the rise of finance capitalism.[19]

The use of the telegraph had become widespread in the larger communities of the United States by 1900. It was preferred over mail services and had become the ". . . most important means of transmitting information in the fields of banking, business, government, railroads, and news gathering. . . ." Messengers were used to pickup and deliver messages, or the customer had the option of dictating the message to the telegraph business office using the telephone. Where companies had an exceptionally large volume of message traffic, private line service was provided.[20] Private line service (introduced about 1879) involved terminating telegraph lines on the customer's premises so that the customer's operators could use the telegraph between specified hours.[21]

Over the years the telegraph has evolved to the point that computerized message-switching systems are now used, both by large and small organizations. Airlines and banks are typical customers. Input/output terminals are normally teleprinters and paper-tape readers, but card readers and special input keyboards are also used.[22] However, it should be noted that telegraph-oriented communications services, while they may play a part in the total information infrastructure of many businesses, comprised less than 4 percent of the business community's outlay for telecommunications services in 1958. In addition, predictions are that the ". . . Bell System and the independent telephone companies will carry the bulk of the data-communications traffic by 1980."[23] This projection seems to be supported by the small percentage of the communications market captured by the specialized and value-added carriers, as well as Western Union, in 1977 (Table 3-2). Most importantly, since ". . . computer networks can use existing telephone company plant--and, in fact, can tie into Western Union and/or special service common carrier plant when desired . . ."[24], the primary emphasis in this examination of telecommunication information systems will focus upon the evolution of a telephone-based information system for business.

TABLE 3-2

BREAKOUT OF TELECOMMUNICATIONS MARKET REVENUES (1977)

AT&T[1]	$36.5 Billion
GTE	4.1 Billion
MAJOR INDEP TELECOS[2]	2.276 Billion
OTHER INDEP TELCOS	0.253 Billion
TELEGRAPH (WU)[3]	0.650 Billion
INTERNATIONAL RECORD CARRIERS[4]	0.350 Billion
COMSAT	0.168 Billion
SPECIALIZED COMMON CARRIERS[5]	0.200 Billion
VALUE-ADDED CARRIERS[6]	0.020 Billion
DOMESTIC SATELLITE CARRIERS[7]	0.060 Billion
	$44.577 Billion

Source: James Peacock, "Business Communications: The New Frontier," Fortune (October 9, 1978), pp. 32-34.

[1]Includes 23 operating companies.

[2]United Telecommunications, Continental Telephone, Central Telephone, Mid-Continental Telephone, Rochester Telephone.

[3]These revenues were described as decreasing for years.

[4]WUI, RCA Global Communications, ITT World Communications, TRT Telecommunications, French Telegraph. These countries provide message transmission links between the U.S. and foreign countries.

[5]Primarily Southern Pacific Communications and MCI Communications.

[6]Telenet, Tymnet, Graphnet

[7]Carriers (Western Union, RCA) and retailers (American Satellite, Southern Satellite, etc.). Revenues are an IDC estimate.

The Telephone

Approximately thirty years after the telegraph was placed in commercial use, the telephone began to be used commercially, primarily as a supplement to the telegraph. While the telegraph remained the dominant electronic communication mode into the early twentieth century, the development of "long-lines" voice transmission capability in the 1890's resulted in increasing use of the telephone for long-distance calls.[25] Businessmen were the primary users of the telephone during its first twenty-five years of commercial use.[26] Table 3-3 clearly reflects the astronomical growth in telephone service between 1920 and 1958. Fritz Machlup,[27] in his study of the emerging information industry, notes that business phones comprised 41 percent of the phones in the United States in 1920, 38 percent in 1940, and 29 percent in 1958. He goes on to remark that the telephone company is convinced that, despite the above figures, business' phones have a greater number of calls and that ". . . long-distance usage per business telephone is much greater than per residence telephone." Despite the continuous decline in the share of total United States telephones used by business, Table 3-3 and Figure 3-3 clearly show that the number of telephones used by business insignificantly increased between 1920 and 1958. During this period the number of business telephones actually increased 253.7 percent while the business community's share of total United States phones in use decreased by only 12 percent (from 41 percent in 1920 to 29 percent in 1958). Such an increase in business telephones was a direct reflection of how valuable a management information tool the telephone had become.

TABLE 3-3

BUSINESS TELEPHONES--1920-1958

Year	% Total U.S.	Actual Number of Business Telephones	% Increase
(a) 1920	41 %	5,464,890	
(b) 1940	38 %	8,332,640	52.5 %
(c) 1958	29 %	19,327,050	131.9 %

Source: Fritz Machlup, The Production and Distribution of Knowledge in the United States (Princeton, 1962), p. 276, Table VI-28.

Note: Figures developed from table and other figures provided in text, same page.

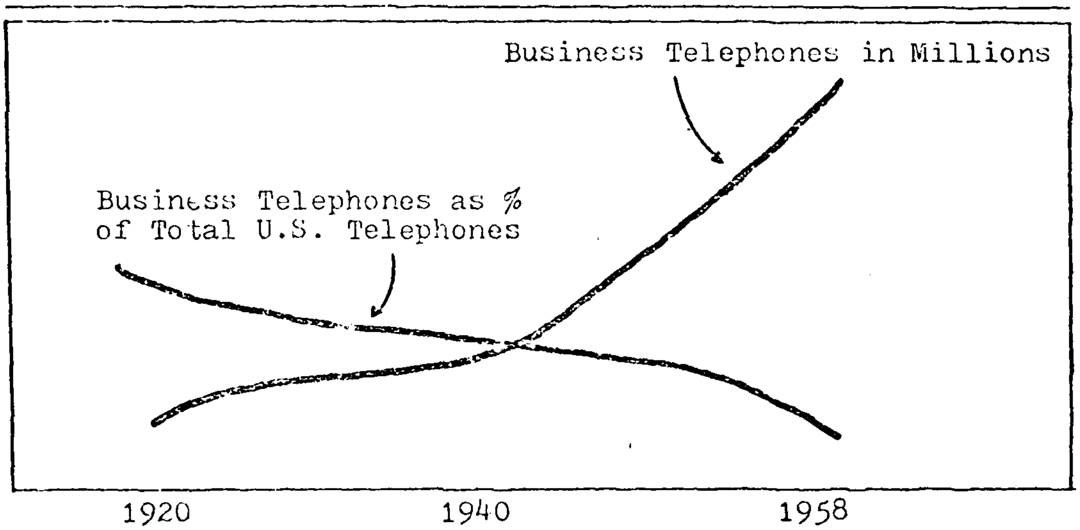


Figure 3-3. Trend Lines: Business Telephones In Use and As Percentage of Total Telephones in U.S. (1920-1958)

An excellent indicator of the increasing use and importance of telephone, telegraph and mail to business, the consumer, and the government is shown in Table 3-4, which indicates their relative traffic shares for the period 1926-1958. Machlup's computations and estimates for business expenditures for telephone, telegraph, and mail service (postage paid) in 1956 and 1958 are given in Table 3-5. These figures, it should be noted, comprise only the charges for services provided by the communications carriers to business systems.

Up to this point the primary emphasis has been upon the telephone itself; the real key to the development and use of the telephone as an information system in the business environment is the Private Branch Exchange (PBX).* Surprisingly, PBXs emerged shortly after the telephone itself, and were almost immediately used by businesses to exploit their capabilities for internal telephone communication within an office or company, and also ". . . to connect the users' local extension lines to the telephone central office over PBX trunks."[28]

> . . . [t]he PBX switchboard made possible both on-premise communication and also communications via the common-carrier network by means of a simple telephone station set for each user location.
>
> The PBX concept had many other advantages besides eliminating the need for separate telephone stations to serve the dual services. Since only a small part of the traffic went through

---

*<u>Private Branch Exchange (PBX)</u>: A private telephone exchange connected to the public telephone network on the users premises. It may be operated by an attendant supplied by the user. Some are automatic. A PBX provides for the transmission of calls internal to the company and to and from the public telephone network.

TABLE 3-4

COMMUNICATIONS: DOMESTIC MESSAGES HANDLED AND REVENUES COLLECTED, BY TELEPHONE, TELEGRAPH, AND POSTAL SERVICE, 1926-1958

NUMBER OF MESSAGES HANDLED

	Total		*Telephone*		*Telegraph*		*First class & airmail*	
Year	Millions	Per cent	Millions	Per cent	Millions	Per cent	Millions	Per cent
1926	41,450	100	25,981	62.7	203	0.5	15,266	36.8
1930	47,598	100	30,485	64.0	212	0.5	16,901	35.5
1935	40,503	100	27,740	68.5	176	0.4	12,587	31.1
1940	51,555	100	35,880	69.6	192	0.4	15,483	30.0
1945	62,747	100	40,625	64.7	236	0.4	21,886	34.9
1950	87,801	100	62,269	70.9	179	0.2	25,353	28.9
1955	105,086	100	74,752	71.1	154	0.2	30,180	28.7
1956	110,776	100	79,059	71.4	152	0.1	31,565	28.5
1957	120,713	100	87,525	72.5	144	0.1	33,044	27.4
1958	125,221	100	91,436	73.0	132	0.1	33,653	26.9

AMOUNTS OF REVENUES COLLECTED

	Total		*Telephone*		*Telegraph*		*First class & airmail*	
	Million dollars	Per cent	Million dollars	Per cent	Million dollars	Per cent	Million dollars	Per cent
1926	1,367	100	896	65.5	150	11.0	321	23.5
1930	1,698	100	1,186	69.9	148	8.7	364	21.4
1935	1,451	100	996	68.6	106	7.3	349	24.1
1940	1,833	100	1,286	70.2	115	6.3	432	23.5
1945	2,992	100	2,114	70.7	182	6.1	696	23.2
1950	4,604	100	3,611	78.4	178	3.9	815	17.7
1955	7,253	100	5,927	81.7	229	3.2	1,097	15.1
1956	7,924	100	6,536	82.5	238	3.0	1,150	14.5
1957	8,567	100	7,102	82.9	246	2.9	1,219	14.2
1958	9,127	100	7,642	83.7	241	2.7	1,244	13.6

Source: Fritz Machlup, The Production and Distribution of Knowledge in the United States (Princeton, 1962), p. 287, Table VI-34.

TABLE 3-5

BUSINESS EXPENDITURES--1956 AND 1958

Service	1956	% of Total [a]	1958	% of Total [b]
Telephone	$2,416,000,000	56.2	$2,813,000,000	56.5
Telegraph	114,000,000	2.7	117,000,000	2.4
Postal Service	1,766,000,000	41.1	2,048,000,000	41.1
Total	$4,296,000,000	100%	$4,978,000,000	100%

Source: Frizt Machlup, The Production and Distribution of Knowledge in the United States (Princeton: Princeton University Press, 1962), pp. 290, 291. Figures were extracted from Table VI-35.

Note: (a) and (b) were independently calculated.

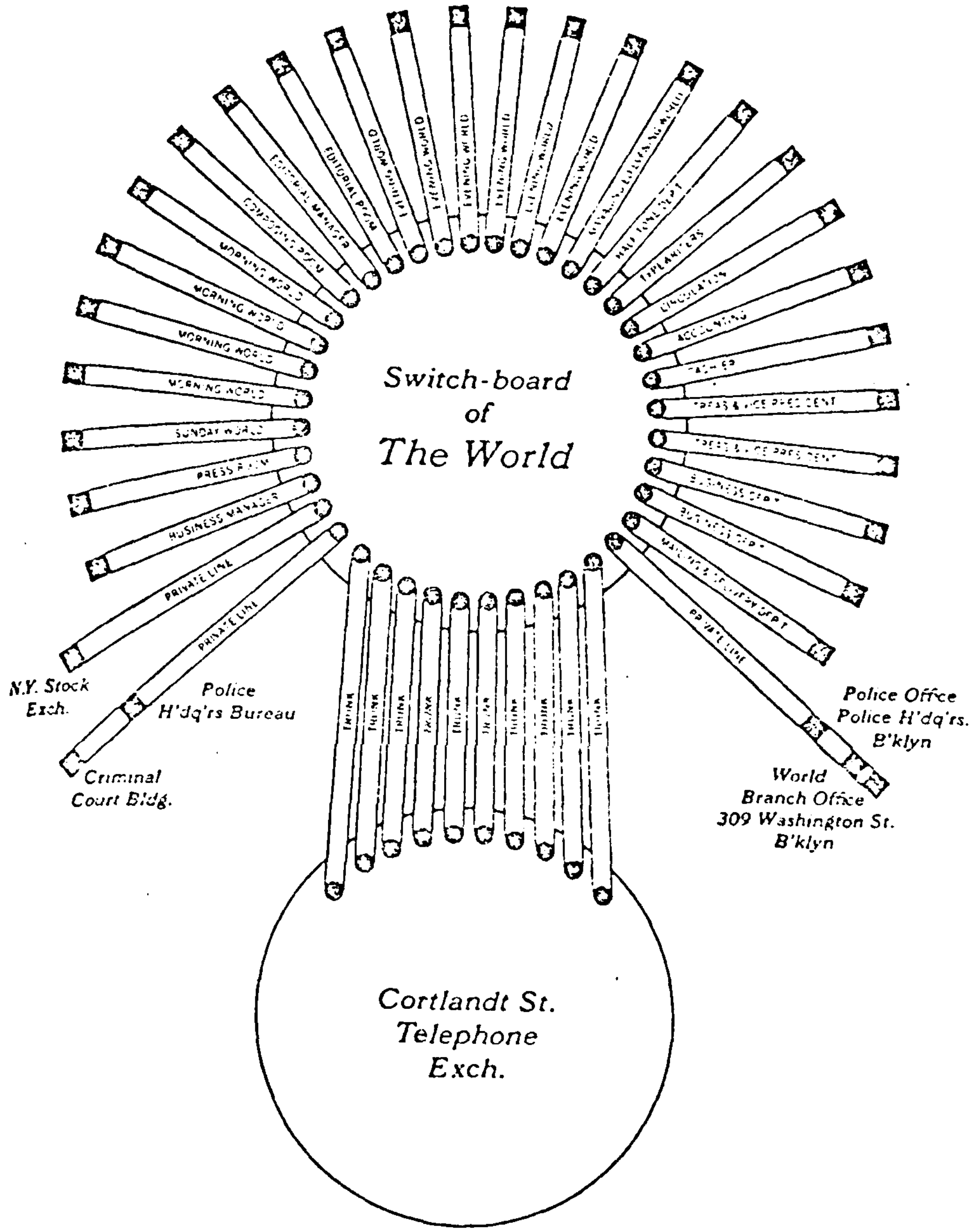
> the PBX to the central office, a relatively small number of PBX trunks could serve in place of the large number of equivalent loops that would have been required if each station had been individually connected to the local office. Thus, there was a considerable saving in outside plant that helped pay the cost of the PBX equipment and operator. Very large organizations, operating at several locations, often had a PBX installation at each location, all being connected together by 'tie lines' which made possible interconnection by PBX switching without going through the common carrier network; thus achieving more economical use of outside plant.[29]

Already in 1879 private intercommunication systems were being installed that were not connected to the central office. By 1887 "consulting" arrangements (conferencing) could be provided. By 1897, PBXs could be fairly complex (see Figure 3-4) and there were one hundred fifty similar PBXs in operation in New York City by that year.[30]

It is worthwhile to review the PBX manufacturing statistics of Western Electric for the years 1910 through 1926 for several reasons (Table 3-6). First, they provide insight into the size of the companies which acquired them. They also give a sense of how deeply the "telephone information system" pervaded the business environment in the first three decades of the twentieth century. By 1929 there were 130,000 PBXs in service, they served almost one-third of the main stations then in existence, and:

> . . . While the trunks to these PBXs accounted for perhaps less than 10% of the total central-office line terminals, in some business districts such as the downtown New York City area, the PBX trunks comprised 75% of the line terminals. In some of the large cities the number of PBX attendants outnumbered the central-office operators: for example, in Manhattan there were 20,000 PBX attendants compared to 9,500 central-office operators.[31]

These figures for New York City's downtown area leave no doubt that by 1930 business in a highly competitive environment was treating the



Private branch exchange of *The New York World* and its connection into the system of the New York Telephone Company, 1897. (From *Electrical Engineer*, November 25, 1897)

Figure 3-4. Switch-board of the *World*

Source: M. D. Fagen, ed., A History of Engineering and Science in the Bell System: The Early Years (1875-1925) (Bell Telephone Laboratories, Inc., 1975), p. 665, Figures 6-94.

TABLE 3-6

PBXs MANUFACTURED BETWEEN 1910 - 1926

PBX	Capacity in Station Lines	Percent of Total Manufactured	Units (Approx.)
No. 505	7	43.5%	43,500
No. 550	30, 80, 320	43.5%	43,500
No. 2 & No. 4	Less than 300*	9 %	9,000
No. 600 C	640		
No. 604 C	2,000	4 %	4,000
No. 605 A	1,500		
No. 606 A	5,000		
		100 %	100,000 Units

telephone as a vital business information system, and was already taking advantage of such features as ". . . station hunting, call transfer, restrictions, night service, conferencing, and inter-connecting PBXs via tie lines. . . ."[32]

Telephony reported in 1961 that Bell and its associated companies had 169,584 PBXs in service in the United States.[33] By 1979 the North American Telephone Association (NATA) estimated that nationally there were 215,000 PBXs.[34] About 90 percent of the PBXs serve less than 200 telephone extensions, while about 190,000 PBXs serve one hundred lines or more.[35] A comparison of the above figures with those in Table 3-6 reveals a significant increase in PBXs serving more than one hundred lines. Assuming that the No. 550 PBXs were evenly divided among the thirty, eighty, and 320 station capacities, 27,500 of the PBXs manufactured between 1910 and 1926 had a capacity of more than one hundred lines. This equates to 27.5 percent of the PBXs manufactured during that period. By the late 1970s, almost 90 percent of the PBXs in use served one hundred or more lines.

The key point to be gleaned from these statistics and developments is that business quickly took advantage of telephones and PBXs. It can also be inferred that the ubiquitous telephone had become more and more essential as a competitive tool in the conduct of business.

Office Information Systems and Computers

Another major office information system evolved, largely independent of the telephone and telegraph, and more closely allied with the United States mails. This office information system has four distinct evolutionary stages in the handling of information: manual, mechanical, electro-mechanical, and electronic. Table 3-7 describes the modalities of collection, conversion, manipulation, storage and communication of the data processed in these information systems, with the overall goal ". . . the treatment and transformation of information necessary for the efficient provision of *goods* and *services*."[36]

The manual stage was sufficient to handle the information in the small, specialized shops of the 1800s (see Note 13). Typically, clerks comprised only one-fortieth of the work force in 1900. They were able to keep up with information processing requirements (record keeping, accounting, and statistics) of the time by

TABLE 3-7

TYPES OF DATA PROCESSING SYSTEMS

Type of data processing system	Data processing functions—selected methods and devices				
	Collection	Conversion	Manipulation	Storage	Communication
Manual	Human observation Written records	Manual rewriting, editing, and posting Ledger card Pegboard	Human brain Written Calculations and analysis Abacus Slide rule	Human brain Written records Ledger card Filing cabinets Carbon paper	Human voice Written reports Chalkboard
Mechanical	Typewriter Cash register	Bookkeeping machines Cash register Typewritten ledger card	Adding machine Calculator Bookkeeping machines Cash register	Typewritten records Motorized files Microfilm Duplicating machines	Typewritten documents Bookkeeping machines
Punched Card	Typewriter Cash register Prepunched Cards	Punched cards Paper tape Card and tape punch machines	Card sorter Card collator Electrical accounting machine Card calculator	Punched cards Paper tape Card reproducer	Machine printed documents Card interpreter
Electronic	Direct-access terminals Punched card, Magnetic, and optical character readers	Punched cards Paper tape Magnetic tape Card and tape punch machines Key to tape machines	Electronic digital computer	Magnetic core, disks, drums, cards, and tapes Semiconductor storage circuitry	Online terminals, visual display, audio-response and typewriter High-speed printers

Source: James A. O'Brien, Computers in Business Management: An Introduction (Homewood, Ill.: Roland D. Irwin, Inc., 1979), p. 11, Figures 1-4.

longhand writing.[37]

The manual stage lasted until the early 1900s, when the mechanization of many office functions began. Adding machines became common office equipment, new methods for reproducing data replaced copy work, and machines which automatically folded outgoing letters and then inserted them into envelopes were used.[38]

Factors influencing the mechanization of office functions included the fact that the size of firms and offices was growing rapidly, the volume of information processed was also growing, and there was a tremendous growth in the number of white-collar workers and associated overhead costs.[39]

> . . . Increasing needs for business information, the rapid expansion of the clerical labor force, with consequent increases in cost, and growing specialization of work prompted introduction of office machinery. After the First World War the first multi-functional business machines were introduced . . . .[40]

To illustrate the tremendous change created by information needs in the post-World War I society, Table 3-8 is provided. As can be seen, approximately one out of twelve workers was a clerk by 1930, and by 1959 one out of seven workers was a clerk.

Mechanical devices such as the typewriter were adopted to make the processing of data more accurate, rapid and legible than had been possible with the manual process. Significant characteristics of the mechanical stage are:

a. Paper media are most often used for both temporary and permanent storage, while the data is either printed or typewritten.

TABLE 3-8

LABOR FORCE: PERCENTAGE DISTRIBUTION OVER BROAD OCCUPATION CATEGORIES, 1900 - 1959

Category	1900	1910	1920	1930	1940	1950	1959
White Collar	17.6	21.3	24.9	29.4	31.1	36.6	42.1
Clerical	(3.02)	(5.33)	(8.02)	(8.91)	(9.65)	(12.25)	(14.06)
Manual & Service	44.9	47.7	48.1	49.4	51.5	51.6	48.0
Farm	37.5	30.9	27.0	21.2	17.4	11.8	9.9

Source: Fritz Machlup, The Production and Distribution of Knowledge in the United States, (Princeton: Princeton University Press, 1962), p. 381, Table X-2 and pp. 384, 385, Table X-3. Clerical figures are derived from Table X-3.

b. Data processing is not continuous because the result of one process must be manually transferred to another.

c. Data was limited to alphabetic or numeric characters.[41]

Despite the factors which precipitated the mechanization of office machinery, clerical work remained very labor intensive up to 1945. The prosperity of the 1920's, as well as the ". . . surplus labor and curtailed operating conditions caused office mechanization to receive low priority in business."[42] While there were some advantages to this (e.g., less capital required), the disadvantages were becoming critical:

a. The probability of human error remained high.

b. Supervision became more difficult due to the increasing size and specialization of the clerical labor force.

c. Managers became further and further divorced from the operating level.

d. Communication became more impersonal and complex.

e. From an organizational point-of-view, departmentalization, greater functionalization, and bureaucracy developed.[43]

The third stage--electro-mechanical processing--is characterized by the use of punch-card accounting machines to provide code compatibility between equipment. This stage very nearly achieved a continuous process, although an operator still had to manually move the block of cards from machine to machine.[44]

Of course, the last stage--the electronic phase--is typified by the use of the computer, whereby the automatic storage and retrieval of information is achieved. Significantly, the first computer was placed in commercial use in 1954[45]--one year before our society crossed-over from an industrial to a post-industrial, information-driven society. By 1961 one expert was predicting that automation would have an especially great impact upon the accomplishment of clerical work:

> . . . In this category would be found industries that require substantial information handling and accounting functions (*continuous processes by nature*). . . . Frequently half or more of the total activity of an industry is essentially clerical. This is true of banking, transportation, communication, large-scale retailing, and the manufacture of certain non-standardized consumer products such as furniture. Information handling and general clerical functions comprise a large and growing share of the total operation in many industries. The increasing size and technical complexity of firms and the resulting managerial bureaucracy create a fertile field for office automation in many industries. . . .[46]

Up to the mid-1960's computers were used almost entirely for the automation of data-collection functions which had pre-occupied business from the manual stage days. Computer applications showed:

> . . . only minimal concern for and assistance to top management (inward functions), or the operations, marketing, and consumer services (*outward functions*). The traditional business applications, such as accounts payable, accounts receivable, payroll, and general ledger, are examples of this early trend. . . . These applications provide little or no new information to top management for planning and control, and little or no new information for operational management. An increasing emphasis is beginning to be placed [as of 1976] on systems that provide information to operational management and that help in the exercise of control.[47]

However, there were severe limitations upon how information could be delivered from the point-of-data collection to the central computer processing site. Until the use of third generation computers became commonplace, access to computer processing was possible only through electronic input and output devices which were collocated with the computer. Off-site users had to either mail or physically deliver the data to the computer center. Return of the processed data, of course, required the same manual and transportation-bound modes of transmission.[48] Since third generation computers were not introduced until 1965, information transfer in the early computer era was still in many respects on a par with those used in the pre-industrial society.

The Union of Communications/Computers

Two major breakthroughs brought about the actual exploitation of communications by computers and resulted in what is called the true modern business information system. The first major breakthrough was the development of input/output terminals which a user could install at his business to access the computer from a remote site. The communication links for these terminal-to-computer transmissions were the telephone and telegraph facilities. However, there were limitations.

a. Remote users were queued up waiting for other customers' jobs to be run on the computer.

b. Remote users often had to wait several hours before their data could be transmitted.

As a result, even the advent of remote terminals did not solve the problem of delivering information in a cheap, efficient manner because the expensive terminal frequently sat idle due to computer processing limitations. Therefore, many users continued to send their data by mail or other manual means. It was the breakthrough in time-sharing technology ". . . which enabled the third generation computers to process several jobs at the same time . . ." that produced the first modern business information system based on integration of computer and telecommunications services.[49] For the first time a Business Information System emerged which satisfied all the criteria delineated by American Telephone and Telegraph (AT&T) in their 1966 definition:

> A Business Information System is a combination of people, data-processing equipment, input/output devices, and communication facilities. It supplies timely information to management and non-management people for the planning and operation of a business. The system must accept information at the source where it is generated, transport it to the point where it is to be processed, process the information, and, finally, deliver it to the point where it is to be used.[50]

The impact of third generation computers on data-communications requirements was significant. Once terminals could remotely access a computer using timesharing technology,

> a. Small firms that did not need or could not afford to buy or lease their own computer began to buy time from computer service bureaus.
>
> b. Large national firms that owned their own computer suddenly found that it was practical and efficient to give [remote] users access to a central computer.
>
> c. The use of both computers and communication facilities to connect the computers with users expanded greatly.[51]

By 1969 approximately one out of every forty establishments (21,375 out of 855,000 businesses) with a net worth of over $20,000 had a computer installation, and the data communication industry (according to AT&T) was a $1.2 billion business in the late 1960's.[52]

The Era of Telecommunications Dependent Data-Processing Systems

Philip C. Onstad[53] of Control Data Corporation, in a paper presented in 1978 at the National Computer Conference, credits telecommunications with making it possible to exploit the full potential of data processing and information systems. Onstad noted that although in the 1950's and 1960's,

> . . . data-processing systems had the power to manipulate information at split second speeds and to store vast amounts of data which could be retrieved in fractions of seconds, 'these capabilities were of little use unless the user was in close proximity to the data processing system'.

The obvious solution, noted Mr. Onstad, was to use ". . . the vast telecommunications networks covering the country and the world" to quickly and efficiently move the information in and out of the data processing system. Ergo, the telecommunications dependent era of data processing had began.[54]

The era of telecommunications-dependent data processing certainly appears to signify the arrival of the technological tools necessary for management to handle the explosion in information that will be the main product of the post-industrial society. The genesis of this integrated tool--telecommunications/computers--can be logically ascribed to the mid-1960's. It was during this period that computer technology really caught-up with (and some would argue "passed") telecommunications and was able to extend data processing to remote users via data communications. As previously noted, the breakthrough technologies were timesharing, remote terminals, and the third generation computer.

Prior to these developments information systems operated on three broad fronts. The first of these fronts was the transportation-dependent mode where communications within a business or between businesses was either by face-to-face conversation or by letter correspondence. On a second front, information systems developed around the telephone/telegraph, with the telephone becoming a dominant technological force in the operation of business. From an organizational standpoint, the telephone and PBX by 1900 were already being consciously implemented and treated as a communications system by business. From a romanticist standpoint, this system became the heart and voice of business. The third and final discernible front--computers--arose out of the natural evolution of the office information systems where accounting, bookkeeping, and general ledger played such an important role in causing the clerical work force to increase. Whereas the telecommunications system functioned as the heart and voice of business, the computer came to represent the brain--the rational aspect of information use, collection, and dissemination. Even today all three of these business information systems are heavily used.

Although the computer was implemented to diminish the dependency of the office information system upon clerks and to process data faster, the anticipated positive impact of the computer and telecommunications upon the relationship between information and productivity does not appear to have occurred. Egor Neuberger[55] describes the information subsystem of an economic system (the other subsystem is production) as,

> . . . the collection, transmission, processing, storage, and retrieval and analysis of economic data, the communication of orders or other signals, and the feedback necessary for the evaluation of decisions taken as a result of signals [and] is a necessary input into every aspect of informational decision making. The larger the number of participants in the economic process, the greater the division of labor, the more complex the technological process, and the wider the assortment of goods and services an economic system produces, the more intensive the information process becomes.

Based on this description of the information subsystem, it can be seen (Figure 3-5) that our economy as a whole is squeezing less productivity out of each informational dollar spent. In the middle 1960's the relationship was approximately $3.00 of market output for each $1.00 spent for information. Despite the automation of clerical functions, the ratio of market output to informational overhead had dropped from a high of nearly twelve-to-one in 1936 to only three-to-one in the mid-1960's, and has remained about three-to-one to the present. Consumption of this information dollar is traced to creators, users, and handlers of information as it supports the end product, i.e., goods or services, provided by the enterprise. For the purpose of this discussion, information dollar consumers are categorized as "informational overhead."[56] In essence, the informational overhead activities are informational services which are not ". . . transacted in a market place as goods or services. Rather they are produced and consumed within firms, or occur in some other market (household or government) planning and decision making."[57] For a more comprehensive discussion of information overhead and productivity, see Appendix C.

Dr. March Uri Porat of the Office of Telecommunications makes some telling comments about the impact of computers, and the potentials of computer and communication technology on the future. In commenting upon the growing numbers of information workers in the expanding private and public bureaucracies, Porat[58] notes that the solution,

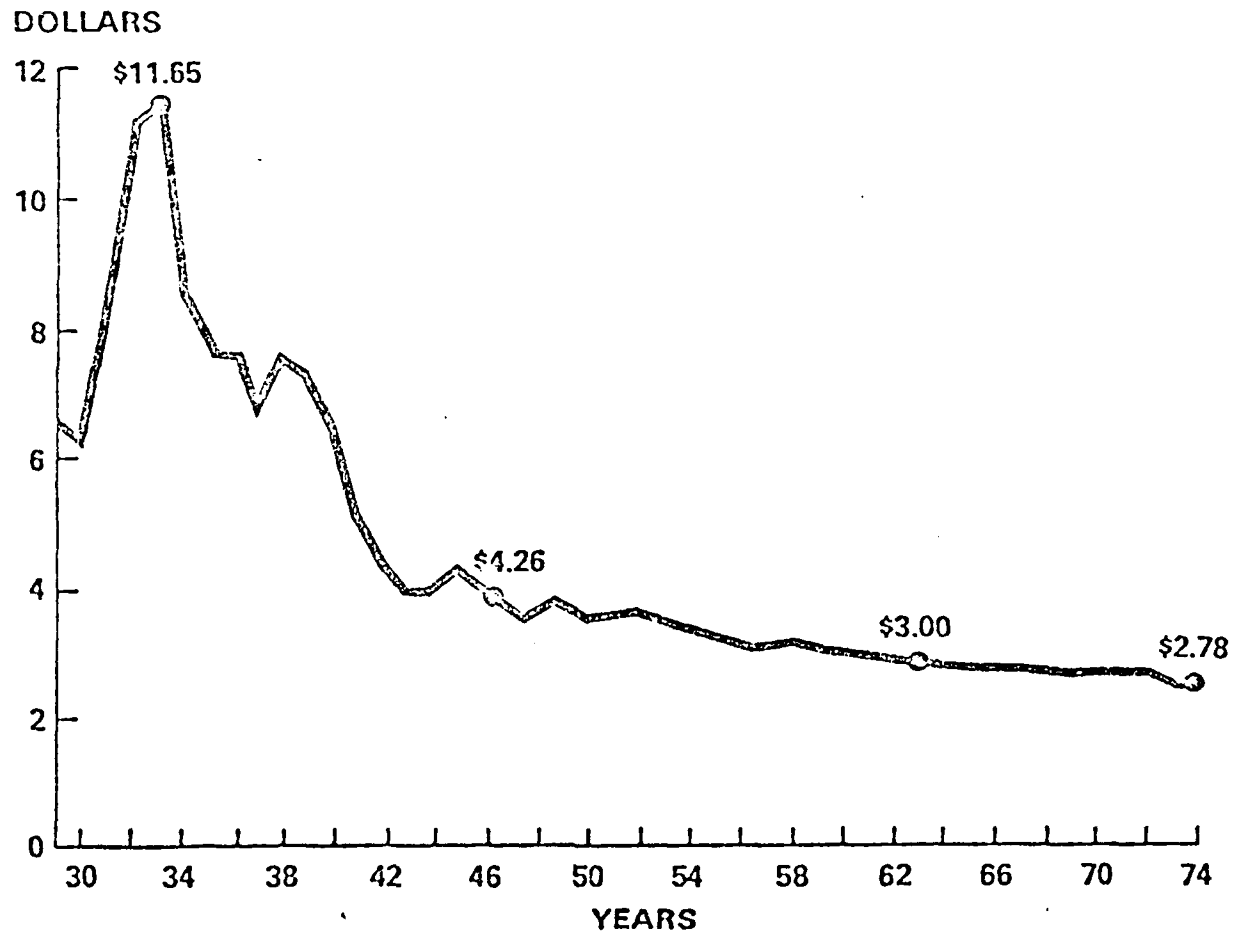


Figure 3-5. Productivity and Information Overhead Expense--1929-1974

Source: U.S. Department of Commerce, Office of Telecommunications, The Information Economy: Definition and Measurement, by Marc Uri Porat, OT Special Publication No. 77-12(1) (Washington, D.C.: Government Printing Office, 1977), p. 179, Figure 9-3.

> . . . is to help them become more productive, hence generating employment and output in all sectors of the economy. And, to bring the paradox a full circle, the most likely source of increased productivity in the secondary sector [managers, secretaries, etc.] is computer and communication technology--precisely the instruments that encouraged the growth of bureaucracies in the first place, and precisely the instruments that have been blamed with automation-induced unemployment.
>
> The computer, it turns out, did *not* eliminate jobs--it created them. But it created jobs for information workers, who are not terribly productive. And now the computer is being sought as a remedy for productivity losses. A better marketing strategy could not have been invented!

Carl Heyel,[59] in reviewing the forces for enhanced information processing, observed in 1969 that while information processing had always been a major administrative activity, there were significant differences emerging in the 1960's. He noted that information processing had become more important because of the increased complexity of business, the increasing volume of paperwork, the increased speed with which information must be processed, and the need for rapid and accurate integration of information as pressure mounted to keep costs (such as inventory) down while business complexities increased. Mechanization and automation of information processing was a natural fallout of these developments because of spiraling labor costs, lack of trained personnel, and demand for shorter working hours in the modern work force.

Despite the advances in information processing to the mid-1960's, Figure 3-5 clearly shows that the productivity/information overhead ratio continues to hover around three-to-one. Porat suggests two reasons for the drop in productivity over the past forty years may be a loss in productivity of the secondary information activities or ". . . an uncompensated rise in the amount of secondary information resources used to produce noninformation goods and services. . . ."*60

The important fact is that information has become a two-edged sword. On the positive side, it has become a powerful competitive tool. It has caused costs of production to plummet as information has led to improved efficiency in production of goods and improved technologies (e.g., semiconductors). However, the transfer of new technology in the information society has meant that these productivity advantages are short-lived. The costs associated with maintenance of the secondary information sectors imbedded in all organizations continue to be factored into the overall cost of the end-product or service. As the three-to-one ratio of Figure 3-5 implies, almost 25 percent of the cost of goods and services in our economy is directly attributable to imbedded information systems (people and equipment). These imbedded information systems produce, handle, create, and disseminate information for users in the organization. None of the costs of these imbedded services are recovered by direct sale of these services outside the organization. As a result, the costs are imbedded in the final cost of the product or goods produced by

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*Neuberger breaks down an economic system into productivity (noninformation) and information subsystems. The information subsystem is composed of two sectors: primary and secondary. The primary information sector is made up of those industries which actually market information goods or services. The secondary information sector is the information services produced for internal consumption by noninformation firms. Even firms in the primary information sector have a secondary information sector. (Appendix C discusses this in greater detail). The secondary information sector equates to information overhead.

the organization.

Therefore, the cost of handling information in the secondary information sector appears to have stabilized the productivity/information overhead ratio around the three-to-one mark. Now new information technologies are making it possible for business to improve the efficiency and effectiveness of the secondary information sector. Reducing the operating cost of information systems such as telephone networks and computer networks, using new information technologies to improve the productivity of employees in the secondary information sector, and improving the flow and accessibility of information equates directly to reduced cost in the secondary information sector. Reduced costs in the secondary information sector can mean reduced production costs, increased profits, and maintenance of a competitive edge.

These factors are discussed in the next chapter, which deals with the development of information systems consequent to the integration of telecommunications and data processing technologies. Emphasis will be placed upon the new information technologies which the marriage of telecommunications and data processing is spawning--technologies which are leading to a total integrated information resource and the much touted "Office-of-the-Future." During the reading of the following chapter, it would be wise to keep in mind John Diebold's prophetic comment in his 1964 book, Beyond Automation, that,

> Information technology is bringing forth entirely new families of machines, of which the electronic computer is only one. Managers must understand the nature of this phenomenon and the forces behind it if they are to properly assess its business consequences.[61]

This has great portent because the emerging office-of-the-future technologies are geared to attack a portion of the office information system that has, for the most part, been ignored until now. This branch of the office information system can best be termed the administrative (versus clerical) subsystem, and includes such mundane tasks as typing, dictation, and managerial time spent on the phone.

CHAPTER III

FOOTNOTES

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[15]Chandler, p. 103.

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[19]Thompson, pp. 444,45.

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[24]Ibid.

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[26]Dennison, p. 228.

[27]Fritz, Machlup, The Production and Distribution of Knowledge in the United States (Princeton University Press, 1962), p. 280.

[28]Fagen, pp. 659, 660.

[29]Ibid., p. 660.

[30]Ibid., pp. 662-664.

[31]Ibid., p. 693.

[32]Ibid.

[33]Telephony's Directory of the Telephone Industry-66th Year--1961 (Chicago: Telephony Publishing Company, 1961), p. 212.

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[39]Gene Dippel and William C. House, Information Systems: Data Processing and Evaluation (Glenview, Ill.: Scott, Foresman and Co., 1969), pp. 8, 9.

[40]Rico, p. 18.

[41]Ibid., p. 29.

[42]Ibid., pp. 30, 31.

[43]Ibid., pp. 30, 32.

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[49]Ibid., pp. 173, 174.

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CHAPTER IV

FORCES FOR INTEGRATION

By the mid-1960s business *et al.*, had begun to use telecommunications to exploit the potentials of the computer. The information system that developed--data communications--was actually a maverick which in effect became a new and distinct member of the family of information systems. Starting as an offshoot of office information systems, it became the fifth of five parallel and distinct entities: mail, telephone (voice), office (secretarial/administrative/managerial), transportation, and data communications.

However, the rapid technological convergence or confluence of computer and communications technology that evolved from the data-processing/telecommunications alliance has proved to be the seedbed for a vast array of new information technologies. These new information technologies appear to be leading inexorably to a synthesis of these five independent information systems, and the arrival of the much discussed "Office-of-the-Future."

The purpose of this chapter is to discuss forces in business that are propelling them toward use of an integrated-information system where voice, data, text, image, and message are intermingled. Particular attention will be paid to the functional backbone of this integrating process--computers and communications. William McGowan,[1] chairman of MCI Communications Corporation, draws a revealing analogy which clearly focuses upon the backbone functionality of computers and communications.

> Just as the factory was the focus of the industrial society that prevailed fifty years ago, so the computer is the focus--or factory, if you will--of the information society that we inhabit today. And if the computer is the factory, then telecommunications is the means of delivering raw materials to, and picking up finished products from that factory. To be useful, both the means of production and the means of distribution must be integrated into a single interactive system that merges their otherwise discrete functions into a continuum of purposeful activity. It is precisely that continuum that is developing in this country today.

A pivotal issue which remains unsettled in the development of integrated-information technologies and systems is whether it is telecommunications or computers which is the key to the exploitation of the new information technologies. The answer to this question would appear to have great import for the business community in two respects: first, in how they implement the new technologies from a planning perspective, and secondly, in how they choose to manage the integrated system. John J. Connell,[2] executive director of Office Technology Research Group, has already concluded that telecommunications is the key because ". . . every new office technology is now or is destined to be interconnected via telecommunications." A closer look at the forces causing business to seek integrated systems may provide insight into what technology (telecommunications, computers, or a hybrid of both) will be predominant in the future. Identification of a predominant technology, in turn, should make it possible to develop management approaches for handling the integrated-information systems of the future.

Office-of-the-Future

A clear definition of what constitutes the "Office-of-the-Future" is essential to understanding the remainder of this chapter.

> In this context the word "office" is used in the broadest possible sense. This term should embrace equally the clerical/management function of government, education, religious or business enterprises. Within business it must include, not just the antiseptic space where accounting is done, but also the rough and tumble of factory management and production control. *The office in this broad sense, is the neural* system of the enterprise.[3]

Thus, the neural system of the office becomes the totality of information systems feeding the enterprise.

Three signs have been predicted which will signify the arrival of the Office-of-the-Future. These signs all relate to the development of information technologies:

> * Traditional technologies will converge.
>
> * The boundaries between the technologies will become blurred, vague, and indistinct.
>
> * Image, voice, text and data will no longer be the separate disciplines that we have all known, but they will blend into a new hybrid technology called the management of the integrated information resource.[4]

The convergence and blurring of boundaries between technologies is graphically illustrated by the communications-data-processing issues with which the Federal Communications Commission has continually struggled during the past ten years. Prime examples are the computerized Private Branch Exchange and the communicating word processor, which has aspects of both telecommunications and electronic mail. Figure 4-1 depicts the convergence of information technologies and the emergence of ". . . hybrid,

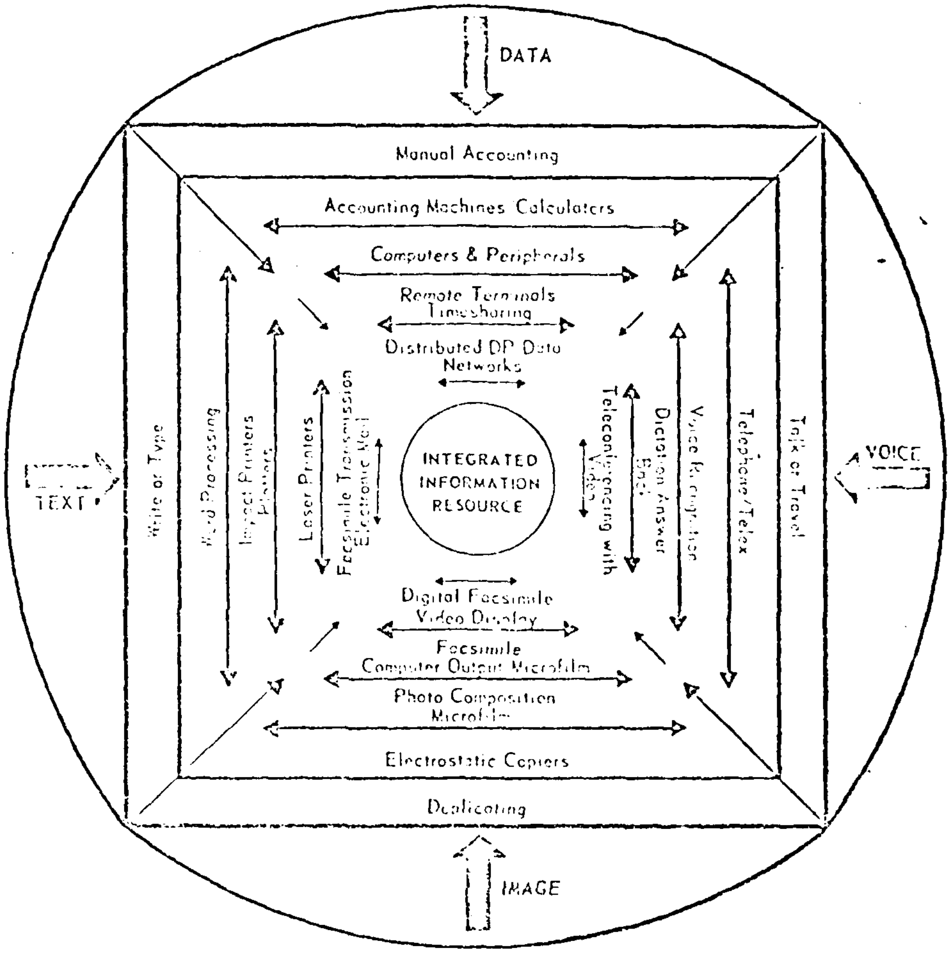

Figure 4-1. Convergence of Information Technology

Source: Fenwicke W. Holmes, "IRM: Organizing for the Office of the Future," Journal of Systems Management 30 (February 1979):26, Figure 1.

multifunctional machines that don't fit in the Computer Room, the Duplicating Department, or the Telegraph Center."[5]

If these signs are correct, then the Office-of-the-Future is no longer only a concept: it can be implemented now. In our opinion, however, the third sign is a managerial, rather than a technological, one. Converging technologies will not bring about the Office-of-the-Future; managers will. An integrated-information resource will not happen by itself, despite technological trends.

What are the advantages offered by the Office-of-the-Future technologies? According to Connell,[6] the Office-of-the-Future will aid in all phases of the *management and operation of its business*. While the use of technology (telecommunications and associated information technologies) is to improve productivity and reduce costs, its primary function is to help management communicate and run the business more efficiently and effectively. The remainder of this chapter will deal with the pressures for integration generated by the increasing use of information technology to improve productivity and reduce costs in the various information systems discussed previously.

Comparison of Capital Equipment Invested

Despite our transition into the Information Age, a comparison of capital equipment invested reveals how inefficiently our young information society handles its main commodity--information. Alan Purchase,[7] senior industrial economist at Stanford Research Institute (SRI) in 1975 noted that this office costs (white-collar workers) comprised between 40 percent and 50 percent of all costs in a company, compared to 20 percent to 30 percent previously. In the same Business Week article, an IBM spokesperson stated that secretarial salaries had gone up 68 percent and that ". . . the cost of turning out a business letter is 40% more than it was 10 years ago." Despite these large increases in information costs, only about $2,000 was invested annually in 1975 in capital equipment to assist office workers, while $25,000 was spent for each factory worker.[8]

Comparable figures for 1979 are even more startling. James Campbell,[9] president of Xerox Business Systems says,

> . . . that the average American farmer is supported by $54,000 worth of capital equipment, and the average factory worker by $31,000 worth. For the office worker, the figure is only $2,300.

The amount of capital equipment support provided office employees is not universally agreed upon. Gnostic Concepts in 1977 quoted the figures $6,000 to $7,000 for office workers versus $25,000 to $30,000 for factory workers.[10] The key point is that there appears to be a concensus that in the most labor intensive part of our work force--the information sector--the application of new technologies to improve productivity has been sadly neglected.

Over the past several years, however, the rising costs of the various information systems have caused business to look for alternatives. Some of the pressures upon each of the systems are discussed in the following sections of this chapter.

Data Communications

With the development of time-sharing, transaction-processing, and distributed processing, companies employing computers found an increasing,

> . . . need for the establishment of networks meeting user needs better than public-switched telephone systems, to provide improved response time, error rate, security, and cost. Large organizations were already doing this [by 1965] by establishing private networks, obtaining only transmission facilities from common carriers, and providing all switching themselves through privately owned equipment. Although this met the needs of the larger user, each was tailor made at great expense, often underutilized, vulnerable to circuit failure, and often incompatible with other networks. . . .[11]

There were 2,500 private data communications networks operational by 1978. According to Howard Anderson[12] of The Yankee Group, ". . . 62% of the Fortune 500 companies are investigating the implementation of an 'intelligent network'. . ." to eliminate the independent, application unique networks which pervade many corporate information structures. AT&T market research revealed that,

> . . . Historically, users have tended to develop and use data communication systems to solve one business problem or application at a time, thereby creating a multiplicity of single application networks. Different technologies and variety of terminals and computers have been used for these networks. As a result, terminals and computers on one network cannot transmit data to terminals and computers on other networks.[13]

A Yankee Group study indicates that 82 percent of all business data communications in the United States is done by approximately 750 companies.[14] Overall, business customers paid more than $25 billion for telecommunications services provided by the domestic telephone industry in 1977. On top of this, the

United States data-processing industry generated $38 billion in sales. The area where the telecommunications/data-processing industries overlap, communications based information systems, is the "fastest growing market segment for both telephone and computer companies."[15]

In 1976 both the telephone and computer industries were growing at a rate of approximately 13 percent per year, and their combined new business revenues were reported to be over $7 billion per year.[16] An independent survey of the Fortune 500/50 companies* which were considered potential leaders in the use of value-added services reveals just how costly business communications is becoming.

> . . . In 1977 the average Fortune 500/50 company spent $8.4 million on all communications services within the U.S. Of this, voice communications totalled $6.3 million and all other (data, text, message, image) amounted to $2.1 million or 25%. Thus the total voice communications expenditures in 1977 for all 800 Fortune 500/50 companies was $5.04 billion and the total for data/text/message/image was $1.68 billion.
>
> By 1982 the total spent by all Fortune 500/50 companies on data/text/message/image communications will increase by a factor of 1.8 to an estimated $3 billion in 1977 dollars.[17]

A closer examination of these cost figures reveals that Fortune 500/50 companies will face a rapid and steady increase in communications costs for the period 1977-1982 if the projections prove true. First, the projected increase in data/text/message/image communications costs between 1977 and 1982 equates to approximately a 10 percent annual growth rate over the six-year period.

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*Fortune 500/50 companies are the top 500 manufacturing companies, plus the top 50 companies from each of the six other industries.

Therefore, the data-communications bill for the average Fortune 500/50 company will increase from $2.1 million in 1977 to $3.75 million (in 1977 dollars) in 1982. Secondly, extrapolation of these projections based on a conservative 7 percent inflation rate reveals that the actual costs will approximate $5.4 million for the average Fortune 500/50 company by 1982.

The latter analysis of the Fortune 500/50 companies noted, however, that technological developments such as electronic mail could very well change the data-communications growth pattern. The analysts believed the key to the change in the rate of growth would be the rapidity and extent to which automation equipment (word processors, facsimile, etc.) is integrated into communications. Projections at the time of their analyses were that the total communications bill for a typical Fortune 500 company would increase by 7.5 percent per year, while the data portion would increase by 12 percent a year (in 1977 dollars).[18] Therefore, by 1982 the data-communications bill for the typical Fortune 500 company could approach $4.15 million (in 1977 dollars) or $5.85 million inflation-adjusted dollars due to use of new information technologies.

The startling fact which emerges is that the data-communications bill for the typical Fortune 500 company will increase by 10 to 12 percent a year in 1977 dollars. If a very conservative 7 percent inflation factor is included, the yearly increase ranges between 17 and 19 percent. With the tremendous economic stress being placed on corporations by labor costs, especially in the white-collar sector, we expect information technologies (especially in the data arena) to be heavily implemented to improve white-collar productivity and reduce office labor overhead. These new information technologies, *in toto,* lead us to believe that new information technologies may have a much greater impact than the previously predicted 2 percent increase.

A good example is the new market trend established by the advent of the "smart" terminal. Once the user could use the "smart" terminal to format, edit, check, and store information locally for later transmission, and also use the terminal to perform the communications processing functions formerly done by the host computer, the distributed processing era had begun. The trend toward distributed processing, in conjunction with the advent of integrated circuitry, which reduced the costs of peripheral devices, meant that,

> . . . data communications could surpass the voice communications business. AT&T marketing estimates project that business expenditures for data terminals will exceed business expenditures for voice terminals by 1980.[19]

The impact of the merger of computers and communications is readily apparent (Figure 4-2). In 1964, when time-sharing was introduced, Stanford Research Institute (SRI) estimated there were approximately 200,000 computer terminals in the United States. By 1984 SRI predicts the number of terminals will exceed five million. Just as significantly, Industrial Outlook 1978 postulated that ". . . 70% of the U.S. computers will be connected for data communications via the telephone networks by 1980."[20]

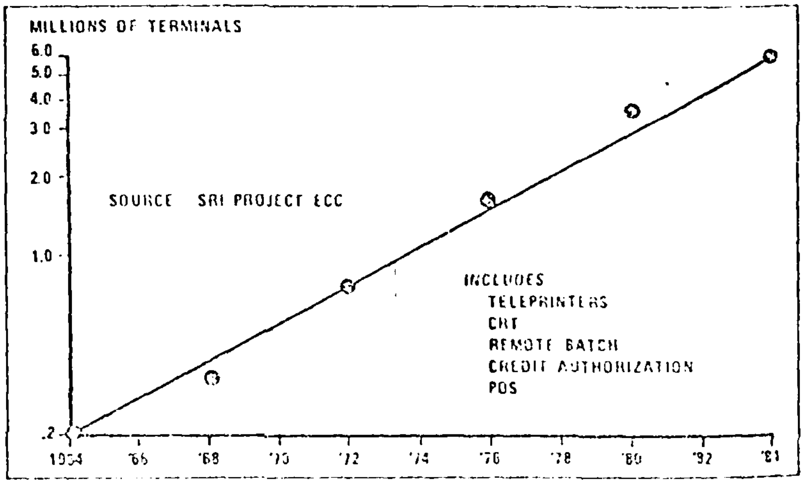


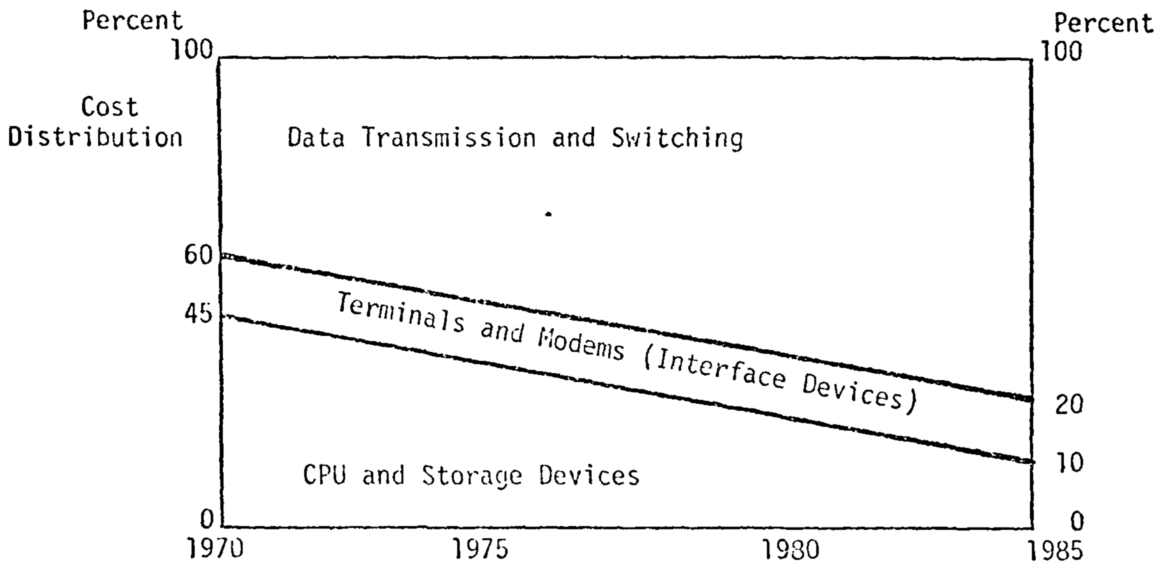
Figure 4-2. Projected Growth of Number of Terminals in the United States.

Source: George A. Champine, Computer Technology Impact on Management (New York: North Holland Publishing Co., 1978), p. 102, Figure 6-1.

On the surface, it would appear that the quantum increase in computer terminals and computer networks is driving data-communications costs up. In addition, the insatiable appetite of business for more and more information might be blamed. For example, James Martin[21] estimates that ". . . the volume of computer data transmitted in many corporations is growing at more than 25 percent per year and is increasing by a factor of 10 between 1970 and 1980." Certainly these are factors in the rise of data communications, but there is a much more basic problem presented by these developments.

By 1985 it has been estimated that data-communications customers will spend far less of their dollars on the actual transmission of the data. AT&T projects that in 1985 data-communications customers will spend only $.20 of their data-communication dollar for transmission, another $.35 for communications processing, and $.45 for media conversion.[22] Expressed another way, AT&T foresees the transmission share of the data-communications market slipping from 60 percent to 20 percent. Conversely, communication processing (message-switching and networking-equipment) and media conversion (primarily data entry) will grow to consume 80 percent of the data-communications dollar.[23]

Another, and perhaps more enlightening, approach is to look at the cost trends for the distribution of telecommunication applications in the data-transmission market. Figure 4-3 shows these trend lines projected through 1985. In this scenario, costs of terminals and costs for processing the information (CPU and storage devices) will drop, while the costs for transmitting the



Environment

Large Central Host Computers	Distributed Computing Network
Analog Terrestrial Network- Low Speed	Over 60% Digital Network
Transmission (2400 baud)	Over 50% High Speed Trans- mission (Above 9600 baud)

Figure 4-3. Cost Trends Distribution of Telecommunicatons System Component Costs

Source: Joseph Ferreira and Jack M. Nilles, "Five-Year Planning for Data Communication," Datamation 22 (October 1976):52, Figure 2.

Note: Terminal and modem costs are expected to drop very little, and processing costs to drop rapidly, making transmission costs an ever larger percentage of the total communications cost.

data will increase proportionately.[24] Of course, one must keep in mind that these are percentages, and that the computer-communications system is expected to change drastically from a centralized to a decentralized environment during the projected fifteen-year period.

From this discussion of data communications several cost factors have emerged that are, from a business point-of-view, prime reasons for integration.

* Unique, application dependent data-communications networks are too expensive both from an operational and a management perspective.

* The telecommunications dependency of computers is increasing. The annual growth rate in data-communications costs is approaching 10 to 12 percent (in 1977 dollars).

* The cost of communicating is consuming a greater share of the data-communications dollar each year.

AT&T surveyed over 2,000 data-communications users in industry, education, and government and interviewed ". . . decision-making personnel of some 65 major data-communications users in 23 industry sectors. . ." over the past three years. The purpose of the survey and interviews was to identify major problem areas encountered by data-communications users.[25] Four major problem areas were identified, and it was these problem areas that the AT&T offering of Advanced Communications Service (ACS) was designed to rectify:

* The incompatibility and under utilization of networks that have resulted from users developing networks for each application or purpose.

* The complexity of modifying existing networks to accommodate changing requirements [and, we might add, to accommodate emerging new information technologies].

* The major expense and effort required to manage multiple networks and monitor their performance.

* The high start-up costs that make it difficult for small users to justify data communications systems and for larger users to add applications that do not support substantial applications.[26]

Voice Communications

In 1977 approximately 75 percent of the average Fortune 500/50 companies' communications bill was for voice communications (telephone). Henry Newton,[27] president of Telecom Marketing Group, stated in February 1978 that,

> Corporate phone bills . . . are rising 17% a year compared to 5% in the mid-1960's. 'Business customers could save $3 billion a year if they just managed their communications better'. . . .

Dan Hosage,[28] senior vice-president of Datapoint, recently declared that ". . . 90% of all American companies are overspending on their communications costs" and ". . . 20% of all long-distance costs are avoidable." Nevertheless, business communications expenditures are increasing at a steady 8 percent to 10 percent rate per year.[29]

Table 4-1 breaks out the costs for corporate telecommunications costs as a percentage of total corporate operating costs. As James Martin[30] notes, most of the cost is for telephone traffic and,

> . . . [s]urprisingly, about three-fourths of this expenditure relates to internal communications. A widespread corporation can therefore profit by having an internal telephone network designed to minimize costs. In spite of the magnitude of the costs [large corporations spend many millions of dollars on their telephone facilities], there is often no technical study of corporate telecommunications or high management involvement,

as there would be with other equipment of similar cost. Accountants take most communications for granted and do not try to justify its cost as they would with, say, computing equipment.

TABLE 4-1

COST OF CORPORATE TELECOMMUNICATIONS AS A PERCENTAGE OF TOTAL OPERATING EXPENSES

Industry	Range (%)	Average (5)
Airlines	3-7	4
Banking and Finance	0.6-4.2	1.5
Insurance	1-3	2
Manufacturing	0.3-2	0.5
Securities	8-12	10

Source: James Martin, The Wired Society (Englewood, N. J.: Prentice-Hall, Inc., 1978), p. 193, Table 17.1.

In response to increasing costs for voice communications, companies are looking for ways in which to economize. One approach has been to seek the professional assistance of communications consultants to help companies streamline the operation, use, and costs associated with their telephone systems. The existence of communications consultants, and the number available in the large metropolitan areas (e.g., Denver has five consulting firms that specialize in telephones) is indicative of the needs within the business community to cut voice-communications costs.

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INTEGRATED INFORMATION SYSTEMS MANAGEMENT: A COORDINATED AND CO--ETC(U)

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Another approach has been to acquire computerized PBXs, which have also been variously described as electronic, digital and/or stored program controlled PBXs. Some of the cost-saving advantages of the electronic PBXs were being realized as early as 1977, when Citibank and Equitable Life Assurance Company installed them. These electronic PBXs,

> In addition to providing such convenience features as conference calling, abbreviated dialing, and automatic call forwarding, . . . are programmed to keep detailed accounting records and to check the condition of extensions and telephone company lines. In some cases, they route toll calls over the least costly paths, cutting charges by as much as 30%.[31]

The electronic PBX acquired by Equitable from Northern Telcom cost $8.5 million and was intended to handle the company's national voice *and* data traffic.[32] This is an early example of the trend toward use of computerized PBXs to handle much more than just voice traffic.

The computerized PBX offers the potential for integrating systems which,

> . . . will be used for a variety of data collection and transfer functions in conjunction with data telephone terminals and advanced word processing systems comprising semiconductor memory-visual display, card reader, keyboard and high speed printer. These integrated systems will not only enable users to harness remote computer power for the automation of local office paperwork, but will give access to mainframe storage in a conversational mode from distant locations in a distributed network environment, for office, hospital, factory, or military application.[33]

Figure 4-4 provides a breakout of the various information systems and technologies which might be integrated through the use of a computerized PBX.

According to James Martin,[34] there are two capabilities of

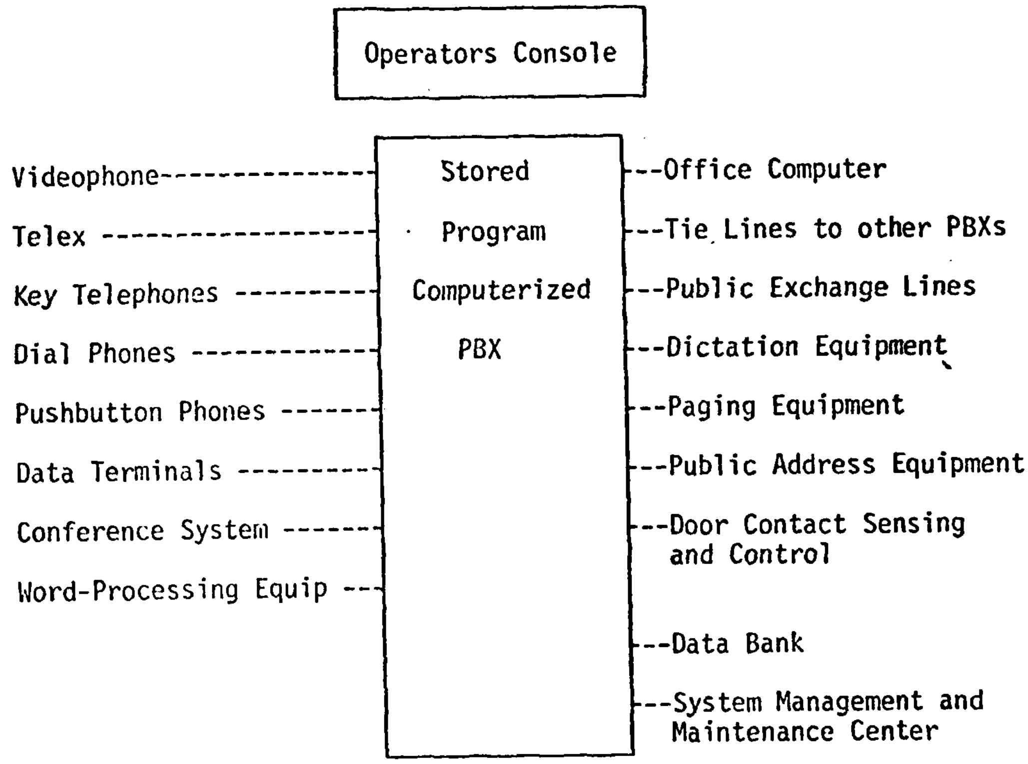


Figure 4-4. Integrated Information Systems With Electronic PBX as Hub

Source: "PBX-Quo Vadis," Telecommunications 11 (January 1977): 38, Figure 3.

computerized PBXs which make them economically desirable, especially as replacements for the approximately 190,000 PBXs serving one hundred lines or more. These economic benefits are that the PBX can be ". . . programmed to control and lower overall telecommunications costs . . ." , and it can be used to carry-out data-processing functions. In addition, one might add as an economic benefit the ability to integrate various office information technologies which will be discussed later.

Because the computerized PBXs ". . . provide many new features and services which the customer *can use to improve the productivity of his organization,* most new PBX installations are of this type. By the 1980s they may number several hundred thousand. . . ." (emphasis added).[35] The pressure for these new features related both to productivity and cost. Statistics show that,

> . . . only 68 percent of long-distance calls and around 70 percent of local calls are completed. The rest encounter busy signals, no answer, or equipment failure. On the completed calls, the called party is reached only 35% of the time. In other words, less than 25 percent of calls attempted reach their desired party. It is estimated that this wastes 200,000 man years of a caller's time, which at $10,000 per year is equivalent to $2 billion.[36]

Rolm Telecommunications has developed a new system (called Rolm Electronic Message System--REMS) which attacks the above problem, especially when the real-time aspect of telephonic communications is either unnecessary or impossible because the called station is busy, unanswered, etc. A study of Fortune 500 companies provides a statistical basis for REMS. The study showed ". . . 60 percent of all messages stay in the same facility; 25 percent are between the same company's facilities, and only 15 percent go outside a company (not including invoices)."[37] Similarly, Richard Moley,[38] vice-president of marketing for Rolm, notes:

> Studies have shown that for every 16 telephone conversations accomplished each day, an additional 41 incompleted calls are attempted. The shadow functions involved with telephoning . . . misdials, busy signals, out-of-office, and the like . . . consume eight-to-ten percent of the time spent in communications activities, reaching a conservative average of 30 minutes of lost managerial time each day.

Basically, Rolm's system permits users to integrate written communications with their phone system. Video display and hard copy units can be connected to the message processor unit of the PBX over the standard office telephone wire. "The system is ideal for the myriad, short, five-to-ten line memos that are so profuse in every office."[39] Figure 4-5 shows how Rolm's REMS might be configured.

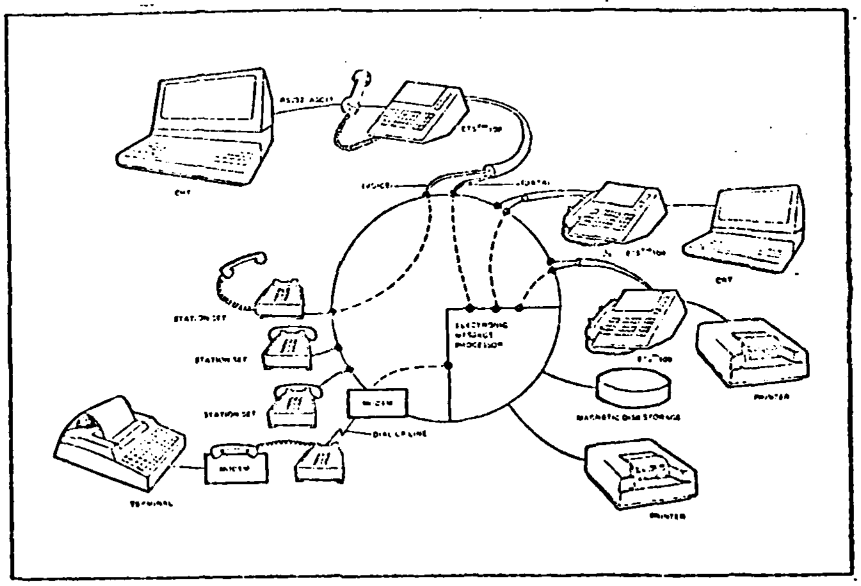


Figure 4-5. Rolm's Electronic Message System

Source: "Newer PABXs Taking Advantage of Computer Power for New Features," Communications News, (July 1979), p. 43.

The Rolm system provides an excellent example of some of the productivity problems facing business and also shows the benefits to be derived from integrating-information systems, in this case, voice and electronic mail, to provide users with viable alternatives. In addition, Rolm's system is a hint of the pivotal role the PBX will play for communications devices in the Office-of-the-Future. While most business communications devices are telephones today (forty million versus three million data terminals), there is a discernible trend toward keyboard CRT devices ". . . on anywhere up to 20 million desks."[40] This trend is indicative of increasing business dependence upon the new information technologies to satisfy increasingly complex information needs.

So what does business seek from PBX systems? American Telephone and Telegraph studies identified four major areas:

* Improve employee productivity, by mechanizing operations previously requiring manual intervention.

* Maximize return of communications investment, through efficient and economical use of physical facilities.

* Control and allocate communications expense, by individualizing calling privileges and by linking costs to the appropriate departments and/or profit centers.

* Finally, providing hands-on management and control to allow rapid response to changing conditions and to insure optimal system performance.[41]

Remarkably, these four areas are almost identical to those identified by AT&T for *data* communications users.

As one can readily see, the electronic PBX has the potential to become much more than just a voice-networking apparatus. With its internal computer, it can also become the hub for a corporate digital network. The telephone and the PBX have been a mainstay of corporate communications systems for over eighty years. Recent technological advances have made them adaptable to a host of new information technologies and may make the PBX an even more important information asset to business. With corporate telephone costs rising 17 percent a year, the new electronic PBXs (and Common Carrier services such as CENTREX) offer business a way to reduce telecommunications costs and open up new ways to enhance corporate information handling.

In concluding our discussion of data communications and voice communications, it would be remiss to ignore the inconsistencies in business communications costs quoted. To put it succinctly, we consider the issue of how much the typical communications bill for a corporation is increasing to be very nebulous. It has been previously noted that business communications bills are increasing by 7.5 percent (see note 18) and 8 to 10 percent (see note 29). Similarly, one source confidently predicts that data-communications costs will increase by 12 percent per year (see note 18) in 1977 dollars, while another source notes that corporate phone bills are rising 17 percent per year (see note 27).

If business communications costs are rising at a steady 7.5 to 10 percent, then either data-communications or telephone costs must be below the average rate. Yet neither appears to be, according to the figures cited. In addition, the previous discussion indicates that business is looking for ways to cut both data-communications and voice-communications costs. The implication is that both costs are out of hand. We do not believe business would have such an urgent need for cost-saving communications alternatives if the cost in either sector showed a reasonable rate of increase. As a result, we suspect that the average business communications cost in large corporations such as those in the Fortune 500 actually may increase by 17 percent to 19 percent per year.

At the very least, one can see that the figures used are imprecise and ill-defined. Nevertheless, they reveal the magnitude of communications costs problems facing business.

Administrative/Managerial Information Systems

The two previous sections dealt with the growth of telecommunications costs and pointed out how corporations were seeking integrated services in data communications and computerized PBXs to reduce those costs, while simultaneously increasing productivity. It was pointed out that business communication costs are rising at a rate of approximately 17 percent to 19 percent per year. However, these cost figures can be misleading. According to Dan Hosage,[42] the average increase in telecommunications costs for a corporation will approximate 15 percent* for the period 1975-1979. He attributes this rise to increased usage and rate increases. The 25 percent per year increase in data traffic is a good example of how usage has increased. Similarly, the increased use of electronic PBXs to control costs, especially in the interstate toll area, suggests that telephone costs are rising through increased use and mismanagement of communications. Usage and rate sensitivity are important

*Hosage's figures seem to confirm the reasonableness of the 17 to 19 percent increase per year figures developed in the preceding paragraphs.

communications-cost factors because they in part help to explain why corporate communications costs are rising despite the fact that for long-haul data communications costs are predicted to drop steadily through 1985.[43] Figure 4-6 graphically depicts the changing cost structure for business information systems for the period 1977 through 1987.

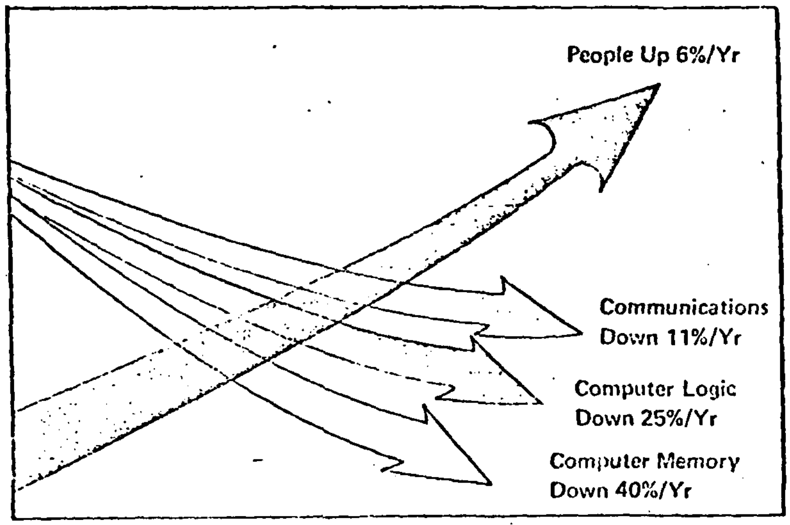


Figure 4-6. Changing Costs for the Period 1977-1987

Source: Christopher Burns, "The Evolution of Office Information Systems." Datamation (April 1977), p. 62.

Figure 4-6 not only points toward a decrease in the cost of the backbone to the information technologies (computers and communications), but also reveals the Achille's heel of many corporate-information systems; people costs associated with handling information. Total costs for communicating in a corporation can be five to ten times as much as the corporate-telecommunication costs. For example, transportation for communications and corporate mail, especially internal mail, are more critical factors in corporate communications costs than telecommunications. As an even more specific example, the average letter in the United States costs at least $10.00 to be ". . . conceived, formulated, copied, transported, received, read, and filed."[44]

> Most corporations today spend a substantial proportion of their money and human talent on communication of one form or another. Business people spend most of their day communicating. Most white-collar workers spend much of their time communicating with superiors, subordinates, customers, suppliers, secretaries, and computers. The information handling process typically costs from 5 to 30 percent of an organization's total expense. Given such a large expenditure, it is desirable to ask how corporate communications can be made as effective and inexpensive as possible.[45]

An illuminating insight into the character of information handling outside the realm of telecommunications and data processing is provided by an Exxon Office Technology Team study of a Business Communications System (BCS). In the BCS breakdown provided at Figure 4-7, one can readily ascertain where the need for new, integrated information technologies lies.

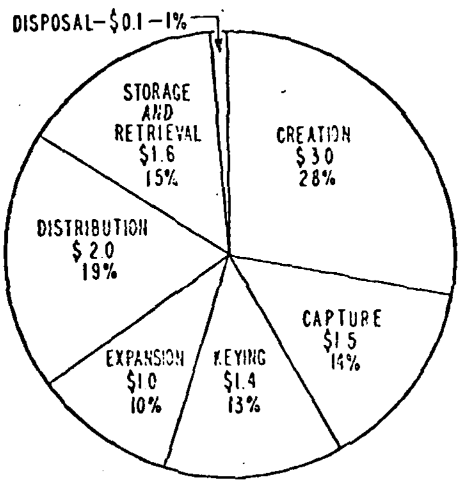
Attributing the process of creation and capture to the manager/professional leaves 58 percent of the information handling process in an office to the secretaries and clerks. Exxon's BCS figures are meaningful because the four hundred people (secretaries, clerks and other office workers), comprising only 29 percent of the total work force being studied, accounted for 58 percent of the documented communication costs ($6.148 million out of $10.6 million).

Based on these figures , it is not surprising that the ratio of information overhead to productivity is so low. The following quote clearly reveals the impact of capital equipment on worker

1000 Professionals

300 Secretaries

100 Clerical and Other Office Workers



- Creation—act of thinking and formulating a communication.
- Capture—placing the communication onto a medium.
- Keyboarding—entry to/processing by/output from a keyboard.
- Distribution—message carrying, mail handling, electronic transmission.
- Expansion—copying, printing, microfilming, duplication of magnetic records.
- Storage and Retrieval—indexing, storing, searching for and finding information.
- Disposal

Figure 4-7. Business Communications System (BCS) Cost Breakdown

Source: Stanley M. Welland, "Micrographics in the Office of the Future," Journal of Micrographics 12 (November/December 1978): 62, Figure 1.

Note: Costs shown are for documented communications: phone, and EDP costs are not included (dollar figures are in millions). Total costs--$10.6 million.

productivity, where factory workers enjoy approximately a fifteen-to-one advantage over office workers in the amount of supportive capital equipment. According to Connell:[46]

> . . . In the past five years there has been an explosion of technology aimed at automating office operations. The motivating force behind the explosion is economic. Some studies indicate that while industrial productivity has increased 90% in the past 10 years, office productivity has risen only 4%. The office is the most labor intensive activity in business today and office salaries are rising 6% to 8% a year. The need to increase office productivity and reduce office costs is becoming more and more important to management--hence the drive for more powerful technological aids.

However, the potential for improved information handling does not stop at the door between the secretary and the boss. Managerial/professional work is equally susceptible to enhancement through use of information technologies. Harvey Poppel,[47] senior vice-president of Booz, Allen, and Hamilton, believes that managerial/professional productivity has been overlooked while so much attention has been paid to improving office worker productivity.

An Office Systems Research Group (OSRG) study concluded that ". . . potential cost savings are much higher for managers and professionals than for secretaries/clerical workers. . . "[48] where office automation is successfully implemented. They found that, despite the fact that managers and professionals are paid two to four times as much as office workers, these people spent an increasing amount of their time doing office support work. This has happened because companies have tried to keep costs down by cutting office support. OSRG found manager-secretary ratios of five-to-one and six-to-one increasingly common, especially in the lower levels of middle management. The result is that $40 per hour managers were doing $12 per hour secretarial work. Since ". . . 70% of the U.S. white-collar wage bill (in 1974) went for managers and professionals," while 2 percent went for typing,[49] this trend is significant. Table 4-2 provides some particularly revealing facts concerning the productivity needs of managers and professionals.

TABLE 4-2

IMPACTING PRINCIPAL TIME:

Examples from a current study at a large oil company (66 principals, 35 support staff)

Source	Hours/ Week	Yearly Cost
Principals spend at copier	79	$113,760
Principals try to reach someone on phone	104	149,760
Principals could save by delegating to secretary	200	288,000
Principals spend doing longhand:		
at office	499	718,560
at home	165	237,600
Principals say work is not getting done due to lack of secretarial support Yes: 25% No: 75%		

Source: Thomas K. Lodahl *et al.*, "Management Forum: Providing Management Support in the Automated Office," Corporate Systems 4 (June 1979), p. 43, Table 1.

Early in this chapter it was noted that office workers have a disproportionately small amount of capital equipment to assist them in their work. Nevertheless, office workers such as secretaries are exceedingly well-supported by information technologies compared to the plight of the managers and professionals they support (Figure 4-8). Again, studies by Booz, Allen and Hamilton reveal that a manager's time can be more productively used when he has information technology to aid him. Table 4-3 lists some of the information technologies which Booz, Allen and Hamilton believe might be used to improve managerial productivity.

Because of the costs involved in communicating in the traditional manner (i.e., by paper, face-to-face, telephone) and the static productivity of office workers, combined with rising labor costs, business began to look for alternatives. Since between 70 percent and 100 percent of a manager's time is spent in communication, business began to increasingly look upon office functions as communication functions. Joel Slutzky[50] of Infodetics Corporation makes the point that ". . . the office* is, in reality, . . . a communications center." Building on this concept, one can visualize a corporation composed of hundreds, or even thousands, of small communication centers, each interconnected through a series of channels: telephone circuits, hallways/corridors, organizational charts, and paperwork channels. To date, the telephone is the only device which has been able to electronically interconnect all these

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*In this context, office should be interpreted as an organizational subsystem, like a manager and his secretary. This definition is distinctly different from the Office-of-the-Future.

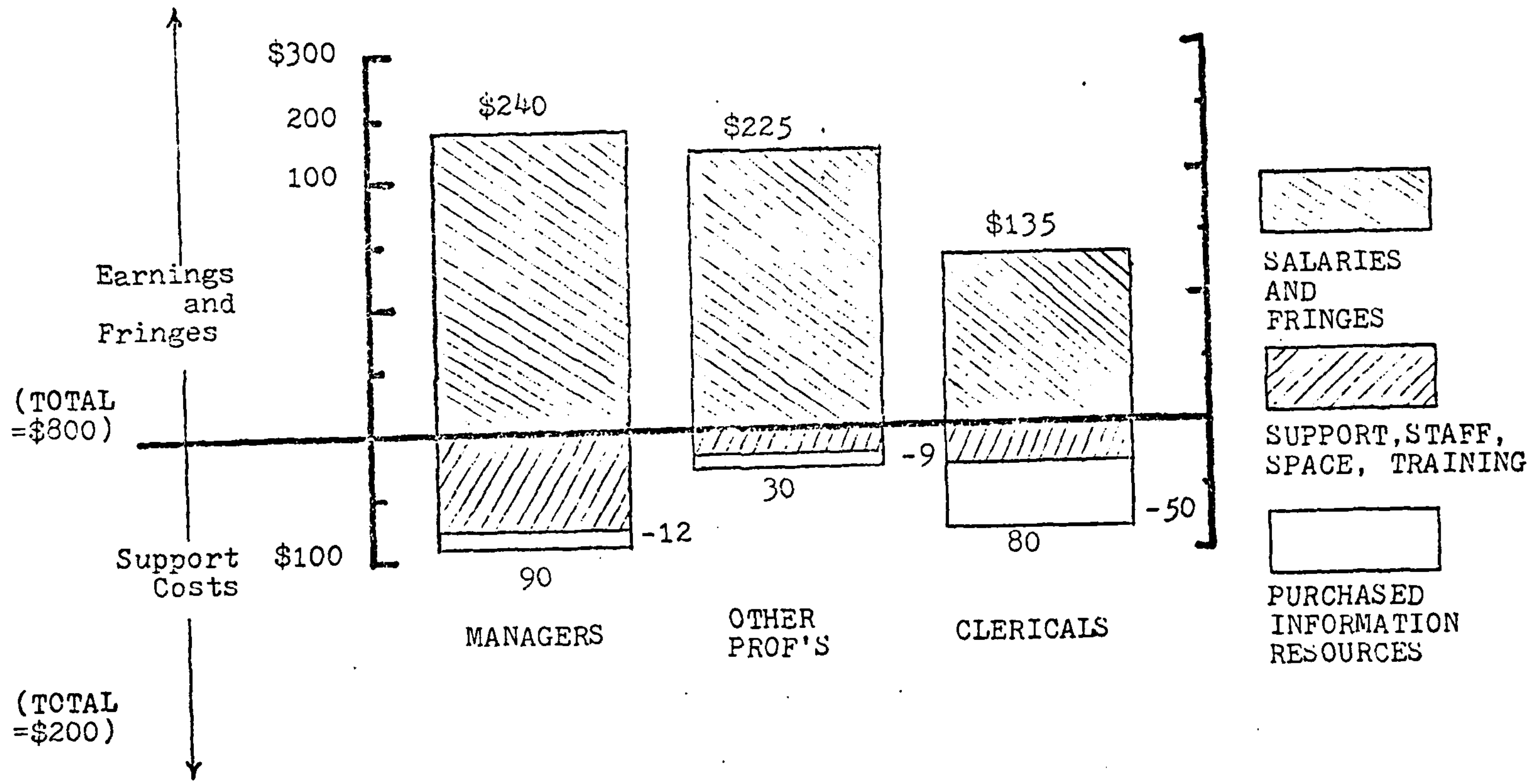

Figure 4-8. 1979 U.S. Business Expenditures For Their Office-Based Human Resources (In Billions)

Source: Morris Edwards, "Automated Office Adds Muscle to White Collar Productivity Drive," Communication News 16 (May 1979):70B, Figure 1.

TABLE 4-3

IMPACT OF AUTOMATED OFFICE APPLICATION ON MANAGERIAL PRODUCTIVITY

	FACE-TO FACE (35-45%)	FACE-TO RECORD (25-30%)	IN TRANSIT (5-10%)	TELEPHONE (5-15%)
ELECTRONIC CORRESPONDENCE	Light	Light	Moderate	Moderate
TELECONFERENCES	Moderate	Moderate	Moderate	Light
INFORMATION RETRIEVAL	Light	Light		Light
EXPEDITE LIST	Moderate	Moderate		Moderate
CALENDAR	Light		Light	Moderate
SPEECH MAIL		Moderate		Heavy

LIGHT ○ MODERATE ⊖ HEAVY ●

Source: Morris Edwards, "Automated Office Adds Muscle to White Collar Productivity Drive," Communications News 16 (May 1979):70K, 71., Figures 2 & 3.

Note: The percentages in parenthesis reflect the typical distribution of a manager's time.

miniature communication centers. However, the telephone has been unable to accommodate the majority of office communications in a time-responsive manner.

Looking upon the office as a communications center, one can see the reasons for integrating information technologies to the benefit of the end user--the office with its managerial core. Slutzky[51] notes:

> Our perception of the office then is one of a communications factory. Someone is generating information, equipment is storing information and someone is requesting and using the information.
>
> And if we think of today's office as a communications center, then the next step, The Office of the Future, should integrate these communication functions: *an office that generates information efficiently, stores information economically and transmits information to the user quickly.*

As a result, the integration of information technologies not only will reduce costs and improve productivity, but it will also improve communications.

How will the individual communications center be interfaced into the emerging integrated information system? Table 4-4 catalogues a variety of interface media which are in use today. In the opinion of many, ". . . the word processing systems, the computer system and the communications system may combine to form the integrated information system of the near future. . . ."[52] Because word processing systems are expected to play such a pivotal role in both the integrated information system and in improving office productivity,[53] it will be discussed as a case-in-point for integrated information systems.

TABLE 4-4

INTERFACE MEDIA FOR INTEGRATED INFORMATION SYSTEMS

*Voice Response	*Teletype Devices
*Speech Recognition	*Remote Batch Terminals
*Badge Readers	*Computer Output Microfilm (COM)
*Bar Code Readers	*Optical Character Recognition (OCR)
*Graphics	*Magnetic Ink Character Recognition
*Hand-held Terminals	*Portable, Acoustic Coupled Terminals
*Keyboard Video Terminals	*Point-of-Sale Terminals
*Keyboardless Video Terminals	
*Word Processors	

Source: George Champine, Computer Technology Impact on Management (New York: North Holland Publishing Company, 1978), pp. 101,102. Champine states that all of these interfaces are in use today, and are expected to be more important in the future.

Word Processors

Business is expecting many benefits to be derived from word-processing systems. The interconnection of word-processing systems through communications systems such as electronic PBXs is expected to speed up the transfer of textual material (memoranda, letters, contracts, etc.) from days to seconds.[54] According to Champine,[55] the following problems would be solved if a CRT-based word-processing system/Management Information System were integrated with a digital communication system:

* Memo/Letter Generation--The CRT allows fast generation, error correction, and recall of previously stored information.

* Mailing--The conventional mailing system would be replaced by sending text information over a digital communications system to an "electronic mail box" (local mass storage) for each addressee. This would be much cheaper and would eliminate the current several day time lag in mailing systems. Already, facsimile transmission is only half as expensive as sending a page of information via the U.S. Postal Service.

* Filing--A memo/letter can be filed in mass storage under several identifiers (e.g., data, topic, or customer) and then accessed by conventional data retrieval methods, thus eliminating the time, expense, and bulk of conventional filing cabinet storage.

* Forms--Rather than having preprinted paper forms, the form will be held in digital form in mass storage to be called up on the CRT screen as required and the blanks filled in.

* MIS Interface--Word-processing interfaces are a simple, natural way to access conventional data-base systems to obtain, for example, marketing reports, inventory data, shipping data, or financial summaries of various kinds.

The ability for information users to input, output, and use data/information stored anywhere in the corporate communication system, regardless of his geographic location, is the primary advantage of such an integrated information system (Figure 4-9). With the introduction of digital telephones and the potential for up to twenty million desk-top terminals in business, integrated-information systems are already becoming a reality in some cases.

The real test of Champine's prognosis is to see to what extent word processing has been implemented in business. Over 150,000 companies used word-processing systems in 1978, and the rate at which they are being acquired is indicative of word-processing's acceptance/key role within the business community.[56] Figure 4-10 depicts the projected United States shipments of word-processing (WP) systems through 1982. If this projection proves

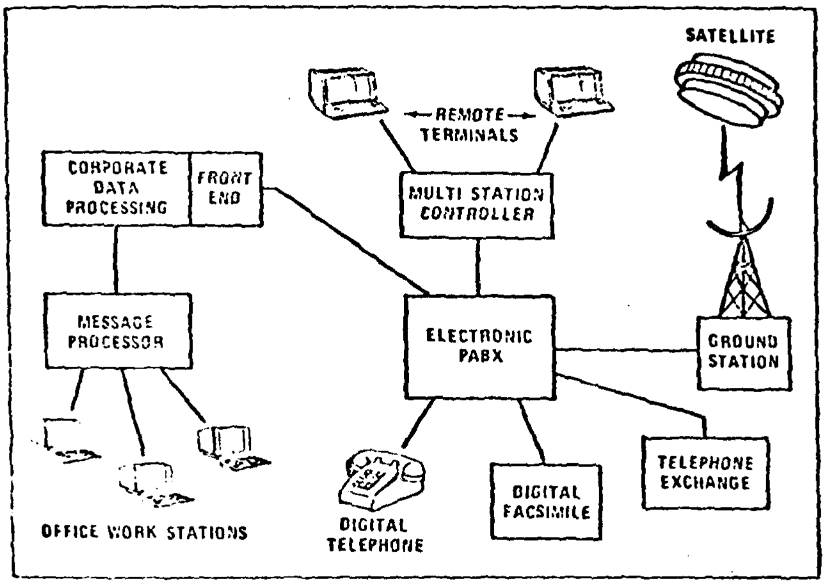

Figure 4-9. Electronic Office System Design

Source: George Champine, Computer Technology Impact on Management (New York: North Holland Publishing Company, 1978), p. 117, Figure 6-3.

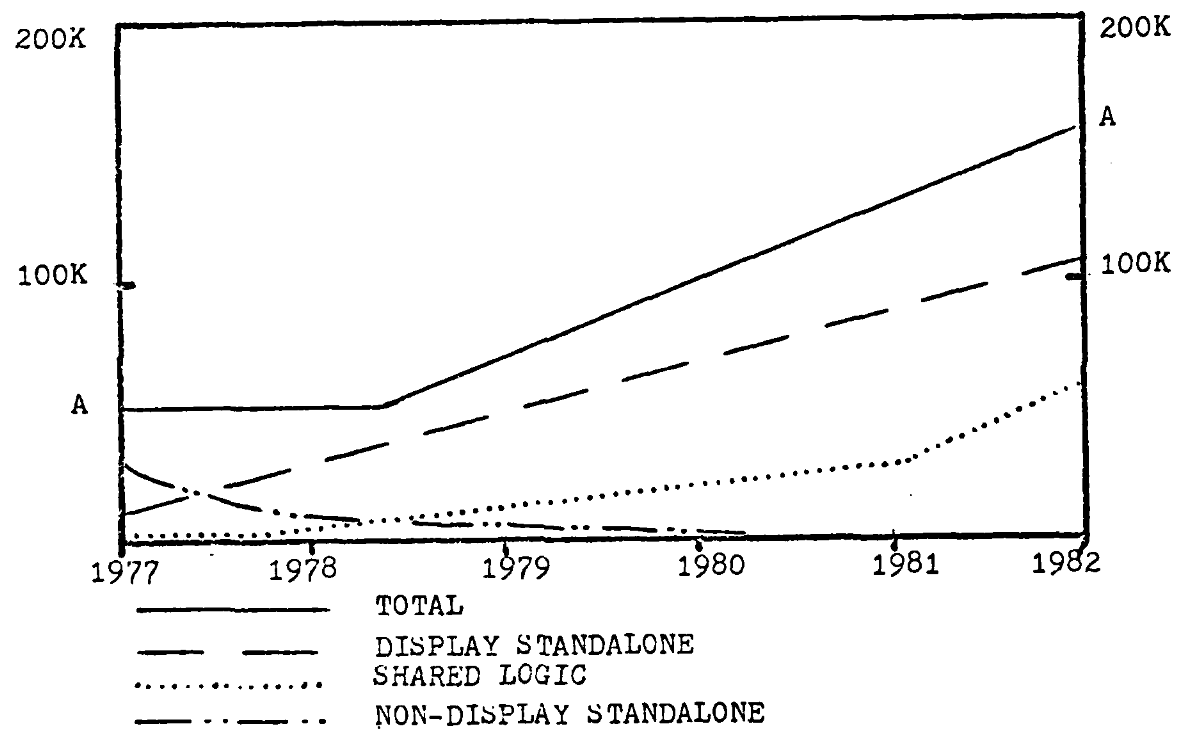

Figure 4-10. U.S. Shipments of Word-Processing Stations

Source: James Peacock, "Business Communications: The New Frontier," <u>Fortune</u> (October 9, 1978):60.

correct, shipments alone will more than triple within six years (1977-1982). The role of standalone WP systems (which are incapable of communicating station to station or to computers) will become very slight, while shared logic systems (which have a minicomputer capable of handling communications) and the display standalones (some of which are capable of handling communications) will dominate the future market. The comments of Richard O'Bailey,[57] president of Lexitron Corporation, are prophetic:

> A typical one-page letter requires less than 20,000 bits when transmitted by a word processor, as compared to some 800,000 bits when sent by a facsimile set. Over a voice-grade line, a letter can be transmitted in one-sixth of a minute versus four to six minutes for facsimile.
>
> With the debut of new private networks from SBS [Satellite Business Systems] and AT&T, electronic mail will receive a real shot in the arm. Digital communications costs are expected to drop by over 50% over the next few years, and there will be adequate capacity to handle a huge increase in electronic mail. And with as much as 80% of business correspondence eligible for electronic formatting, the outlook for communicating word processing systems is bright indeed.

One particularly intriguing application for corporations is the potential of electronic mail. In the previous chapter it was observed that the business community spent $1.766 billion in 1956 and $2.048 billion in 1958 for postage paid as a business expense. Those figures do not include the cost of preparing those letters, but still reflect the high cost of mail to business.

Statistics show that business-to-business mail comprises 25.8 percent of the U.S. mail (Table 4-5). A large portion of this will be eligible for electronic mail applications as integrated-information systems become more widespread. If anything, the opportunity to use the word-processing/computer/communications alliance to save

TABLE 4-5

BUSINESS-TO-BUSINESS MAIL

	% U.S. Mail	% B to B Mail
To Suppliers*	3.9	15.1
Intracompany*	1.4	5.4
To Stockholders	0.7	2.7
To Customers*		
Order Acknowledgements*	0.2	0.7
Bills*	6.7	26.0
Product Distribution	1.3	5.0
Promotional Materials	5.4	20.9
Other*	6.2	24.0
Total	25.8%	99.8%

Source: James Martin, The Wired Society (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1978), p. 109.

Note: Figures taken from source's Figure 4-2.
*Applications considered potential electronic mail candidates.

mail costs may, in part, pay for the additional communication capabilities mentioned by Champine. The benefits to be derived from electronic mail correlate directly to the number of corporations which implement the process. In an average company where electronic mail is implemented, the United States mail bill might be reduced by 5.4 percent as intracompany mail is eliminated. As customers and suppliers implement electronic mail (assuming 50 percent penetration), savings in United States mail might approach

30-35 percent by using those areas considered potential electronic mail candidates.

Just how seriously are companies considering using electronic mail? According to one source, virtually every one of the fifty largest companies was engaged in 1978 in the formulation or implementation of some form of electronic mail[58] (see also Appendix B, responses to Questions 12 and 13). The motivation for using electronic mail, especially in large industries, is graphically revealed by mail costs in the banking industry. The American Bankers Association has compiled the following data:

* The United States Postal Service obtains almost ten percent of its revenues from first class mail from the nation's banks.

* A typical large bank with $500 million or more in deposits spends approximately $2 million per year on postage.[59]

Transportation Alternatives

Information technologies based upon computer-communications not only offer economical alternatives to traditional office "communications centers" and the United States mail, but also a suitable alternative to executive travel in many business instances. Both teleconferencing and video conferencing offer viable alternatives to rising travel expenses, which are caused, in part, by inflation, and also by rising energy costs associated with the rapid depletion of economical energy resources.

The Diebold Research Program in 1976 conducted a cost comparison of communications conferencing and travel costs for executive meetings. The results are quite astounding (Table 4-6).

While the figures for 1977 were projections, they reveal a tremendous cost savings when conferencing is used as an alternative to travel.

TABLE 4-6

AVERAGE RATIOS FOR TRAVEL COSTS/COMMUNICATIONS COSTS

Method of Conferencing	1975	1977
Computer Conferencing		
Commercial time-sharing	2/1	3/1
Minicomputer packet switching	11/1	17/1
Voice Teleconferencing		
Voice-grade lines	2/1	3/1
Specialized carriers	-	4/1
Visual Teleconferencing		
2-person conference	1.1/1	1.2/1
6-person conference	2.1/1	3.2/1

Source: Joseph Ferreira and Jack M. Niles, "Five-Year Planning For Data Communications," Datamation 22 (October 1976), p. 51, Table 1.

Note: The various forms of conferencing already show cost advantages compared to the costs of executive travel. The ratios above assume very good conditions for travel, including: perfectly suitable air schedules, only major city access, and good weather. Costs computed include: air fare, ground transportation, meals, lodging, and executive salaries (figured both at $10 and $20 per hour). The visual teleconferencing costs were figured for a Chicago-New York-Washington loop.

James Martin[60] observed in The Wired Society that telecommunications is a viable substitute for some types of travel, and that the result could be great savings both financially and from a human-time perspective.

> Not only is the total cost of typing and filing memos greater than the telephone bill in most corporations, but the total cost of business travel is also greater--and the cost is rising. Some large corporations spend more than $100 million per year on business travel within the United States. This cost does not include the time of the person traveling or the effects of wear and tear on them, which for some executives are considerable.

The communications alternative to travel seems to be an area where many corporations could reap great economic benefits. Video-conferencing is a good example. It has always been mentioned as a viable business application. To test its potential, Satellite Business Systems conducted video-conferencing experiments with Montgomery Ward, Texaco, and Rockwell International. The experiments were code named, perhaps prophetically, Project Prelude.[61] Subsequent market research/public education efforts produced some interesting findings:

* Seventy-four percent of those surveyed (over 1,500 middle, line, and top managers) said video-conferencing was better than travel.

* The ability to make decisions quicker was a greater incentive than cutting travel costs or lost executive time.

* The use of freeze-frame video (one picture every several seconds) was acceptable to one-third and would preclude video-conferencing for only seven percent.

* Fifteen percent of the respondents, given the chance, would move immediately toward video-conferencing.[62]

Two significant conclusions can be drawn from the results of the SBS market research. First, the quality of the information was more important than reduced costs as an incentive to use video conferencing. This tells us that corporations/managers will not accept less than adequate information flow and accessibility in an attempt to cut communications or travel costs. Second, reducing travel costs through use of communications is dependent upon information technologies giving managers a suitable equivalent to the face-to-face communications derived from travel.

Summary

The various information systems used by business have become inextricably intertwined since the mid-1960s. Just as the confluence of computers and communications created a regulatory dilemma for the FCC in determining where data processing stopped and communications began, so now the distinction between the office, mail, data- and voice-communications networks of corporations is becoming more and more a semantic, rather than a functional, distinction. Computers and telecommunications have emerged as the backbone of a new information system which is a synthesis of the many information systems discussed. Three major computer-communication offerings are indicative of this trend: ACS, SBS (Satellite Business Systems), and XTEN (Xerox Telecommunication Network). While ACS is designed to make dissimilar computers and terminals compatible, the SBS and XTEN offerings actually integrate data, test, message, and image communications in a single package.

The factors forcing integration are many. Increased use of computers and telecommunications is counterbalanced by a desire to hold down or reduce communication costs (both voice and data). Static productivity in the office environment (the mini-communications center), rising labor costs, and inefficient information-handling processes in the office have given rise to new information technologies based on computers and communications.

Most significant of the factors forcing integration, however, is the opening-up of information resources to the wide realm of corporate management, and/or expediting the transfer of information. The drive toward compatibility between independent data networks, automation of office file systems, increasing use of communicating word processors, user stress in the video-conferencing experiments upon the ability to make rapid decisions, etc., are testimony to the management concerns for opening-up information resources.

Early in this chapter it was stated that identification of a predominant technology should make it possible to develop management approaches for handling the integrated-information systems of the future. It becomes apparent that, in fact, there is no single predominant technology in the integrated-information system. Rather, there is a blurring of technologies. This suggests that *integrated management* is the key to successful exploitation of information-system technologies. Lack of integrated management, according to Hosage,[63] ". . . results in higher operating costs, communications breakdowns and a general loss of managerial control." Hosage continues:

> To increase productivity in the office, professional managers must attack the areas with the greatest payoff. Primary among these are the non-integrated functions in the business data processing and business telecommunications areas. The convergence of these two functions will result in cost efficiencies and a very significant increase in managerial control. The technology to affect this merger exists today.

The technology does exist as we have seen. Whether management elects to exercise this approach, and how it is exercised, may well affect the future corporate position of integrated information systems.

CHAPTER IV

FOOTNOTES

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[63]Hosage, p. 80.

CHAPTER V

MANAGEMENT IMPLICATIONS

The preceding chapters have shown the increasing reliance of business on information systems, the evolution of those systems, and the increasing blurring of distinctions between the various technological entities that comprise an integrated-information system. One of the best examples of the blurring of distinctions is the communicating word processor (CWP). Michael E. Dortch,[1] Manager of Information Technologies for The Yankee Group, predicts that CWP's will evolve into "Communicating Multi-function Terminals" which will have the ability to act as communications terminals with each other and with central computers. They will have the capability for document distribution, data entry/ retrieval, optical character recognition, off-line programming, and information processing. When this happens, it will be even more difficult to draw the line between the office, communications, and data-processing systems. As another member of The Yankee Group said:

> . . . if the driving force of technology continues tomorrow as it has in the past, we will undoubtedly see more, rather than less, of an overlap between computers and communications . . . .[2]

The purpose of this chapter will be to investigate the impact of integrated-information systems on organizational management, and conversely, the impact of organizational management on integrated-information systems. It will be seen that a coordinated and cooperative approach to managing-information systems *is essential* to exploit their full potential. We call this approach Integrated-Information Systems Management (I^2SM).

<u>Integrated-Information Systems And Organizational Management</u>

Before a discussion of the impact of integrated-information systems on organizational management can become meaningful the two entities must be defined. The first, integrated-information systems, has been defined in preceding chapters by a description of the various elements and the interdependence and convergence of their technologies and applications. The second, organizational management, is much more difficult to define. Libraries are full of books, periodicals, reports, and dissertations which attempt to define this term. It has been called an art, a science, a process, etc. A comprehensive definition will not, therefore, be attempted here. It is more useful for present purposes to examine the impact of integrated-information systems in terms of what managers do. Harold Koontz and Cyril O'Donnell[3] propose five basic functions of managers.

* Planning: A decision-making process which involves ". . . selecting objectives--and the strategies, policies, programs, and procedures for achieving them--either for the entire enterprise or for any organized past thereof. . . ." All managers plan, or should, and planning, or the lack of it, is crucial to the outcome of any undertaking.

* Organizing: A process of establishing a structure to achieve goals as set forth in the planning process. Authority relationships are created, activities grouped under managers, and communications/informational routes are set. ". . . The organization structure must fit the task--not vice versa. . . ," and must also ". . . reflect the environment of the enterprise."

* Staffing: The personnel function of manning the structure. It involves the activities of hiring and firing, appraising, compensating, and personnel development.

* Directing and Leading: The method will vary from manager to manager, but the objectives of this function remain: orientation, guidance, and encouragement for subordinates.

*Controlling: Evaluating and acting on the activities and performance of subordinates. Koontz and O'Donnell's definition is negativistic, assuming correction as the sole action. However, it is entirely possible to control by positive action such as evaluating why a particular activity was accomplished better than expected and taking action to insure recurrence.

Of these five, only the function of Directing and Leading has not been regarded as fertile area for direct augmentation by information technology. In his chapter, "Computer Implications for Management," Sanders[4] completely ignores this function. From the narrow viewpoint of computer technology, he was probably correct in doing so since directing and leading is, in its essence, a human relations activity. In the broader context of integrated-information systems, however, increased information flow will have an effect even on this function.

It is important to recognize two facets of managing which are essential for its success: decision making, which is central to all five functions; and control, which while identified as a separate function, has important implications for all. The remainder of this section will focus on these two facets.

Chapter II discussed the relationship between information and decision making. In essence, it was stated that decisions become better as more pertinent information is available. Sanders[5] writes:

> . . . quality information can support good decisions; good decisions should lead to effective performance of managerial functions; and effective functional performance should lead to the attainment of organizational goals. It is not surprising, therefore, that the aquisition and use of a computer (or any tool that promises to dramatically improve the quality of information) may have important managerial implications.

Information systems alone do not make decisions. They may respond to a certain type of input in such a way as to *appear* to have made a decision, but that response was programmed based on judgmental decisions made by people. Walter Buckingham[6] stated in 1961 that decisions based on judgment would never be possible with ". . . a mere machine. . . ." In light of attempts to improve computer ability to solve ill-structured problems and to develop so-called artificial intelligence, the platitude "never say never" should be a *caveat* worth remembering. For the forseeable future, however, judgments will, in all probability, remain within the realm of the manager.

The importance of information systems in the decision-making process, according to Sanders,[7] lies in four basic areas:

* Enabling management to become aware of problems and opportunities faster by quickly signalling out-of-control situations; providing methods to analyze historical data, trends, and correlations; and by providing inquiry/reply techniques to insure rapid availability of needed information.

* Freeing the manager from time-consuming information gathering tasks and permitting more time to be devoted to the "analytical and intellectual" aspects of planning and decision making.

* Assisting in various decision-implementing activities such as project scheduling and development of subordinate plans.

* Enabling the manager to devote more time to evaluate complex relationships between alternatives such as the political, sociological, and economic impacts of varying courses of action.

The first three of these areas have been the predominant focus of information systems in the past. The fourth area, however, is of such significance that it bears closer scrutiny.

Writing in 1970, Joel E. Ross[8] suggested that ". . . *automatizing* or *programming* decisions. . ." is a development of ". . . extraordinary importance. . .:"

> . . . If decisions can be made based upon a policy, a procedure, or a rule, they are likely to be made better and with more economy. Moreover, if the decision rule can be programmed for computer application, the potential exists for faster, more accurate, and more economical operations. . . .

Figure 5-1 shows four types of decisions and their relationship to automation as proposed by Ross. The impact of integrated information systems will be to shift the boundaries of automation farther

TYPE I	TYPE II	TYPE III	TYPE IV
PROGRAMMED (Automatic)	SEMI-AUTOMATIC (Policy)	JUDGMENT, ETC.	UNEXPLORED
Payroll	Inventory Levels	New Products	Political and Economic Premises
Accounts Payable	Pricing	Plant Size	Major Objectives
Shipping	Personnel Actions	Capital Budget	Foreign Expansion
Purchasing	Etc.	Union Contracts	Etc.
Etc.		Etc.	

Figure 5-1. Boundaries of Management Decisions

Source: Joel E. Ross, Management By Information System (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1970), p. 17, Figure 1-5.

to the right:

> . . . As the boundaries of each category of decision making are moved to the right and as more and more decisions lend themselves to programmed rules, the manager will have more time and opportunity to concern himself with the more difficult and demanding decisions of Types III and IV and expand his managerial horizons through the use of information systems.[9]

An outstanding example of the work now being done to push the boundaries to the right, and, in effect, moving computers into areas traditionally thought to be unsuited for automation due to the qualitative nature of the data, is that of the Department of Defense (DOD) in the area of crisis forecasting. Currently under development is a ". . . computer-based, fully automated system for monitoring and evaluating international information and events . . . ."[10] Responsibility for crisis assessment is currently spread over many agencies including the ". . . Defense Intelligence Agency, the Office of the Assistant Secretary of Defense for International Security Affairs, the Central Intelligence Agency, the National Security Agency, the many US military commands, and other offices and agencies. . . ."[11] The methods now used involve a great deal of tedious review of all sorts of information from sources ranging from newspapers and wire services to classified intelligence activities. It is a highly judgmental process involving manual information processing and relies primarily upon military factors, rather than socio-political and economic developments. Additionally, the data analyzed is predominantly qualitative. During the thirty-year period from 1946-1976, the successful forecasting rate was a mere 54 percent.[12] To improve this rather dim picture, the DOD's computerized system has been developed around *three parts: quantitative political indicators*, a *monitoring and* short-range quantitative statistical forecasting element, and a computer data base.

Decade-long research has produced a recognition of sixty-three ". . . distinct kinds of international political events . . ." which have been grouped into twenty-two categories (Table 5-1). A number of data-base groups have been generated including a 110,000 event file compiled from the New York Times. This file includes:

> . . . information on who did what to whom, i.e., what country projected (sent) what kind of action to which other country. An event thus consists of an initiator, a type, a target or recipient, and a calendar date. All of these coding elements have numeric equivalents and are stored digitally on computer tape or disc.[13]

From this data base, *quantitative* indicators of political behavior have been developed which include: the total of all events exchanged by a pair of countries, the total of all cooperative or adversary events exchanged, political tension, and political uncertainty. The data base serves as a measurement for current developments upon which the monitoring and short-range forecasting element can draw.

Utilizing the data base, this second element is able to project the probability of a crisis developing between any two pairs of countries.

The computer base itself is currently contained in a PDP 11/70 mini-computer accessible through graphic display terminals. Hard-copy outputs of anything appearing on the display unit are available. The system also has a keyword search capability to

TABLE 5-1

CODING SCHEME FOR WORLD EVENT INTERACTION SURVEY DATA

1. YIELD
   - 011 Surrender, yield to order, submit to arrest, etc.
   - 012 Yield position; retreat; evacuate
   - 013 Admit wrongdoing; retract statement
2. COMMENT
   - 021 Explicit decline to comment
   - 022 Comment on situation-pessimistic
   - 023 Comment on situation-neutral
   - 024 Comment on situation-optimistic
   - 025 Explain policy or future position
3. CONSULT
   - 031 Meet with; at a neutral site; or send note
   - 032 Visit; go to
   - 033 Receive visit; host
4. APPROVE
   - 041 Praise, hail, applaud, condolences
   - 042 Endorse other policy or position; give verbal support
5. PROMISE
   - 051 Promise own policy support
   - 052 Promise material support
   - 053 Promise other future support
   - 054 Assure; reassure
6. GRANT
   - 061 Express regret; apologize
   - 062 Give state invitation
   - 063 Grant asylum
   - 064 Grant privilege, diplomatic recognition, de facto relations, etc
   - 065 Suspend negative sanctions, truce
   - 066 Release and/or return persons or property
7. REWARD
   - 071 Extend economic aid
   - 072 Extend military assistance
   - 073 Give other assistance
8. AGREE
   - 081 Make substantive agreement
   - 082 Agree to future action or procedure; agree to meet, to negotiate
9. REQUEST
   - 091 Ask for information
   - 092 Ask for policy assistance
   - 093 Ask for material assistance
   - 094 Request action; call for
   - 095 Entreat; plead, appeal to
10. PROPOSE
    - 101 Offer proposal
    - 102 Urge or suggest action or policy
11. REJECT
    - 111 Turn down proposal; reject protest demand, threat, etc.
    - 112 Refuse; oppose, refuse to allow
12. ACCUSE
    - 121 Charge, criticize; blame; disapprove
    - 122 Denounce; denigrate; abuse
13. PROTEST
    - 131 Make complaint (not formal)
    - 132 Formal complaint or protest
14. DENY
    - 141 Deny an accusation
    - 142 Deny an attributed policy, action, role, or position
15. DEMAND
    - 150 Issue order or command, insist; demand compliance, etc.
16. WARN
    - 160 Give warning
17. THREATEN
    - 171 Threat without specific negative sanctions
    - 172 Threat with specific negative sanctions
    - 173 Threat with force specified
    - 174 Ultimatum; threat with time limit and negative sanctions specified
18. DEMONSTRATE
    - 181 Nonmilitary demonstration; walk out on
    - 182 Armed force mobilization, exercise and/or display
19. REDUCE RELATIONSHIP
    - 191 Cancel or postpone event
    - 192 Reduce routine international activity; recall officials, etc.
    - 194 Halt negotiations
    - 195 Break diplomatic relations
20. EXPEL
    - 201 Order personnel out of country
    - 202 Expel organization or group
21. SEIZE
    - 211 Seize position or possessions
    - 212 Detain or arrest person(s)
22. FORCE
    - 221 Noninjury destructive act
    - 222 Nonmilitary injury/destruction
    - 223 Military engagement

Source: Steven J. Andriole and Judith Ayers Daly, "Computerized Crisis Forecasting," _Air Force_ 62 (July 1979):89, Figure 1.

allow retrieval of texts containing any combination of key words. Future enhancements will allow integration with military assessment systems and will automate even further (presently, it only responds to direct queries from the user).[14]

As sophisticated as this system is, it does not, and should not, replace human judgment. Yet, it provides necessary information rapidly, concisely, and in near real-time to allow more effective decision making.

The ability to enhance managerial control is another major impact area for integrated-information systmes. Thomas L. Whisler[15] states that ". . . [i]nformation technology is linked with organizational control . . . writers assert that its basic contribution to organized activity is the increased effectiveness of control it makes possible. . . ." Concepts of information technology have concentrated on the ability of the computer to provide managers with more effective tools to control things such as inventories, budgets, and the like. With the integrated-information systems now available, however, it is possible to increase control even further. Harold J. Leavitt, writing with Whisler,[16] published an article in 1958 which has since been often quoted. In the article, they predicted,

> . . . that large industrial organizations will recentralize, that top managers will take an even larger proportion of the innovating, planning, and other 'creative' functions than they have now.

In 1970, Whisler defended this prediction, saying that "[e]vidence to date seems still to support our centralization thesis. . . ."[17] In the areas of telecommunications and data processing, our own research bears this out. We questioned

99 companies selected from Standard and Poor's "500" price index. Of forty-two responding, long-range planning for total system requirements was centrally managed at the corporate level in thirty-four cases for telecommunications and in thirty-one cases for data processing (see Appendix B). Of these, operational management was decentralized in only fifteen cases for telecommunications and sixteen for data processing.

For the twenty years preceding the publication of Leavitt and Whisler's article, it had been ". . . argued that decentralization was necessary for good management. . . ."[18] In order to understand the reason for the move back to more centralized control, it is important to understand the reasons for the initial decentralization.

Gilbert Burck[19] discusses the primary reasons:

> . . . As companies grew larger and more complex or more diversified, one man or a small group was no longer able to run them directly. So top managers broke down their organizations functionally, and delegated authority to divisional managers, who were often assigned divisional profit goals. . . .

He continues by discussing the example of General Motors which decentralized so successfully that it has functioned ". . . almost as smoothly as a small homogenous company. . . ." Burck argues that what is really meant by this statement is that,

> . . . the ideal administrative setup is provided by the small tight company, in which one man knows everything that is going on and can make decisions without cutting red tape, when and as he thinks best. . . .[20]

Since Burck wrote, the marriage of telecommunications and data processing has been all but consummated from a technological standpoint. The vast potential of integrated-information systems now provides the capability for significantly increased span of control and a more centralized organizational structure. Howard Anderson,[21] president of The Yankee Group, reports that Citibank, through the use of electronics, expects to be able to increase executive span of control from the present seven-to-one to as high as nine-to-one. He asserts that this capability, not ". . . savings in secretarial time, paper, filing costs, telephone expenses, or even increased productivity . . .", is the *best* argument for integrated-information systems. In the case of Citibank, if span of control can be increased as high as nine-to-one, the savings in additional executive salaries and related costs would be as much as $150 million over a six-year growth period.[22] The point is that these kinds of savings *are in fact* new profits for the company.

It must be recognized that the same features of integrated-information systems that make recentralization possible, also facilitate the decentralization of an enterprise. Managers subordinate to corporate headquarters will have all the required information they need to make decisions involving their activity, regardless of its physical or geographical location within the company. Buckingham,[23] discussing the effects of information systems on organizational structure, wrote:

> . . . The growing rationalization of decision making and the narrowing of alternatives should tend to cause different persons with the same qualifications and facts to make the same decision. This would permit greater delegation of decision-making responsibility and decentralization of management, since one of the main factors preventing delegation is lack of assurance that sound decisions will be made by subordinates. Delegation is possible only where responsible officials are confident that subordinates will be likely to make the same decisions they themselves would make in the same situation.

Top management must re-examine their corporate structure in light of integrated-information systems. A whole new philosophy of management may develop. Organizational structure may, in fact, move from an essential bureaucracy to more of an "ad-hocracy," with project teams established and disbanded as necessary, team members changing as required, and the entire process much more fluid than the line and staff arrangements now extant. Figure 5-2 shows possible changes in structure as more information technology is incorporated into the management process (stage I, lowest use, mainly written; stage IV, extensive use). The idea of a fluid structure, however, necessitates more effective control mechanisms by top management. In effect, a broader span of control is essential to keep the reins as taut as required. The integrated-information system provides the means to centralize or decentralize by enabling the manager to control and guide individual activities toward achievement of organizational goals.

Organizational Management and Integrated-Information Systems

There is very little consistency today in the management of integrated-information systems. This inconsistency cuts across both industrial and governmental sectors. Although our research showed that only slightly less than one-half of the corporations responding to our questions have a common manager for telecommunications and data processing, the remainder had varying management schemes from no telecommunications department to telecommunications at a higher level than data processing (Appendix B). Only one, however, had no corporate level data-processing department. Even

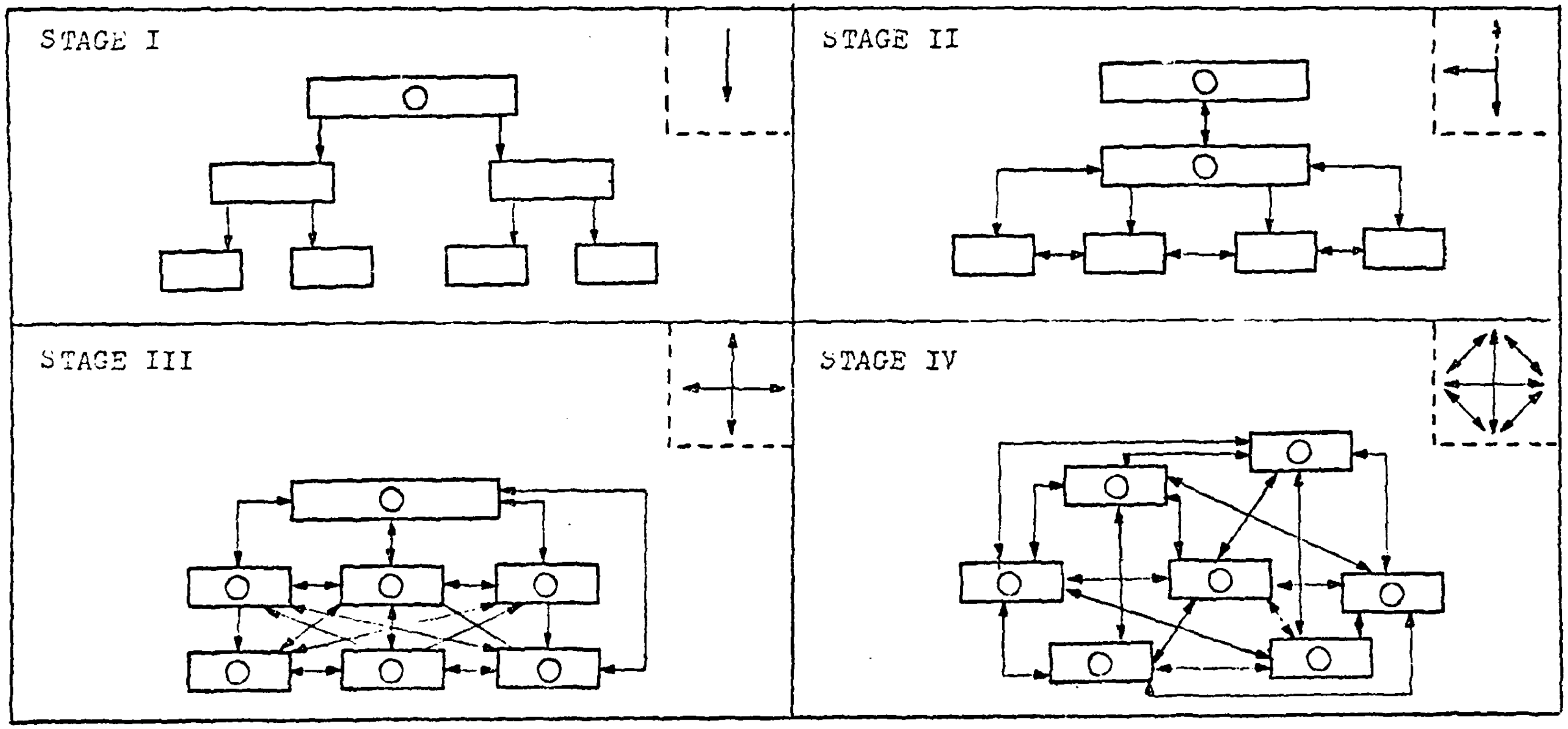


Figure 5-2. Effects of Information Technology on Corporate Structure

Source: John McHale, "The Changing Information Environment: A Selected Topography," in Information Technology: Some Critical Implications for Decision Makers (New York: The Conference Board, 1972), p. 210.

Note: Circles show major decision centers, inserts show information flow.

among those respondents with common management, isolation from the Chief Executive Officer (CEO) ranged from one level to as many as six levels below. For some others, the CEO *was* the common manager. Interestingly, this variance in structures had absolutely no correlation with the types of corporation involved. Stock brokerage firms were as different from each other and other financial institutions as they were from hotel chains and heavy equipment manufacturers.

Within government there is also a disparity in management of telecommunications and data processing. The General Services Administration, for example, has a commissioner for Automated Data and Telecommunications Services, while the Department of the Air Force manages data processing under the Comptroller, at Headquarters U.S. Air Force, and telecommunications is under a major air command (Air Force Communications Service).

Corporations today spend nearly the same amounts of money for data processing and communications, not including salaries, but telecommunications managers typically find themselves with only one-tenth the number of professionals available to the data-processing manager.[24] Part of this problem is historical. It was not until about ten years ago that the telecommunications manager had choices in employable technologies and services other than those available from the phone company (telco). In 1968 the FCC ruled that equipment other than that provided by the telco could be attached to the phone system provided there were adequate protective arrangements to isolate any spurious power surges from damaging the system. This was the now famous "Carterfone" decision. Since that time an arrangement similar to type-acceptance has all but eliminated the need for the protective devices and the so-called interconnect market has flourished. The telecommunications manager is now in a position to choose that overall system which best meets the needs of his organization.

Progress has been slow, however, in upgrading the position and responsibilities of the telecommunications manager. One of the reasons most often cited is that telecommunications is considered by top management as an expense--an unavoidable overhead--and the result is a focus on cost control rather than profit improvement.[25] As noted earlier, however, Citibank's imaginative use of integrated-information systems in which telecommunications plays a key role is expected to generate millions in savings, money which would have been overhead but instead will become profits. Buckingham[26] wrote in 1961 concerning computer automation: ". . . Lethargy, traditional thinking, and lack of information are more important deterrents to installation of automation than technological or economic barriers. . . ."

A specific example of lethargy and traditional thinking acting as deterrents to the application of information systems, despite its potential for saving costs, is the problem of the transportation-telecommunications tradeoff.

Alfred E. Kahn and Charles A. Zielinski[27] wrote in 1976:

> The observation is by now commonplace that, as energy seems destined to become ever more costly and environmentally damaging, we must look forward to long-distance electronic communications progressively substituting for physical travel.

In our research, we asked if there was a stated corporate policy to use telecommunications, where possible, to replace travel. We also asked to what extent telecommunications *did* replace travel. The results are found in Appendix B. It can be seen that where there is no policy (the predominant case), there is a corresponding lack of such use. At the same time, where there is a stated policy, the use of telecommunications to replace travel is only slightly higher. Thus, despite the savings that could be derived, as shown in Chapter IV, these savings have not materialized.

The sociological impact of replacing face-to-face communications with long-distance electronic communications may be a factor in this problem and could be a fruitful area for further research. It is likely, however, that increased support, encouragement, and participation of top management in the imaginative application of information technologies would have a dramatic effect in areas such as the telecommunications-transportation tradeoff issue.

Nancy Foy[28] quotes Russell McFall, chairman of Western Union:

> . . . The concept of the information revolution hasn't helped much, . . . Companies fall into two classes: those who are standing and waiting for the revolution to come, and those who feel it's already here. . . .

In either case the point is clear. Top management either does not understand the concept of total integrated information systems, or does not grasp the importance of the concept to overall profitability . . . or both. Telecommunications is no longer something that only involves the telco. Each corporate entity either has, or is capable of having, its own telephone company with its own users and requirements. Many companies have recognized this fact and are doing something about it. Xerox, for example, integrated its voice telecommunications networks in 1978 into a single integrated network for corporate communications. They are currently working on integrating their twenty separate data-communications networks into a single system. Ultimately, the concepts used for this data network will be incorporated into their public switched data network (XTEN).[29] Within Xerox, the telecommunications department is regarded as a profit center, "customers" are free to shop elsewhere for their telecommunications needs, but the department strives to provide services at a cost at least 20 percent below that available on the open market.[30] The goal, of course, is to seek as low a cost as possible and yet provide services that will enhance the overall profitability of Xerox.

According to Bernard Overeynder,[31] Xerox's telecommunications manager, the data-processing people in charge of time-sharing were reluctant to give up data communications to the telecommunications function. Top management, however, recognized the logic of the move and the transfer took place. It is apparent that two forces were at work here: one was the credibility with top management the telecommunications department had established, and the other, a fear on the part of the data-processing people of "losing control" of their communications. This fear of losing control, or put another way, the propensity to "empire-protection" is not solely resident with data processing. There was a period during the mid-1970's when communications and data processing were controlled under one directorate at Headquarters, U.S. Air Force. However, the concept collapsed and management reverted to the structure described earlier, perhaps due to the fears of the Communications Service of "losing control" or of losing identity.[32]

Speculation as to which manager will prevail is rife in journals catering to telecommunications, data processing, administrative management, and other specialized groups. An article in Datamation contains this warning:

> . . . Dp [data processing] management will be joined, or eclipsed by: a corporate communications architect/administrator, an information inventory/resource manager, and a corporate teleprocessing/communications manager.[33]

Harry Newton[34] gives a similar warning to telecommunications managers:

> . . . Look at your EDP [electronic data processing] department. Follow what they're doing. You'd better--not only because many of them are going more 'communications', but also because they are eyeing *your* communications department as a likely takeover candidate. . . .

Paul Neuman[35] contends that the ". . . primary battle for control . . ." of telecommunications will involve the administrative, EDP, word processing, management information system, and the communications systems managers. As to the outcome of the struggle, ne references Dale Kutnick of The Yankee Group:

> . . . According to Dale Kutnick . . . the communications manager has the inside track. Kutnick believes that computers (hardware and software) will become a subset of the communication manager's responsibilities by 1980.

It is tempting to be philosophical and lament the argumentation and empire-protection mentality evidenced by these statements. It would be easy to wonder why there is conflict which ultimately hurts the progress of all parties, and why all parties involved do not cooperate and get on with the business of establishing fully integrated systems to the ultimate benefit of all.

Chris Argyris,[36] a noted management theorist, discussed the effects of organizational structure on individuals. One of his propositions has particular significance to the problem of conflict and empire-protection:

> *Proposition 4: The nature of the formal principals of organization cause the subordinates, at any given level, to experience competition, rivalry, intersubordinate hostility and to develop a focus toward the parts rather than the whole.*

Competition, of course, is good. It is the basis of our entire society. Competition forces the competitors to continually re-evaluate their actions and strategies in order to gain an upper hand and, in the end, to win. When competition between entities interferes with their common objective, however, it becomes destructive. When the competition involves a situation such as corporate telecommunications and data processing, which are so interdependent, it is, as Fenwicke Holmes[37] states, ". . . like running cattle and sheep on the same range. An inevitable conflict is foreseeable. . . ." He further states that ". . . [o]rganizations with built-in adversary relationships such as this should be neither created nor perpetuated. . . ." Neither telecommunications nor data processing operate in a vacuum. They are not ends in themselves, but rather provide essential services to management that facilitate accomplishment of organizational objectives.

The other force apparently at work in the Xerox example was defined as the credibility the telecommunications manager had established with top management. Unfortunately, this important factor is not often easy to obtain. It is further compounded by a lack of understanding on the part of top management of what is involved in the telecommunications business and a consequent lack of understanding of what is involved in integrated-information systems. From the standpoint of data communications, Nancy Foy[38] states:

> . . . The data communications manager ought to be a high-level executive who understands the flow of information throughout the organization; instead, in most companies, he is a telephone technician who has been elevated from his corner within the facilities group simply because he is the only one in the company able to talk to the "mysterious" people from the telephone company.

Others have blamed the telecommunications managers themselves for their lack of credibility, citing the fact that they are too technically oriented and do not understand the politics of making their successes known to management. As one put it: ". . . We have done a great job . . . of keeping management unaware!"[39] If this lack of corporate political "savvy" is a result of being too technically oriented, it is not corroborated by the results of our research into the educational/experience backgrounds of telecommunications and data-processing managers. Table 5-2 shows a comparison of these backgrounds. It will be seen that telecommunications managers have as broad, or broader, backgrounds than data-processing managers. If technical orientation is a detriment to credibility and/or visibility, it may not be a result of previous education or experience. More likely reasons may be traced to the cost control attitude of top management which results in telecommunications managers spending the majority of their time, due to lack of personnel resources, putting out brush fires rather than concentrating on long-range planning and dialogue with their superiors. Newton[40] states that the communications manager is

TABLE 5-2

EDUCATIONAL/EXPERIENCE BACKGROUNDS OF CORPORATE INFORMATION SYSTEMS MANAGERS

Background Category*	Telecommunications Manager	Data-Processing Manager
a**	16 (1)	11 (2)
b**	11 (2)	32 (11)
c**	28 (9)	5 (2)
d**	18 (3)	19 (3)
a + c + other	13	
a + b + other		8
c + d + other	13	
b + d + other		16
a + c + d + other	8	
a + b + d + other		4

Note: Table based on 42 respondents out of 99 questioned. Numbers shown are absolute, not percentages.

* a = engineering; b = data processing; c = telecommunications; d = business administration.

** Respondents with *only* these backgrounds are in parentheses.

caught in a circle:

> . . . With little senior management understanding, the communications manager cannot command the resources (bodies and dollars) he needs. Without these resources he can neither command the attention of senior management nor effectively manage his company's communications. Most important he cannot *measure* the results of his efforts and communicate his success to senior management.

It is also very possible that telecommunications managers are regarded as too technically oriented because that is the manner in which top management chooses to think of them. The example cited earlier characterizing the data-communications manager as a telephone technician promoted because he could understand the "mysterious" people from the telephone company is a-case-in-point. Such practices bespeak of tokenism, not to appease the telecommunications staff, but rather as an intimidation factor when dealing with the telco; the feeling being that better service will result from an executive-to-telco contact than from a technician-to-telco exchange. Beyond this function, the telecommunications manager may be nothing more than an adjunct to the accounting department.

If this be the case, it is truly unfortunate. Telecommunications and data processing are no longer confined to the technical and operational aspects of communications and computer services. In fact, managers of both functions are being forced to become intimately involved in the national and international political, social, and economic aspects of their respective services. The problems of transborder data flow, dealing with foreign ministries of Post, Telephone, and Telegraph, and privacy and security, among others, require both the data-processing and the telecommunications managers to become involved in the basic decision-making process at the highest levels of management. More and more, telecommunications is being characterized as an interdisciplinary field. The same characterization can be extended to the data-processing area. Perhaps more importantly, as the politico-socio-economic issues become more important and interrelated, the telecommunications and data-processing functions cannot afford to be segregated into distinct and separate categories.

It is essential not only that data-processing and telecommunications managers stop thinking of each other as adversaries, but also that top management recognize the need for a coordinated and fully cooperative management approach to these vital services.

The conclusion is clear. Both the data-processing and the telecommunications manager must be more than technicians or engineers. They must also be generalists. If either is unable to transcend his technical background and relate the total picture of integrated-information systems to top management in top managements' terms, then either the wrong man is filling that managerial position, or a new managerial structure must be established to integrate not only the technologies, but also the management of those technologies.

CHAPTER V

FOOTNOTES

[1] Michael E. Dortch, "Future Trends in Electronic Information Transfer," address delivered to the Telecommunications Seminar, University of Colorado at Boulder, April 16, 1979 (unpublished).

[2] Manley, R. Irwin, "The Future of Telecommunications: Competition and Computers," Computers and People, 25 (March 1976):16.

[3] Harold Koontz and Cyril O'Donnell, Management: A Systems and Contingency Analysis of Managerial Functions, 6th ed. (New York: McGraw-Hill Book Company, 1976), pp. 69-73.

[4] Donald H. Sanders, Computers and Management in a Changing Society, 2nd ed. (New York: McGraw-Hill Book Company, 1974), pp. 169-83.

[5] Ibid., p. 172.

[6] Walter Buckingham, Automation: Its Impact on Business and People (New York: Harper and Brothers, 1961), p. 51.

[7] Sanders, pp. 174-79.

[8] Joel E. Ross, Management by Information System (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), pp. 8, 9.

[9] Ibid., pp. 17, 18.

[10] Stephen J. Andriole and Judith Ayres Daly, "Computerized Crisis Forecasting," Air Force 62 (July 1979):88.

[11] Ibid.

[12] Ibid., p. 89.

[13] Ibid., p. 90.

[14] Ibid., pp. 90-92.

[15] Thomas L. Whisler, Information Technology and Organizational Change (Belmont, MA: Wadsworth Publishing Company, Inc., 1970), pp. 52, 53.

[16] Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980's," Harvard Business Review 36 (November-December, 1958): pp. 41, 42.

[17] Whisler, Information Technology, p. 54.

[18]Ibid., p. 53.

[19]Gilbert Burck, The Computer Age and Its Potential for Management (New York: Harper and Row, 1965), p. 102.

[20]Ibid.

[21]Howard Anderson, "What's Here, What's Ahead," Administrative Management 39 (August 1978):31.

[22]Ibid.

[23]Buckingham, p. 59.

[24]Harry Newton, "Visibility: Why You Need It and How You Can Achieve It," Communication News, 15 (July 1978): 26.

[25]Joseph Timpe, "Organizing the Telecom Function to Seek Minimum Cost Alternatives," Communications News 16 (April 1979):22. See also Newton, and various other issues of Communications News.

[26]Buckingham, p. 39.

[27]Alfred E. Kahn and Charles A. Zielinski, "New Rate Structures in Communications," Public Utilities Fortnightly 97 (March 25, 1976):19.

[28]Nancy Foy, Computer Management: A Common Sense Approach (Philadelphia: Auerbach Publishers, Inc., 1972), p. 174.

[29]Bernard Overeynder, "Internal Voice and Data Communications at Xerox," address delivered to the Telecommunications Seminar, University of Colorado at Boulder, March 19, 1979, (unpublished).

[30]Ibid.

[31]Ibid.

[32]This suspicion is shared by at least one Air Force Colonel whose name and position will not be divulged.

[33]Edward W. Pullen and Robert G. Simko, "Our Changing Industry," Datamation 23 (January 1977):54.

[34]Newton, p. 27.

[35]Paul Neuman, "The Politics of the Matter," Administrative Management 39 (August 1978):34, 35.

[36]Chris Argyris, "The Impact of the Formal Organization upon the Individual," in D. S. Pugh, ed., Organization Theory (London: Cox and Wyman, Ltd., 1971), p. 269.

[37]Fenwicke W. Holmes, "IRM Organizing for the Office of the Future," Journal of Systems Management 30 (January 1979):28.

[38] Foy, p. 176.

[39] "Telecommunications Management is a Multi-Faceted Function," Communications News 15 (December 1978):92.

[40] Newton, p. 26.

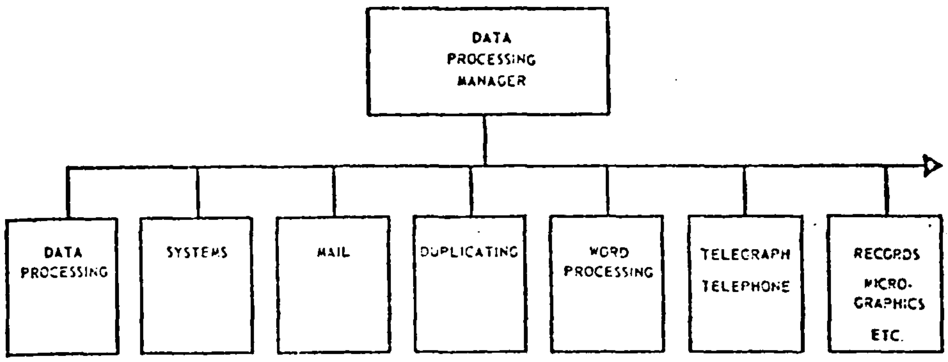
CHAPTER VI

INTEGRATED INFORMATION SYSTEMS MANAGEMENT

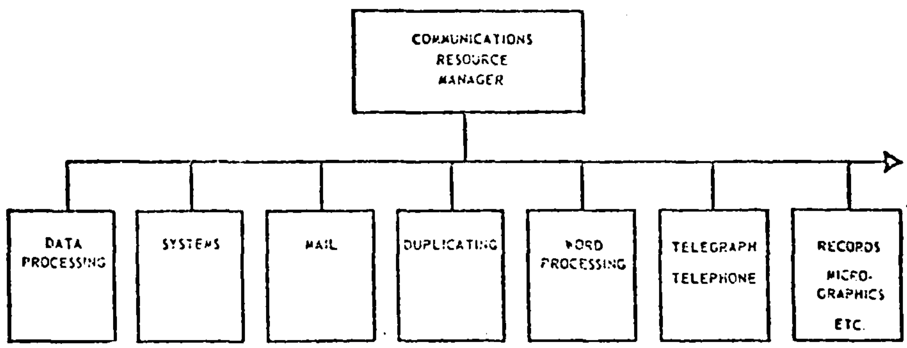
The last chapter concluded with the suggestion that a new management structure may be necessary to integrate information systems technologies. This new management structure reflects a recognition that planning, both long-range and short-range, for data processing, telecommunications, and computer/communications based information technologies cannot continue to be treated as separate management concerns. An important distinction is made here: The focus must be on the management process rather than on the operational employment of these technologies.

Several organizational structures for managing information resources have been proposed in the past (Figures 6-1, 6-2) and others are in use in various corporations and government organizations. Structures in use range from separate subsidiaries for data processing or telecommunications to no departments for one or the other. It is essential to realize, however, that juggling the blocks in the organizational chart will not, of itself, have a great effect on the successful integration of information systems, either technologically or managerially. Fenwicke Holmes[1] asserts:

> . . . The arrangement of the boxes will not, of and by itself, make the Integrated Information Resource become a reality. If each technical specialty area insists on doing its own thing and defends its territory from external encroachments, there will be no synthesis and no cost-benefit trade-offs.



(a) Alternative 1



(b) Alternative 2

Figure 6-1. Integrated-Information Systems Management Structure

Source: Fenwicke W. Holmes, "IRM: Organizing for the Office-of-the-Future," Journal of Systems Management 30 (January 1979):28, 29, Figures 3 and 4.

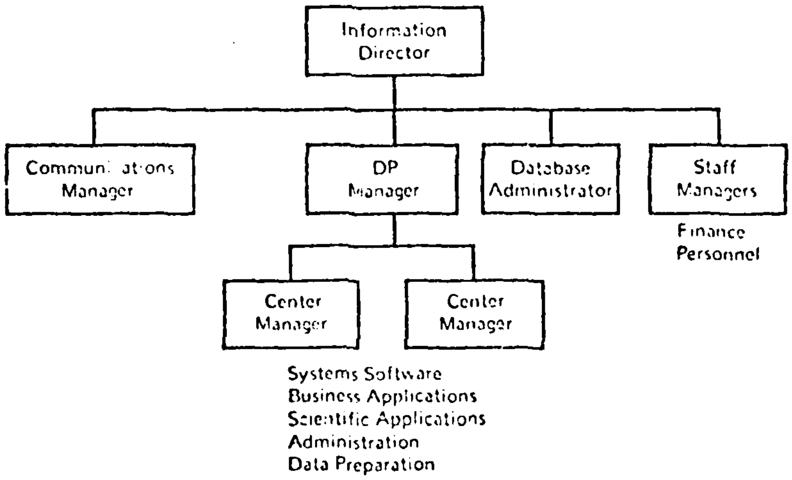


Figure 6-2. Integrated-Information Systems Management Structure

Source: Nancy Fox, Computer Management: A Common Sense Approach (Philadelphia: Auerbach Publishers, Inc., 1972), p. 10, Figure 1-3. Attributed to Philip Dorn.

A change in organizational structure may help, but what is needed is a restructuring of ideas, attitudes, and perceptions regarding the managerial interface with the integrated information system (I^2S). Throughout this work, integrated information system has been used to describe the interrelated technologies of computers, telecommunications, and such related entities as word processors, reprographics, etc. In a broader sense, integrated information systems management (I^2SM) encompasses the concepts of managing the technologies and using the technologies to manage as well. In this context, it is helpful to analyze I^2SM from an organizational standpoint. To do so, the multivariate approach espoused by Harold J. Leavitt[2] will be used. In this approach, organizations are viewed as systems in which ". . . at least four interacting variables loom especially large: the variables of task, structure, technology, and actors (usually people)." Because Leavitt's interacting variables relate so well to integrated information systems management, they provide a convenient framework for discussing I^2SM in the context of organizational objectives (Figure 6-3). Each of these variables has been discussed to a greater or lesser extent previously, and will be summarized in the following order: *structure*, or the impact of information systems upon the organization itself; *people*, in information-systems planning, controlling, and decision-making roles; *technology*, the information systems themselves; and the *task*, or insuring information is provided as required in support of organizational goals.

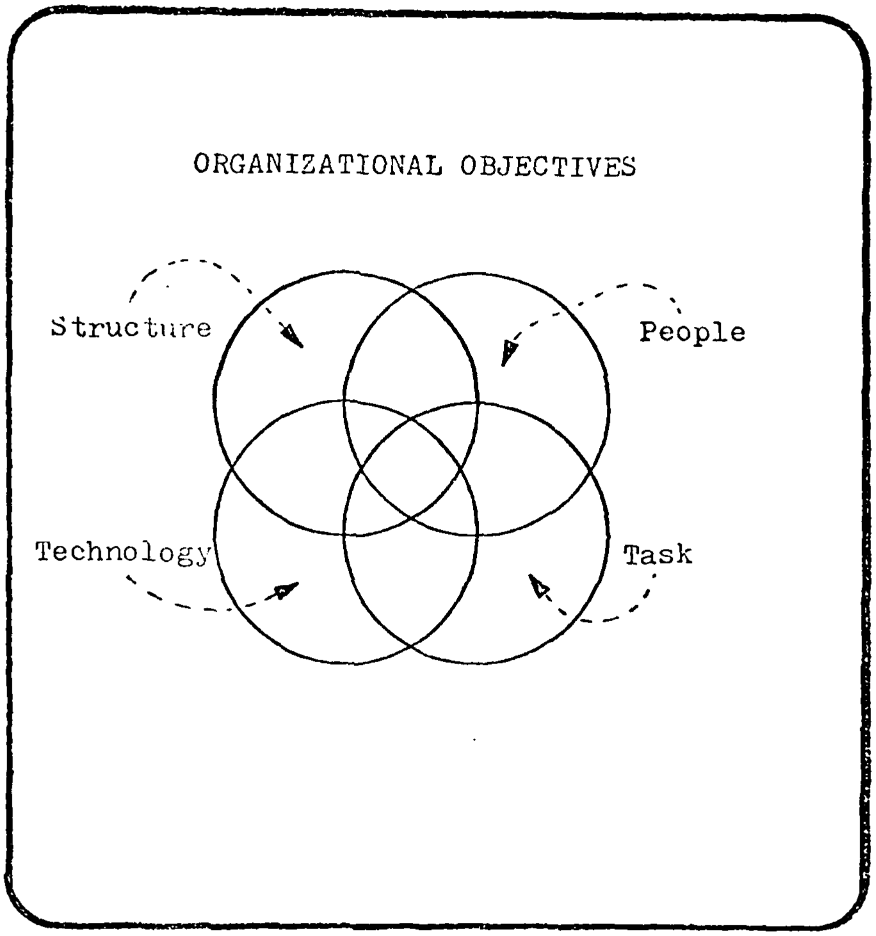


Figure 6-3. Interacting Variables in Organizations

Changing the Structure of Organizations

Some structural effects of integrated information systems have already been discussed in Chapter V, notably the impact on span of control and the traditional bureaucratic forms commonly known as line and staff. This analysis will build on and expand those ideas.

I^2SM will assist in all phases of management and operation. While the use of technology (computers, telecommunications and their associated office technologies) is to improve productivity and reduce costs, technology's primary function is to help management communicate and run the business more efficiently and effectively.[3]

> Consider . . . the way in which management organizes an enterprise, the hierarchial structure, the span of control, ground rules, etc., is based upon perceived business requirements and a given communications capability. Introduce a technology which improves that communications capability substantially and new approaches can be taken to the basic strategy of organization. Hierarchical levels can be eliminated, middle management personnel utilized more effectively, better coordination introduced in responding to changing business conditions, etc. Thus, the Office-of-the-Future is not just the automated office . . . rather, it is one in which new technologies give senior management the opportunity to consider entirely new approaches as to how best to organize, manage and control the enterprise.[4]

Based on the premise that computers and telecommunications are the backbone technologies in the Office-of-the-Future, it is reasonable to speculate that the much heralded large-scale teleprocessing systems such as ACS, SBS, and XTEN (see Appendix D) may only be the first step in a process which will ultimately change the organizational and operational structure of business. Through the computer/telecommunications pipeline will flow data, voice, message (text), pictures or graphics, and facsimile, at significant savings in dollars and with significant enhancement of management functions.[5]

Studies conducted at the University of Southern California discovered that the long-range impact of telecommunications on organizations may be to foster increased decentralization by fragmentation, dispersion, and diffusion (Figure 6-4).[6] Fragmentation is the first phase and is comprised of two parts. Segmentation involves locating a function, such as the shipping department, remotely from the administrative center and communicating with it electronically. Branching involves breaking up an administrative center such as a large bank, for example, into smaller but functionally complete branch banks in which only certain specified transactions must be referred to central headquarters. The next phase, dispersion, occurs when a firm establishes a number of scattered locations. An employee reports to a local work site because it is local, the closest to his home, not necessarily because his administrative unit is located there. An example of dispersion is the trend to locate industrial segments in areas where labor is plentiful and information requirements are satisfied both from local sources and from central data-bases through distributed networks. The final phase, diffusion, will occur when an employee is able to work in his own location (e.g., his home), receiving his work input and delivering his work output through telecommunications channels.[7]

While such restructuring, or geographic decentralization, is technically feasible, this does not mean that it will occur.

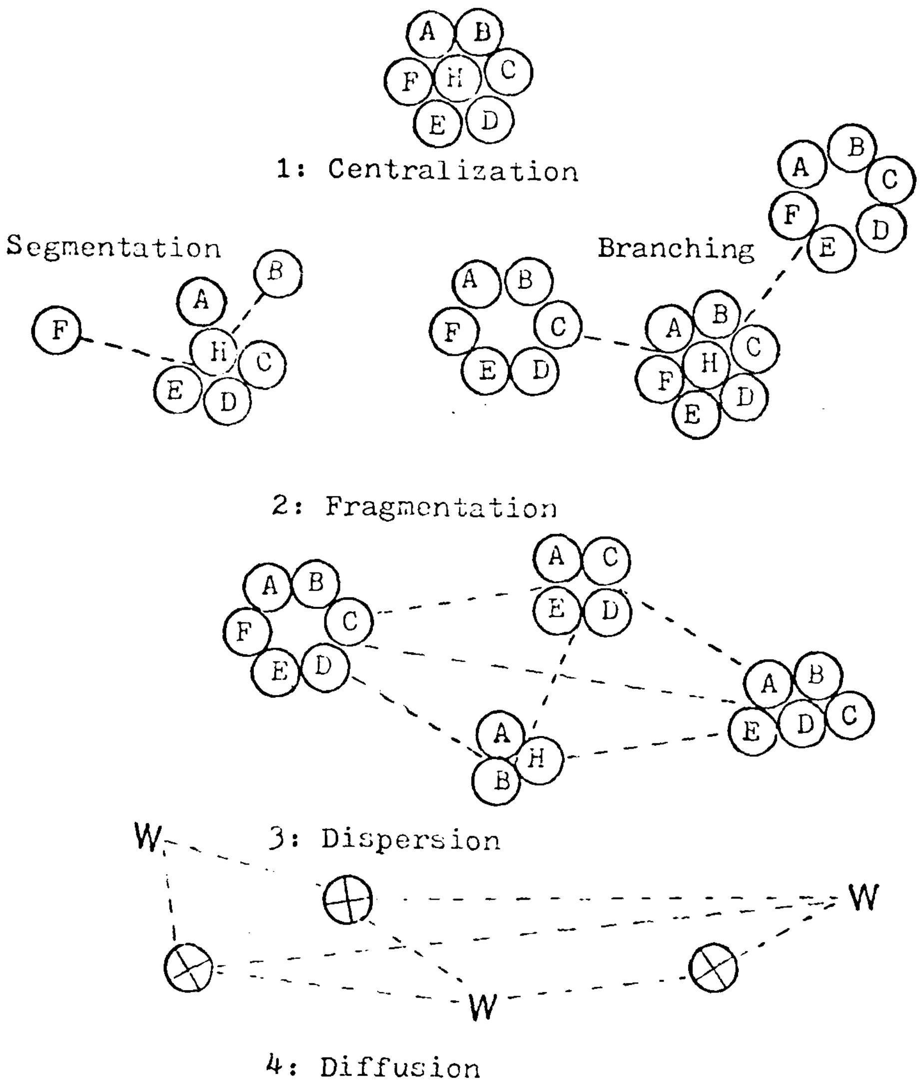


Figure 6-4. Evolution of Organizational Decentralization

Source: Joseph Ferreira and Jack M. Nilles, "Five-Year Planning for Data Communications," Datamation 22 (October 1976):55.

However, compelling economic reasons suggest that it *will* occur to the extent that organizational objectives can be met. As geographic decentralization progresses through the four phases, the benefits would appear as:

* reduced real estate costs through the reduction of space requirements in high-priced centralized locations,

* relief of labor scarcities,

* reduced employee dissatisfaction with commuting and business travel,

* reduced pressures on transportation systems,

* a displacement by communications of energy-intensive transportation, and

* savings in travel time and travel costs.[8]

The salient point is that the I^2S technologies are being implemented to increase office productivity, reduce office costs, and improve the flow of management information. In addition the use of telecommunications has made it possible to decentralize organizational functions while re-establishing effective control which in turn will increase the demand for information services even more. It is the latter impact which has yet to be recognized and acted upon by many senior managers and even by the I^2S managers themselves.

<u>People Effects</u>

If the predictions of organizational decentralization, due to the economic forces discussed in Chapter IV, prove correct, the integrating function becomes that much more critical. An excellent analogy is that of logistics support for a forward military operation. As lines of supply are extended further and further, the transportation system becomes more and more critical. In exactly the same manner, the lines of communication become more and more important as an organization's subunits become more dispersed. Decentralization of organizational functions strongly suggests that there should be a concomitant centralization of information resource management. Thus, the implication of geographic or functional recentralization discussed in Chapter V should rather be considered as a *new* centralization of decision making and control functions in *support* of any geographic dispersal.

This concept, in conjunction with the interdisciplinary nature of I^2SM, implies several things. First, the high caliber professionals necessary to make I^2S work in the manner of which it is capable must be attracted to the organization. To do so, their association with the organization, both within the I^2S structure and within the organization as a whole, must provide several basic needs: a professional challenge leading to personal growth and development; responsibility; an opportunity for achievement, i.e., to overcome the challenge; and recognition of that achievement, most often realized in the form of promotion or added responsibility. It is not surprising that these factors were identified by Frederick Herzberg as those which motivate people to be more productive and satisfied in their work.[9]

Certainly I^2S provides the professional both with a challenge and an opportunity for growth. Evolutionary processes are continuous and there is no reason to believe that the evolution of integrated information systems is at an end. As new requirements engender new technologies, so new technologies are often applied in areas where the original designers had not conceived of their use. It is doubtful, for instance, if Alexander Graham Bell foresaw the ability to send pictures over telephone lines.

As management has become more and more dependent on information systems, the responsibilities of information-system managers have grown to staggering proportions. Satellite Business Systems found that of seven "representative" large U. S. companies averaging $7.7 billion in sales per annum, an average of $43.5 million went for information systems, and this figure does not include salaries for the over 1,100 information-system employees.[10] These are direct costs. Judging the influence of information systems on generating that $7.7 billion in sales would at best be speculation, but certainly it is enormous in today's business environment. In discussing the mission of the Aerospace Defense Command of the U. S. Air Force, the late General Daniel James[11] commented: ". . . The success of my mission has become *totally* dependent on communications, electronic sensors, and the use of computers. . . ." (emphasis added) In both the corporate and government sectors, the role of integrated information systems has become more and more closely allied with successful accomplishment of objectives and the responsibilities of those directly involved with these systems has grown with that role.

The prospects for achievement are somewhat more difficult for the I^2S professional to see due to the present management attitudes toward information systems, particularly for the telecommunications professional. As previously noted, too much emphasis in this field has been on cost reduction, rather than on improvements. This is particularly interesting since the only overriding reason for the existence of the I^2S function *is* improvement.[12] It is perhaps not unreasonable to extend this statement to the corporate level data-processing department as well.

A manager need not have a telecommunications or data-processing department to suggest that he needs improved phone service or computer assistance. So long as budgetary constraints are observed and he can justify the need, he can effect the system acquisition. He may even establish an intra-departmental function to manage it. In large, diversified organizations, however, the waste would be enormous. The realization that he can be a factor in improvement not only for his department, but also for the entire organization, creates for the I^2S professional a significant potential for achievement.

Recognition is an even more nebulous prospect. For the information systems manager, recognition is often negative, resulting from a system failure. Part of the problem for the telecommunications professional (as described in the preceding chapter) is that his ability to cause improvement and thereby win recognition is really only a decade old, essentially dating to the "Carterfone" decision. During this decade he has primarily been pre-occupied with getting the best technical system. In many cases he has not yet learned how to relate to top management views. Generalists, however, are emerging from both the data-processing and telecommunications areas. The possibility that some are finding paths blocked in organizational advancement could be the reason for the phenomenon described as a growing loyalty to profession rather than to organization. In the end, this could be detrimental to organizational objectives in the sense that it would be difficult for the I^2S professionals to be fully in tune with those objectives.

Information Systems Technology: The Prime Mover

The impact of information systems technologies on organizations and management has been thoroughly discussed elsewhere. These technologies have created a cycle of interdependence in which information needs of the organization create a response in the form of more and better applications and the concomitant need for newer and more effective technologies.

It has been stated that the technologies to effect total I^2SM are available today. The sample group of 99 corporations was asked to respond to questions concerning their present use of nineteen listed available technologies and services, plus any others we may have omitted. They were also asked to project their use of these technologies/services five to ten years hence (Appendix A, questions 12 and 13). These were extremely difficult questions to answer as evidenced by the fact that eleven of the 42 respondents elected not to answer one or both of them. The answers were compared and the projected increase/decrease in use is charted in Appendix B. The results lead to two conclusions. First, the majority of the "new" technologies/services show a significant projected increase over this period, while the use of "old" or widely used technologies/services, such as WATS, record communications, key telephone systems, etc., is projected to remain static or to decrease. It should be noted, however, that part of the reason for the trend in the "old" technologies is the fact that they are already used at or near the maximum use levels as defined in the questionnaire. The second conclusion was, to us, somewhat startling, yet it confirms a statement made earlier. The technologies *do* exist today, though not all are yet widely used. Not one respondent suggested a technology/service that was not listed. This suggests that it is now up to the integrated information systems management process to bring about improvement through the imaginative application of these technologies and services in order to meet the information demands of the organization.

Planning: The Central Task

If the purpose of integrated information systems is to provide information as required to attain organizational objectives, and the only valid reason for the existence of I^2S departments is to cause improvement in their use, then the most important task for integrated information systems management is planning for improvement to better meet those objectives.

Comprehensive planning for both telecommunications and data processing was overwhelmingly supported by our respondents, who ranged from corporate Vice-Presidents to Directors of Public Relations. Of 41 answering regarding telecommunications (Appendix A, question 31), only one disagreed that a comprehensive plan is necessary. There were 42 responses to the same question for data processing (Appendix A, question 32), of which one strongly disagreed, one disagreed, one was neutral, and the rest agreed or strongly agreed (Table 6-1). It is interesting to note that the one strong disagreement to question 32 came from a large financial services institution whose data-processing functions are *totally* decentralized; and whose telecommunications function has taken a dominant role in corporate management.

TABLE 6-1

RESPONSES TO QUESTIONS 31 and 32 (Appendix A)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Question 31:	0	1	0	17	23
Question 32:	1	1	1	14	25

Note: Numbers are absolute, not percentages.

Further importance of planning is evidenced by the responses to our questions concerning whether plans existed and who was involved in those plans (Appendix A, questions 14 and 15). Table 6-2 summarizes these findings for organizations whose data-processing and telecommunications managers report to the same supervisor, and for all others.

These figures show that where there is common management, there is a higher degree of coordination between telecommunications and data-processing departments, at least for telecommunications

TABLE 6-2

INFORMATION SYSTEMS PLANNING PRACTICES

	Report to Same Supervisor			Other		
Number of Respondents:	19			16		
Number with plans:						
Telecom	17			14		
DP	16			11		
Entities involved in planning process:	Telcom Dept.	DP Dept.	Users	Telcom Dept.	DP Dept.	Users
For Telecom plan	17	11	17	13	3	11
For DP plan	9	16	16	5	11	9

Note: Numbers are absolute, not percentages.

planning, than when there is not a common supervisor. A higher degree of coordination, though it exists, is not as dramatic in data-processing planning. Discussing the technologies of word processing, repregraphics, and telecommunications, John J. Connell[13] stated:

> . . . Every one of the office technologies just described has developed as a separate, discrete activity with its own manufacturers, its own techniques and its own jargon. Organizationally, these technologies usually report to different department heads and the idea of developing coordinated plans for all office operations has seldom even been contemplated.

The results of our questionnaire do not fully support Connell's contention that coordinated plans are seldom contemplated, but they do show a far less than unanimous concern for the concept in practice as evidenced by the results shown in Table 6-2. There is concern, and again, overwhelming endorsement, however, for the concept in theory. Table 6-3 shows the response to our questions concerning what should, or could, be the final result of cooperative and fully coordinated management of telecommunications and data processing, or I^2SM (Appendix A, questions 27 and 28).

With this kind of endorsement for I^2SM, it seems incongruous that the planning of information systems does not reflect the same degree of support, *even where common management exists!* This reinforces the idea that the creation of an information director, or whatever the common manager is called, does not bring about true I^2SM. The adversary, or at best, noncooperative relationship still appears to exist. This results in the task being viewed parochially as a telecommunications or a data-processing task, and not as the integrated information systems task of planning for improvement to meet organizational goals.

TABLE 6-3

RESPONSES TO QUESTIONS 27 and 28 (Appendix A)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Question 27: I^2SM will produce more economical information systems	0	1	2	18	20
Question 28: I^2SM will produce more effective information systems	0	1	2	14	24

The four variables, structure, people, technology, and task, are interacting elements of a total system of management. In the context of integrated-information systems, each must be considered, not as a solitary element, but in the full spectrum of its interdependence with the other elements and its relationship to the organization's objectives.

Harold Koontz and Cyril O'Donnell[14] state that the ". . . structure must fit the task--not vice versa. . . ." We submit that in the case I^2SM it must also reflect the technology and that the people involved in integrated information systems management, from top management on down, consider themselves and each other as part of a process that could well change the manner in which organizations interact within themselves and with their environment.

CHAPTER VI

FOOTNOTES

[1]Fenwicke W. Holmes, "IRM: Organizing for the Office-of-the-Future," Journal of Systems Management 30 (Janauary 1979):29.

[2]Harold J. Leavitt, "Applied Organizational Change in Industry: Structural, Technical, and Human Approaches," in F. E. Kast and J. E. Rosenzweig, eds. Contingency Views of Organization and Management (Chicago: Science Research Institute, Inc., 1973), p. 57.

[3]John J. Connell, "The-Office-of-the-Future," Journal of Systems Management 30 (February 1979):8.

[4]Ibid., p. 9.

[5]Joseph Ferreira and Jack M. Nilles, "Five Year Planning for Data Communications," Datamation 22 (October 1976):51.

[6]Ibid., p. 55.

[7]Ibid., p. 54.

[8]Ibid.

[9]Paul Hersey and Kenneth H. Blanchard, Management of Organizational Behavior: Utilizing Human Resources, 2nd ed. (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1972), p. 55.

[10]Harry Newton, "Visibility: Why You Need It And How You Can Achieve It," Communications News 15 (July 1978):26.

[11]General Daniel James, Jr., "Communications, Electronics, and Computers in NORAD/ADCOM," Communications-Electronics Newsletter, AFRP 100-1, 15 (July 15, 1977):2.

[12]Joseph Timpe, "Organizing the Telecom Function To Seek Minimum Cost Alternatives," Communications News 16 (April 1979):22.

[13]Connell, p. 9.

[14]Harold Koontz and Cyril O'Donnell, Management: A Systems and Contingency Analysis of Managerial Functions, 6th ed. (New York: McGraw-Hill Co., 1976), p. 71.

CHAPTER VII

FINAL THOUGHTS

The convergence of information technologies presents management with a challenge. Should information systems continue to be treated as distinct entities, or should new management approaches be adopted that exploit the commonalities of their functions? We believe that the interacting variables of people, structure, technologies and task will have a profound effect upon the information system(s) used by an organization. The challenge to management is to make sure the information system(s) adopted satisfy organizational objectives in the context of these variables. A review of important points developed thus far will clarify this belief.

The purpose of any information system is to deliver information to decision makers. Effective decision-making is dependent upon accurate information which is available in the right form and at the right time. The importance of this cannot be overemphasized and should not be underestimated since achievement of organizational objectives is directly related to the quality of decisions.

The relationship between information and achievement of organizational objectives has established a cycle in which information requirements have escalated in order for the organization to remain competitive. As competition escalates, greater information requirements are established. This appetite for information has led to the development and use of an ever-increasing diversity of information systems. As these systems developed, they began to merge with communications-based systems incorporating computer technologies and computer-based systems incorporating communications technologies. The ability of these systems to handle quantities of information quickly and efficiently has had a catalytic effect upon the cycle.

The need for information has continued to rise unabated, and we have no doubt that this trend will continue. This has been reflected in increasingly integrated information systems being developed to meet the needs of the competitive environment and organizational complexity.

As would be expected, the growth in the need for and complexity of information systems has generated increasing expenditures for these systems, which in turn have provided improved information flow and accessibility. However, there has been an unexpected explosion in costs for the white-collar labor force in the form of information overhead. This labor force has grown, rather than diminished, despite the introduction of new information technologies, and now consumes approximately one-fourth of the total costs of producing goods and services in our economy. In effect, the requirement for more, better, and timely information to efficiently produce goods and services has created a burgeoning body of information creators and handlers.

The growth in information overhead can be compared to the ecological problem which developed from the use of phosphates in laundry detergent. Phosphates were introduced to boost the cleaning power in detergents, but were found to have an unexpected and undesireable side effect. The phosphates entered lakes, rivers, and ponds and stimulated plant growth. Though a certain level of plant growth is necessary to maintain ecological balance, the unbridled proliferation of organic matter upset this balance.

Unlike the phosphates, which had to be eliminated from detergents, information technologies offer the potential to solve the information overhead problem which they helped create. The evidence indicates that it has been the increasing need for information and the maintenance of independent information systems which created and have perpetuated the problem of information overhead. Through integration of information systems using a management approach such as I^2SM, management obtains a way to reduce the dependence of the overall information system on information handlers and, at the same time, improve the productivity of information users.

The benefits deriving from this approach, however, will not be without a price. If integration of information systems has the capacity for increasing the productivity of the secondary information sector, what effect will this have? It may enable management to do more with fewer people, or to do far more with the same people. At what point must organizational objectives be redefined to cope with this increased productivity? At what point does it begin to impact those involved in the secondary information sector or society as a whole? These are difficult problems which management must resolve.

Two important issues remain to be addressed. First, information was described not only as a resource, but also as a power influence. Integrated information systems, by definition, means that information will become more accessible to the entire organization. At the same time, however, it means that control of the organization's information power base may become more centralized in the hands of only one or a few individuals. The possibility that an information elite may evolve in the secondary information sector, especially among the support functions of data processing/telecommunications, needs to be considered.

Second, telecommunications and data processing function to provide service to the remainder of the secondary information sector. In an integrated information system these functions need to be brought into the mainstream of organizational management. Information professionals will begin to realize they are an important factor in achieving objectives and will begin to take more of a top management view. They will think of data processing, telecommunications, word processing, etc., not as ends unto themselves, but as part of an overall strategy to achieve objectives. Planning for new systems will reflect top management views, and will be better suited to meet the needs of the organization.

We consider this a critical factor to the successful implementation of integrated information systems. Unless the integrated information system satisfies organizational objectives when implemented, and is kept on course, there is a strong likelihood that it may be less effective and efficient in meeting those objectives than the independent systems it replaced.

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APPENDIX A

UNIVERSITY OF COLORADO
GRADUATE COMMITTEE ON TELECOMMUNICATIONS
ENGINEERING CENTER OT 2 32
BOULDER, COLORADO 80309
(303) 492-3916 or 5424

Boulder Campus
Box 425

May 18, 1979

We are graduate students at the University of Colorado pursuing a Master of Science degree in Telecommunications Management. One of the requirements of the program is the preparation of a thesis dealing with some aspect of telecommunications.

The enclosed questionnaire will serve as a research foundation for our study of the effects of the information revolution on corporate management. We would appreciate if you would transmit this questionnaire to the proper office so that it may be completed and returned to us by June 15, 1979. Please feel free to add any other comments or information you feel may be pertinent.

Paul J. Knudsen
Steven N. Strominger

☐ Check if you do not desire answers to be attributed to your corporation.

A. Please answer for both Telecommunications and Data Processing. Please enter N/A where answer is not applicable.

Telecom	Data Proc	
Y N	Y N	1. Does your corporation have a department for Telecommunications and/or Data Processing?
Y	N	2. Do the Telecommunications and Data Processing managers report to the same supervisor?
Y N		3. Does the Telecommunications manager report to the Data Processing manager?
	Y N	4. Does the Data Processing manager report to the Telecommunications manager?
☐	☐	5. If you answered "NO" to questions 2-4, how many levels above them do the Data Processing and Telecommunications managers' supervisory chain come together? (Enter a number in each column)
☐		6. How many levels above the common management level is the Chief Executive Officer?
Y N	Y N	7. Is long range planning for total system requirements for Telecommunications and/or Data Processing centrally managed at the corporate level?
Y N	Y N	8. Is operational management of Data Processing and/or Telecommunications activities decentralized?
		9. What are the backgrounds of the Data Processing and Telecommunications managers? (More than one may apply)
a	a	a. Engineering
b	b	b. Data Processing
c	c	c. Telecommunications
d	d	d. Business Administration
e	e	e. Other (specify)

B. For questions 10 through 13, please refer to the following list of technologies/services:

a. Word processors
b. Mini computers
c. Mainframe computers
d. PABX systems
e. Key telephone systems
f. WATS
g. Value added networks (Tymnet, etc)
h. Microwave
i. Optical Communications
j. Company owned voice networks
k. Specialized Common Carriers(MCI, etc)
l. *Company owned* data networks
m. Computer output microfische
n. Record communications (TWX, TELEX, etc)
o. Electronic mail
p. Teleconferencing (voice only)
q. Video conferencing
r. Micrographics
s. Distributed processing
t. Other ____________________

Telecom	Data Proc	Other

10. What department is responsible for aquisition decisions relating to the above technologies/services? (Enter as many letters as apply)

11. What department is responsible for day-to-day managing of the above technologies/services? (Enter as many as apply)

For questions 12 through 13, use the following scale:

In use as a percentage of the workday

NONE	1-20%	21-40%	41-60%	61-80%	81-100%
0	1	2	3	4	5

12. To what extent are the above technologies/services used by your company?

a___	f___	k___	p___
b___	g___	l___	q___
c___	h___	m___	r___
d___	i___	n___	s___
e___	j___	o___	t___

13. To what extent will they be used 5 to 10 years hence?

a___	f___	k___	p___
b___	g___	l___	q___
c___	h___	m___	r___
d___	i___	n___	s___
e___	j___	o___	t___

C. Please answer as indicated

Telecom	Data Proc	
Y N	Y N	14. Are your Telecommunications and Data Processing systems being developed according to a comprehensive plan? If answer is "NO", skip to 18.
		15. Who has contributed to the plan's development? (Circle as many as apply):
a	a	a. In-house Telecommunications dept
b	b	b. In-house Data Processing dept
c	c	c. Users
d	d	d. Consultants (extra corporate)
e	e	e. Non-Telecommunications and/or Data Processing management
f	f	f. Others (specify)
Y N	Y N	16. Were committees established to formulate the plan?
Y N	Y N	17. Did the committees include participants from all the gr ups indicated in your answer to question 15?
Y N	Y N	18. Is there a stated corporate policy to use Telecommunications instead of travel where possible?

For questions 19 and 20, please use the following scale:

0-20%	21-40%	41-60%	61-80%	81-100%
1	2	3	4	5

1 2 3 4 5 19. To what extent does Telecommunications replace travel for sales contacts?

1 2 3 4 5 20. To what extent does Telecommunications replace travel for corporate management purposes?

D. For questions 21 through 26, please use the following scale:

NONE	1-5%	6-10%	11-20%	21-50%	51-99%
0	1	2	3	4	5

(WE RECOGNIZE THESE ARE BEST ESTIMATES)

Circle Answer

0 1 2 3 4 5 21. Estimate the amount of their time top management uses Telecommunications technologies/services.

0 1 2 3 4 5 22. Estimate the amount of their time middle management uses Telecommunications technologies/services.

0 1 2 3 4 5 23. Estimate the amount of their time top management uses Data Processing or its products.

0 1 2 3 4 5 24. Estimate the amount of their time middle management uses Data Processing or its products.

0 1 2 3 4 5 25. Estimate the amount of time Telecommunications is used for intra-corporate communications.

0 1 2 3 4 5 26. Estimate the amount of time Telecommunications is used for extra-corporate communications.

E. For statements 27 through 32, please respond using the following scale:

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
1	2	3	4	5

Circle Answer

1 2 3 4 5   27. Cooperative and fully coordinated management of Telecommunications and Data Processing will produce a more economical information system.

1 2 3 4 5   28. Cooperative and fully coordinated management of Telecommunications and Data Processing will produce a more effective information system.

1 2 3 4 5   29. A study which will examine the growing interdependence of Telecommunications and Data Processing will be beneficial to you.

1 2 3 4 5   30. A study which will propose a management approach to facilitate maximum coordination and exploitation of Telecommunications and Data Processing will be beneficial to you.

1 2 3 4 5   31. A comprehensive plan is necessary for developing Telecommunications to meet future information system requirements.

1 2 3 4 5   32. A comprehensive plan is necessary for developing Data Processing to meet future information system requirements.

1 2 3 4 5   33. Data Processing and Telecommunications managers should both report to the same supervisor.

F. Please provide the following information for the person(s) completing this questionnaire (optional):

NAME

TITLE or RESPONSIBILITY

ADDRESS

PHONE NUMBER

AD-A090 619 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH F/G 17/2
INTEGRATED INFORMATION SYSTEMS MANAGEMENT: A COORDINATED AND CO--ETC(U)
AUG 79 P J KNUDSEN, S N STROMINGER
UNCLASSIFIED AFIT-CI-79-197T NL

3 of 3
AD
A090619

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APPENDIX B

APPENDIX B

TABULATION OF RESPONSES TO QUESTIONNARE

The questionnaire at Appendix A was sent to 99 corporations selected from Standard and Poor's "500" price index. A list of these corporations is contained in this appendix. Of 46 responses generated, 42 were completed while the other 4 were uncompleted due to corporate policy. In most cases, the questionnaires were carefully filled out, but some questions were left blank by some respondents. Any discrepancies from the total of 42 in the tabulated results may be attributed to this fact. Unless otherwise indicated, all numbers shown are absolute, not percentages.

The tabulations for certain questions require some amplification as follows:

QUESTION 6: Question 6 is tabulated to show separations between common management points and the Chief Executive Officers. It should be noted that in most cases for "other," the closer the common management point is to the CEO, the farther that common point is from the respective information system manager. In at least one case, this isolation factor was as high as 11.

QUESTION 10 and 11: Since there were few differences between responses to these questions, question 11 is not tabulated separately.

QUESTIONS 12 and 13: These questions were compared, and the *change* in usage level is tabulated.

QUESTIONS 16 and 17: The results for these questions will be given here. For telecommunications, committees were established in 11 cases and in 8 of those cases, all entities identified in question 15 were members. The respective figures for data processing are 18 and 15. Additionally, 2 reported having permanent planning committees, but only 1 utilized members identified in question 15. There were 31 respondents for telecommunications and 30 for data processing. The remainder either had no formal planning program, or declined to answer for an unspecified reason.

CORPORATIONS TO WHICH QUESTIONNAIRES WERE SENT

<u>Industrials</u>

Martin Marietta

Raytheon Company

Rockwell International Corp

Emery Air Freight Corporation

Kaiser Aluminum & Chemical Corporation

General Motors Corporation

Cummins Engine Co., Incorporated

Anheuser-Busch Incorporated

Adolph Coors Company

Coca-Cola Company

PepsiCo Incorporated

American Cyanamid Company

Gulf & Western Industries Incorporated

Litton Industries Incorporated

Teledyne Incorporated

Kennecott Copper Corporation

Avon Products Incorporated

Fabergé Incorporated

Bristol-Meyers Company

Eli Lilly and Company

General Electric Company

Westinghouse Electric Corporation

Maytag Company

Whirlpool Corporation

Perkin-Elmer Corporation

Fairchild Camera and Instrument Corporation

National Semiconductor Corporation

Texas Instruments Incorporated

Warner Communications Incorporated

General Foods Corporation

Ralston Purina Company

Weyerhauser Company

U. S. Home Corporation

Hospital Corporation of America

Johnson and Johnson

Hilton Hotels Corporation

Ramada Inns Incorporated

AMF Incorporated

Tandy Corporation

International Harvester

Hobart Corporation

American Telephone and Telegraph Company

Black & Decker Manufacturing Company

Corning Glass Works

Owens-Corning Fiberglass Corporation

Control Data Corporation

Digital Equipment Corporation

International Business Machines Corporation

NCR Corporation

Xerox Corporation

Phillips Petroleum Company

Union Oil Company of California

Exxon Corporation

Standard Oil Company of California

Kimberly-Clark Corporation

St. Regis Paper Company

McGraw-Hill Incorporated

Time Incorporated

Gannett Company Incorporated

Knight-Ridder Newspapers Incorporated

American Broadcasting Company

Marriott Corporation

McDonald's Corporation

May Department Stores Company

The Kroger Company

Safeway Stores Incorporated

J. C. Penny Company Incorporated

Sears, Roebuck & Company

Colgate-Palmolive Company

Proctor & Gamble Company

Inland Steel Company

National Steel Corporation

Republic Steel Corporation

Burlington Industries Incorporated

West Point-Pepperell Incorporated

Firestone Tire & Rubber

The Goodyear Tire and Rubber Company

Addressograph-Multigraph Corporation

U. S. Industries Incorporated

Public Utilities

Consolidated Edison Company of New York Incorporated

Pacific Gas & Electric Company

Southern Company

Texas Utilities Company

General Telephone and Electronics Corporation

United Telecommunications Incorporated

Transportation

Delta Airlines Incorporated

UAL Incorporated

Burlington Northern Incorporated

Union Pacific Corporation

Consolidated Freightways Incorporated

Financial

CitiCorp

BankAmerica Corporation

First National Boston Corporation

Connecticut General Insurance Corporation

Aetna Life & Casualty Company

Beneficial Corporation

American Express Company

Dean-Witter-Reynolds Incorporated

Paine-Webber-Jackson Incorporated

INFORMATION SYSTEMS MANAGEMENT STRUCTURES

Questions 1-4 - Appendix A

TELECOM	DP	
Y: 40, N: 2	Y: 41, N: 1	1. Does your corporation have a department for Telecommunications and/or Data Processing?
Y: 21, N: 21		2. Do the Telecommunications and Data Processing managers report to the same supervisor?
Y: 6, N: 35		3. Does the Telecommunications manager report to the Data Processing manager?
	Y: , N: 41	4. Does the Data Processing manager report to the Telecommunications manager?

INFORMATION SYSTEM MANAGEMENT STRUCTURES

Questions 5 & 6 - Appendix A

Question 5:

Number of levels separating common management point from:

Telecom Manager	DP Manager	Number of Respondents reporting indicated Structure
1	1	19
2	2	4
3	3	2
4	4	2
1	2	1
2	1	2
4	3	1
4	2	1
3	2	1
3	4	3

NOTE: In addition, one respondent indicated that the telecommunications manager reported to the data processing manager.

Question 6:

Number of levels separating common management point from CEO.

	0	1	2	3	4	5	6	7
Common Manager		1	9	6	1	1	1	
Other	3	4	4	3	4	1	1	1

Number of respondents reporting indicated separation

CENTRALIZED PLANNING CONTROL vs.
DECENTRALIZED OPERATIONAL CONTROL

Questions 7 & 8 - Appendix A

Question 7: Is long range planning centrally managed?

Question 8: Is operational management decentralized?

	TELECOMMUNICATIONS			
Question 7	Y	Y	N	N
Question 8	Y	N	Y	N
Common Manager	5	13	1	0
Other	10	6	3	2

	DATA PROCESSING			
Question 7	Y	Y	N	N
Question 8	Y	N	Y	N
Common Manager	7	9	2	1
Other	10	6	3	3

EDUCATIONAL/EXPERIENCE BACKGROUNDS OF CORPORATE INFORMATION SYSTEMS MANAGERS

Question 9 - Appendix A

Background Category*	Telecommunications Manager	Data Processing Manager
a**	16 (1)	11 (2)
b**	11 (2)	32 (11)
c**	28 (9)	5 (2)
d**	18 (3)	19 (3)
a + c + other	13	
a + b + other		8
c + d + other	13	
b + d + other		16
a + c + d + other	8	
a + b + d + other		4

* a= engineering; b= data processing; c= telecommunications; d= business administration.

** Respondents with <u>only</u> these backgrounds are in parentheses.

WHO MAKES ACQUISITION DECISIONS

Question 10 - Appendix A

	TELECOM	DP	OTHER
Word Processing	9	13	18
Mini-computers	11	34	5
Main Frame Computers	1	40	1
PABX	38	0	2
Key Telephones	35	0	4
WATS	38	2	3
Value Added Carriers	31	7	2
Microwave	28	3	2
Optical Communications	21	2	2
Company Owned Voice Networks	30	1	1
Specialized Common Carriers	34	5	0
Company Owned Data Networks	26	14	1
Computer Output Microfische	3	32	7
Record Communications	34	3	3
Electronic Mail	21	5	6
Teleconferencing	30	0	0
Video-conferencing	21	2	1
Micrographics	6	14	11
Distributed Processing	4	33	3

CHANGE IN USE OF TECHNOLOGIES DURING NEXT 5-10 YEARS

Questions 12 & 13 - Appendix A

	-5	-4	-3	-2	-1	0	1	2	3	4	5
Word Processing						6	6	12	4	2	
Mini-computers						13	9	6	1	2	
Main Frame Computers					1	27	3				
PABX						27	2	1			
Key Telephones			1	1	2	25		1			
WATS	1			5		21	2				
Value Added Carriers				1		10	7	2	4	3	3
Microwave						11	10	5		1	3
Optical Communications						5	13	4	2	3	1
Company Owned Voice Networks						20	5		3		2
Specialized Common Carriers						9	12	6	1	1	1
Company Owned Data Networks				1		18	5		1		4
Computer Output Microfische				1		10	13	1	3	1	
Record Communications		2	1	1	5	13	5	1	1		
Electronic Mail						3	5	7	7	5	4
Teleconferencing						8	12	4	5	1	
Video-conferencing						3	15	4	5	2	1
Micrographics					1	11	7	4	1	2	1
Distributed Processing						6	14	4	2	2	2

Note: Each increment is a change of up to 20 percent.

INFORMATION SYSTEMS PLANNING PRACTICES

Questions 14 & 15 - Appendix A

	Report to Same Supervisor			Other		
Number of Respondents:	19			16		
Number with plans: Telecom DP	 17 16			 14 11		
Entities involved in planning process:	Telcom Dept.	DP Dept.	Users	Telcom Dept.	DP Dept.	Users
For Telecom plan	17	11	17	13	3	11
For DP plan	9	16	16	5	11	9

Note: numbers are absolute, not percentages.

TRANSPORTATION/TELECOMMUNICATIONS TRADEOFF

Questions 18-20 - Appendix A

For Questions 19 and 20, the following scale was used:

0-20%	21-41%	41-60%	61-80%	81-100%
1	2	3	4	5

Question	YES 8						NO 31					
18. Is there a stated corporate policy to use Telecommunications instead of travel where possible?	N/A	1	2	3	4	5	N/A	1	2	3	4	5
19. To what extent does Telecommunications replace travel for sales contacts?		2	2	1	3		9	16	3	3		
20. To what extent does Telecommunications replace travel for corporate management purposes?		2	3	3			6	16	5	3	1	

REPORTED USE OF TELECOMMUNICATIONS/DATA PROCESSING FOR MANAGEMENT

Questions 21-26 - Appendix A

For Questions 21-26, the following scale was used:

NONE	1-5%	6-10%	11-20%	21-50%	51-99%
0	1	2	3	4	5

Numbers of respondents reporting indicated usage level

Usage Level	0	1	2	3	4	5	
21.	1	6	11	10	10	1	Estimate the amount of their time top management uses Telecommunications technologies/services.
22.		1	10	10	15	3	Estimate the amount of their time middle management uses Telecommunications technologies/services.
23.		9	12	10	3	5	Estimate the amount of their time top management uses Data Processing or its products.
24.		1	9	9	12	9	Estimate the amount of their time middle management uses Data Processing or its products.
25.	1	3	3	7	17	9	Estimate the amount of time Telecommunications is used for intra-corporate communications.
26.	1	5	6	7	14	15	Estimate the amount of time Telecommunications is used for extra-corporate communications.

ATTITUDES REPORTED BY RESPONDENTS

Questions 27-33 - Appendix A

For Questions 27-33, the following scale was used:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

N/A	1	2	3	4	5	Question
1		1	2	18	20	27. Cooperative and fully coordinated management of Telecommunications and Data Processing will produce a more economical information system.
1		1	2	14	24	28. Cooperative and fully coordinated management of Telecommunications and Data Processing will produce a more effective information system.
2	5	6	9	12	7	29. A study which will examine the growing interdependence of Telecommunications and Data Processing will be beneficial to you.
1	4	5	5	21	6	30. A study which will propose a management approach to facilitate maximum coordination and exploitation of Telecommunications and Data Processing will be beneficial to you.
1		1		17	23	31. A comprehensive plan is necessary for developing Telecommunications to meet future information system requirements.
	1	1	1	14	25	32. A comprehensive plan is necessary for developing Data Processing to meet future information system requirements.
1	3	5	4	10	19	33. Data Processing and Telecommunications managers should both report to the same supervisor.

APPENDIX C

APPENDIX C

INFORMATION OVERHEAD AND PRODUCTIVITY DEFINED

Information overhead equates to the secondary-information sector. The secondary-information sector actually functions in support of the production system in a noninformation industry.

> Every noninformation firm produces and consumes a variety of informational services internally as part of its operation. Every large firm needs a planning capability, financial control and analysis, a communications network, computer processing, typing, filing, duplication services, and so on. The private bureaucracies consume a tremendous amount of both capital and human resources in producing these overhead information services. Their inputs are computers, facsimile machines, laboratory equipment, office buildings, office machines, telephones, and trash baskets. They hire managers, research scientists, programmers, accountants, typists, and librarians. These resources are organized into production units that play a purely informational role. Large corporations are likely to create a "planning group," "R&D group," "electronic data-processing group," "advertising group," etc. Each unit has a well-defined technology--with recognizable inputs and outputs and can be conceptualized as a "quasi-firm" embedded within a noninformation enterprise. Its information producing, processing, and distribution activities are *ancillary to* or in *support of* the main productive activity. For example, if an automobile manufacturer installs a data-processing facility in house, hires programmers and analysts, leases peripheral equipment, and extends the facility through a private data network, then this would be a clear case that a "quasi-EDP firm" has been created within the firm. These quasi-firms have direct analogs in the primary-information sector. In many respects, the economics of the quasi-firm are indistinguishable from those of an established independent data-processing vendor selling its services to the auto manufacterer.[1]

The formula used in OT Special Publication 77-12(1) to derive the index of productivity depicted in Figure 3-5 follows. This formula, along with a definition of the factors which are used, gives one an excellent perception of the nature and impact of the secondary-information sector.

$$H_1 = \frac{\widetilde{GNP}}{\widetilde{N^s}} = \frac{N^n + \left(N^p - N^p\left(\frac{N^s}{N^t}\right)\right) + d}{N^s + N^p\left(\frac{N^s}{N^t}\right)}$$

where, N^n = national income in the noninformation industries (employee compensation of noninformation workers plus profits, interest and rents)

N^p = national income in the primary-information sector

N^s = national income in the secondary-information sector

N^t = total national income

d = depreciation

The numerator, then, contains a modified version of GNP which captures *only* real output, including:

(i) national income originating in the purely noninformational sectors of the economy; PLUS

(ii) the national income in the primary-information sector LESS an inputed cost of operating the bureaucracies within primary sector firms. (This imputation is derived from the overall economy's ratio of secondary information to total income. It is a global parameter which can obviously vary between industries. . . ;) PLUS

(iii) depreciation taken on all equipment other than information machines used in the secondary sector.

The denominator contains three residual information overhead components removed from GNP:

(i) the pure secondary-information income; PLUS

(ii) the imputation of secondary-type income originating in the primary-information industries; PLUS

(iii) depreciation on information machines used in a secondary activity.2

APPENDIX C

FOOTNOTES

[1]U. S. Department of Commerce Office of Telecommunications, The Information Economy: Definition and Measurement, by Marc Uri Porat. OT Special Publication No. 77-12(1) (Washington, D. C.: Government Printing Office, 1977), pp. 148, 149.

[2]Ibid., pp. 176, 177.

APPENDIX D

APPENDIX D

A BRIEF DESCRIPTION OF ACS

American Telephone and Telegraph (AT&T), Xerox, and the consortium of International Business Machines (IBM), Aetna Life Insurance Company, and Communication Satellite (COMSAT), have introduced plans for public-data networks. Two of these offerings involve the integration of voice, data, text or message, and image services: these are the Satellite Business Systems (SBS) entry of IBM *et al.*, and Xerox's Telecommunications Network (XTEN). While SBS and XTEN are intended to provide large business corporations with an alternative to establishing independent, company owned data-communication networks, AT&T's competitive offering (Advanced Communications Service--ACS) proposes to meet the emerging data-communication needs of the smaller corporations. Contingent upon approval of these networks by the Federal Communications Commission (FCC), SBS, XTEN and ACS all may be operational by 1981.

While all three of these offerings are aimed at the capture of a portion of the burgeoning data-communications market in the United States, this Appendix will focus on ACS for conceptual purposes. ACS is described as an intelligent, packet-switched network[1] designed to provide four basic functions to its users:[2]

* Terminal and computer compatibility on a terminal-terminal, computer-computer, and terminal-computer basis, both for inter-company and intracompany applications, "without the requirement that the terminals and computers all use the same protocol."

* Control by the customer of his own "virtual subnetwork" within ACS. Areas such as file access rights, software and network management fall within this area.

* Low entry threshold, in order that small companies with data-communication applications, who are unable to afford the development of an independent network, may gain the benefits of data communications at a low entry cost.

* Adaptability to new uses, which AT&T will provide as new markets or customer needs emerge.

Approximately 450 terminal models (general purpose) manufactured by about 100 different companies can be connected to the system. According to AT&T, these 450 models comprise more than two-thirds of the general purpose terminals on the market.[3] AT&T's long-range plan is for ACS to be comprised of 100 access nodes located in major cities.[4] The first node is to be located in the Chicago area, with the subsequent two nodes to be located in New York and Los Angeles areas.[5]

There are a variety of ways to access or egress ACS. When a customer's premises is located within an ACS serving area, a digital or analog ACS access line can be used. If the customer is located outside the ACS serving area, access can be obtained via private line service, Dataphone Digital Service, telephone company-provided entrance facilities, or through the public switched network.[6]

AT&T, in their petition to the FCC, described ACS as "a shared, switched data-communications network service for the transmission of data."[7] Certainly, it is regarded by many within the communications/computer industries as AT&T's competitive response to the challenge of SBS and XTEN. However, this appears to be too simplistic a rationale for the introduction of ACS.

Although ACS is tentatively slated to benefit mostly the smaller companies by providing cost-effective data communications to the approximately 4,000 data-communications users not targeted by SBS and XTEN,[8] some communications experts are already predicting a second-generation ACS offering. The second-generation ACS would integrate voice, data, text, and video into a nationwide service to business on essentially the same basis as telephone service. ". . . Users could plug in typewriters, facsimile machines, video display devices . . . to tap a wide variety of information services, with pricing based on usage."[9]

APPENDIX D

FOOTNOTES

[1]Barbetta, Frank, "Computer Industry Ponders Potential Benefits, Risks of Planned Network," Electronic News 23 (February 1978):12.

[2]"AT&T Describes Proposed Service as Flexible Data Transmission Net," Electronic News 24 (July 1978):32.

[3]Ibid., p. 42.

[4]"AT&T Files Data Net Plan: Stresses Service Role," Electronic News 25 (July 1978):1.

[5]"AT&T Specialists Supply Technical Details on ACS Net," Data Communications (August 1978):15.

[6]"AT&T Describes . . . Net," p. 46.

[7]"AT&T Specialists . . . on ACS Net," p. 15.

[8]"ACS Good for Small Users, Bad for Intelligent Terminals," Infosystems 125 (August 1978):22.

[9]Saxton, Dr. William A., "ACS to Play Major Role in Industry Future," Communications News 15 (November 1978):67.

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