The Diverse Effects of Compunications Uses: A Suggested Diagnostic Framework

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EXECUTIVE SUMMARY

The purpose of this study is to develop a detailed diagnostic checklist helpful to managers concerned with the possible effects of compunications uses on their respective organizations. (For the convenience of the reader, the checklist is reproduced at the end of the Summary.) The degree to which the checklist will be considered helpful by managers will depend on the extent of their desire to anticipate even the unexpected by canvassing the widest possible range of effects that might results from compunications uses.

The checklist is organized as follows: compunications uses are divided into three categories--information content, information handling processes, and information formats; effects are divided into three categories--operational, internal organizational and external organizational effects. The items listed in each of those six categories are derived from an analysis of seven cases which are presented in the study. The cases are drawn from private and public, civilian and military sectors. They involve compunications uses, managers' expectations regarding such uses, and subsequent assessments of expected and unexpected effects. The case findings illustrate that impacts range from limited operational results, such as dollar savings, to fundamental changes in the relationships between the organizations and their environment.

Conclusions suggest that changes resulting from organizational use of compunications resources are diverse, complex and dependent on the environment in which they occur as well as on the perceptions of

their observers. Unintended or ripple effects are the rule more than the exception: Deployment of an information resource is likely to have impacts which transcend the original objectives.

These conclusions may be of particular interest to managers who seek to anticipate the unexpected.

DETAILED DIAGNOSTIC CHECKLIST
BASED ON CASE FINDINGS

Compunications Uses

Information Content	Information Handling Processes	Information Format
novelty	improved access to information	graphs, designs etc. replacing words, numbers, symbols
correctness	more complete information	VDS replacing or supplementing oral (telephone) or ink-on-paper (Telex, telegraph or mail)
	prompter availability	
	greater convenience	
	directions of information flow	
	computer operations replacing manual operations	

Effects

Operational	Organizational	
	Internal	External
cost savings	work force size type of work supervision work shifts working conditions physical psychological	position (image) vis-a-vis customers competitors suppliers power wielders
productivity		autonomy (external power wielders)
controls	separate data processing department	bargaining chip
possibility of excessive use of controls	relations with other departments	options: external transactions replacing internal
quality of services or products	centralization	power relations
substitution of other resources	de-centralization	
responsiveness of organization	autonomy (departments, subsidiaries)	
buying or selling methods	bargaining chip	
profitability	options: internal transactions replacing external	
feedbacks	power relations	
risks		
information security		

PREFACE

The percentage of U.S. workers employed in information handling of one kind or another passed the 50 percent mark in the early 1970s. This and other changes have led some observers to dub our culture "the information society."

Operationally and structurally, what are compunications doing for and to organizations which use them? More specifically, what benefits do organizations reap from their investments in compunications facilities and services? What problems may compunications create for them? What organizational or managerial tools are required to deal with the special properties of compunications? These are some of the questions the Program on Information Resources Policy will address as it moves into a new area of investigation.

Since its inception in 1972, the Program has focused on the changes taking place within and among the information industries themselves. We are now beginning to round out the picture by examining the effects on the users of these products and services. This study of compunications uses is our first attempt to take a look at the civilian applications of information resources. A parallel effort is investigating command, control, communications, and intelligence (C^3I) functions in military and other facets of national and international security.

Why should such studies be undertaken? Studies of policies relating to other resources--energy and transportation resources, for example--would be considered incomplete if they were limited to the

providers of such resources and did not extend to the users and the effects on them. The same is true of information resources. For more complete understanding, we must study not only providers but also users of information resources and the effects of those resources on them.

I. THE DIVERSE EFFECTS OF COMPUNICATIONS USES*

"Compunications" are the sum of computer and communication technologies. Compunications constitute a prominent part of novel information resources.

There are persuasive macro-economic data to the effect that the developed countries spend ever-increasing amounts of money on information resources and on labor working with such resources. This has led some observers to speak of the arrival of the "information society" or the "post-industrial society," thus creating a certain mystique regarding the use of information resources.[1]

Even if speaking of a new society or economy instead of an information-intensive one may be hyperbolic, numerous new providers of information-handling products and information services interact with one another and with the old ones. Most studies to date have looked at how these providers perceive themselves and how others--competitors, suppliers, customers, regulators among others--perceive them, and what the nature is of the interactions among them: Do they compete with, complement, or supplant one another?

Far less emphasis has been given to studies of how the users who are spending ever-increasing amounts of money on compunications and other information resources perceive the various consequences of the use of these resources. The users and uses of compunications which

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*Throughout this draft we will use the word "effect", as well as various related words, such as "impact", "consequence", "result", "implication", and "outcome". We regard the present stage of the investigation as too early to frame an exacting definition and choose a correct term of art.

this study encompasses are the organizational users in the private and public sectors who use compunications facilities and services in carrying on their activities, including the production of goods or services. This paper is not concerned with individuals or groups who use compunications facilities and services for their own ultimate ends (leisure, education, references, etc.) rather than the production of goods or services for sale.

II. STUDY PURPOSE

The purpose of this study is to develop a diagnostic checklist to help managers who are concerned with the uses of compunications in organizations when they undertake the task of formulating their expectations regarding such uses and in making subsequent assessments of the effects of such uses.

This paper suggests a basic framework dealing with the following questions:

1) Do particular compunications uses involve changes in
   a) information content,
   b) information-handling processes, or
   c) information format?

2) What are the operational and organizational effects that are expected to result from such changes and what do subsequent assessments reveal regarding expected and unexpected results?

This framework is followed by a series of cases involving compunications uses, expectations regarding effects of such uses and assessments of expected and unexpected effects. Some of the findings from the cases will be summarized and related to the suggested basic framework presented earlier. The diagnostic checklist is based on the case findings presented in the six categories of the framework.

The case discussed in Section V is of a different order. It does not involve the handling of data by compunications facilities or services. Rather, it deals with the development of knowledge by interpreting data according to particular theories or assumptions. As

compunications become smarter, the interpreting function may be performed increasingly--or at least aided to increasing degrees--by compunications facilities or services. Since the case deals with organizational effects which are likely to occur as a result of information, it requires attention.

Finally, some conclusions and suggestions for further research directions are presented.

III. SUGGESTED BASIC DIAGNOSTIC FRAMEWORK

FIGURE 1: COMPUNICATIONS USES BY ORGANIZATIONS

Compunications Uses			Effects	
Information Content	Information Handling Processes	Information Format	Operational	Organizational
			Internal	External

Compunications uses may be viewed from four vantage points:

Do they involve information content?

Do they involve information handling processes?

Do they involve information format?

Do they involve one, two or all of these aspects?

An example will show what is meant by content, handling processes, and format. Sun dials, watches and clocks tell the time of the day. That is the information content, and it is the same whether the time piece is a sun dial, a watch or a clock.

The handling processes vary significantly. In the case of the sun dial, a lengthy object throws the sun's shadow onto a dial. In the cases of watches and clocks, mechanical means (springs or weights), electric motors, electronic or other methods constitute the handling processes.

The format consists of moving shadows, moving hands, pealing bells, a recorded announcement over telephone lines, numbers shown on a watch surface, outdoor signs, a television screen, etc.

More generally, the terms may be defined as follows:

Content is information substance. Content includes, for example, symbols, letters, numbers, words, graphs, and designs.

Handling Processes refers to the various methods by which compunications facilities or services transmit or otherwise handle content. The methods include transmitting, storing, gathering, transforming, etc.

Format is the form in which content is presented. Format includes video on screen (VDT), ink on paper, sound (electronic or mechanical), and optical/mechanical light projection, among others.

As will be discussed below, perceptions differ as to whether particular handling methods produce changes in format or content or both.

III. ILLUSTRATIVE CASES

Case 1: Computerized Telephone Management System* (CTMS)

Expectations:

Faced with a move to a new facility, a major engineering and design firm began searching for a computerized telephone management system that would provide the benefits of least cost routing and, more importantly, a more efficient method of call record keeping for distributing costs.

The firm also needed a system that could automatically identify the station from which the call was being placed and automatically accept a charge number.

The firm had been spending an average of $50,000/month for approximately 22,000 calls. Half of the calls were DDD, while the other half were placed on the firm's 18 WATS lines. The firm sought to reduce these costs.

The firm formerly employed eight operators to process and ticket 50% of its outgoing toll calls. The rest of the calls were dialed directly by the extension users. The manual callers kept records to identify who called whom. On the basis of those records, the direct-dial calls had to be distributed to the proper account at a later date. The firm sought to reduce the number of operators and to secure more correct cost information regarding toll calls.

The firm decided to acquire the automated system, in the expectation of controlling long distance costs and recording calls

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*This case is based on information published in an article by Computerworld, the full text of which appears in Appendix 1.

according to charge number in order to distribute costs among the firm's various branches.

Assessment:

The firm now employs only three operators, and the entire calling system is automated, saving the firm 35%--more than $17,000/month according to the firm's manager of Information Systems and Facilities Group.

To place a call, a user enters a seven-digit code to identify the accounts to be billed and then dials the standard telephone number. Only international calls are allowed to go DDD.

Though the system involved dialing a few more digits, it was felt that the accounts were considerably easier to handle than through the manually kept call logs and the verification procedure used previously.

All call information is transferred to the firm's Treasury Division which bills the calls to various divisions.

The firm's manager of the Information Systems and Facilities Group is quoted as follows: "It would be hard to dislike something that is saving you $17,000 a month. Top management likes it and so do the people that use it every day, which I think is also an important factor."

Case Discussion:

The Computerized Telephone Management System case shows how expected operational goals--improved productivity and improved controls--were achieved through the installation of a computerized

telephone management and call record keeping system. The account procedure used by the firm involved allocating as accurately as possible specific toll calls among the firm's branches and clients.

The case quotes the firm's manager of the Information Systems and Facilities Group as stating "Top management likes it"--that is, the monthly savings of $17,000. The case does not state whether top management tried to answer another operational question: Should the firm have abandoned its procedure of allocating and controlling costs in favor of an alternative procedure, such as averaging toll calling costs among the firm's branches and the firm's clients? Such a change would not have required the installation of complex and expensive automated equipment and the dialing of seven extra digits whenever a toll call is made.

The case further does not discuss another operational question, namely, what impacts might the changeover have on uses of the firm's telephone system by employees for their own private purposes? Automatic record keeping might have a deterring effect on such uses.

The use of the computerized telephone management and call record keeping system changed some aspects of information handling processes. Automatic record keeping replaced manual record keeping. Information content (pertaining to the stations originating the calls and the account numbers to which the calls would be charged) and the ultimate format (ink on paper) remained unchanged.

The use of the new system had operational impacts (saving operating costs, requiring the dialing of additional digits and eliminating DDD dialing). Organizational impacts (except for reduced employment of operators) within and outside the firm are likely to be

nonexistent or trivial. For example, there is no information on clients' reactions to the system or even whether they were aware of the system's existence.

Case 2: Parts Distribution Management (PDM)

A major manufacturer of heavy duty automotive and industrial equipment established a parts distribution management (PDM) system. PDM is a data bank which tells each of the company's 93 national dealers who operate at 321 different locations which parts are available at each of these locations and at the 15 company operated parts depots scattered throughout the country. The system enables the dealers to fill 99% of special parts orders within 24 hours. PDM replaced TELEX communications with the depots and one-by-one long distance calls to individual dealers.

The average dealer pays less than $1,000/month instead of incurring extensive phone and TELEX bills plus associated personnel costs.

Expectations:

Instituting the PDM system was perceived by the company and its dealers as an important aspect of their "value" oriented long-term market strategy of offering superior customer support, response time, attention and service, giving the company and its dealers an edge on their competitors in highly competitive product markets such as earth moving equipment and medium duty truck engines.

Assessment:

Demonstrating the system to a potential customer was perceived as an invaluable selling aid.

Since equipment downtime can be very expensive to contractors, getting the needed part promptly can save customers a great deal of money. The company's and the dealer's superior customer service generates customer loyalty to the company's products.

Improved operational efficiencies on the part of dealer organizations or saving in telephone bills are perceived as minor though welcome aspects of PDM.

Improved dealer ability to cope with parts and finished products supply interruptions (caused, for example, by strikes) constitutes another favorable aspect of PDM since it permits dealers' access to each other's inventories. Use of PDM is not aimed at achieving resource substitution by permitting dealers to reduce their regular inventories of parts and finished products below what they would be compelled to carry without PDM.

Case Discussion:

The Parts Distribution Management case shows that a technologically more advanced information resource--a computerized data bank showing the location of sources of parts--improved the firm's organizational image to its customer, a well-established strategic goal. This information resource supported a market strategy of offering superior customer support, response time, attention and service to give the company and its dealers an edge on their competitors in highly competitive product markets. Previously, Telex

communications and one-by-one long distance calls to dealers had been used to achieve the strategic goal of offering superior customer service.

In this case, information handling processes are changed greatly: access to information (which part is available where) is improved although information content is unchanged. Information is available on all dealers' inventories instead of the inventories of those dealers who are contacted by phone or Telex. Information format is changed: VDS or a computer print-out replaces oral (telephone) delivery or ink-on-paper, as with Telex. Information used to flow from the inquiring dealer to nearby dealers, and if they replied in the negative, to dealers in more remote locations until the needed part was located. The information flow started when a needed part was not available in a dealer's inventory. Now, however, the information flows on an ongoing basis from every dealer to a central point--the data bank. When an inquiry reaches the data bank, the inquiring dealer receives complete information on all locations of a particular part almost in real time. Thus, information access is improved greatly: More complete information becomes accessible in less time with reduced efforts.

Improved access may have operational impacts such as cost savings and improved efficiencies of dealer operations. Improved access, however, is also perceived as having organizational impacts such as improved service relations between dealers and customers, improved sales methods to attract new customers, and improved positioning of the firm vis-a-vis its competitors.

The case shows that the company considered the achievement of operational goals--such as savings in telephone bills, operational efficiencies on the part of dealer organizations and possible reductions in part inventories--as minor goals when contrasted with facilitating achievement of the company's strategic goal of more clearly distinguishing the firm from its competitors by making even more effective its long-term marketing strategy of stressing superior customer service.

The case does not show, however, whether the impacts which the PDM system had on actual and potential customers were minor or major.

The case further does not show whether the firm's competitors lost customers to the firm employing PDM or whether the competitors were impelled to install similar systems.

Case 3: Computer Aided Designing (CAD)

The firm involved is a prominent photographic equipment manufacturer. The principal organizations involved in planning CAD are the firm's engineering management and, more specifically, their engineering analytical support group. The principal products involved are 2-D circuit boards utilized in industrial products and overall product instrumentation. The designing of such boards is considered a routine operation, well developed and suited to CAD.

Expectations:

The senior principal engineer responsible for the CAD installation felt that improved time productivity in designing the 2-D

circuit boards constituted the best justification for acquisition of the computer. The CAD system could also be used for 3-D mechanical design work but improved quality of such work with fewer errors was perceived as a less persuasive justification than "raw speed."

After talking to several vendors and users and attending demonstrations, the firm purchased a particular computer. It instituted a six-month training program for a group of employees, and upon completion of their training, the firm ran a productivity test to compare the output levels achieved by the firm's employees with those attained by other firms. On the basis of these tests, the firm expected a three-fold increase in productivity measured as units of output per unit of time.

Assessment and New Expectations:

Evidently, the CAD system lives up to expectations with regard to increased productivity of circuit boards. However, only 50% of the jobs performed by the system are circuit boards, and another 10% involve equally elementary jobs. The remainder of the jobs involve 3-D mechanical design work, and the manager of the CAD system expects that percentage to increase since the system staff has brought itself to a high level of expertise in this more challenging work. The staff has a long list of potential applications: piping, office lay-outs, form designs, punching NC tapes, finite-element modelling for structural problems, chemistry, etc. There is a special interest in the system's capability of designing products and test equipment for such products interactively.

To accommodate the various design centers which propose to use the CAD system, a policy committee representing the different users was formed. The committee had to address a number of organizational problems, such as scheduling (the time of the skilled operators was originally broken down into two hour blocks but this proved insufficient and six hour blocks were substituted); work shifts of CAD operators (the work shifts were increased from one to two, and an increase to three was under discussion); cooperation between engineers and system operators (multiple shifts for operators and single shifts for engineers have created problems); supervision of system operators (operators cannot be supervised the way draftsmen were supervised).

Purchase of a second computer was under consideration to perform all the jobs that the system users have in mind and to have a back-up system available.

Case Discussion:

The CAD case involves improved productivity and internal organizational changes resulting from the versatility of the information resource.

The CAD system changes information handling processes. One aspect of such information handling processes is transforming information from one form (words, numbers, symbols, etc.) into another form (graphs, designs, etc.). Transformation functions performed before manually by engineers and designers, for example, are now done by computers, operated by CAD system staff members. There is no indication of changes in information content.

The ever-expanding operational demands made upon the CAD system by different departments necessitated organizational reforms. The level assigned to each of these organizational reforms, ranging from "trivial" through "minor but requiring action" to "major," is likely to depend on the individuals or groups within the organization perceiving these impacts.

Except for circuit boards, the case does not indicate to what degree the CAD system is perceived (and by whom) as improving productivity or the quality of some of the firm's products. The case further does not suggest that the CAD system is perceived as making more profitable the firm's sales of goods or services. These questions may be answered differently by different individuals depending on their different professional backgrounds. For example, engineers and comptrollers may differ in their perceptions. Finally, the case does not indicate whether members of the top management team have sought answers to questions which belong in these categories.

Case 4: U.S. Coast Guard's AMVER Program (AMVER)

AMVER stands for Automated Mutual-assistance Vessel Rescue. The U.S. Coast Guard's AMVER program began in the Western Atlantic in 1958 and spread out over the next ten years to cover the seven seas. It is a vessel-tracking data base maintained by the U.S. Coast Guard on the basis of information supplied voluntarily by participating vessels. It furnishes Search And Rescue (SAR) agencies a SURface PICture (SURPIC) of the relevant area showing which of the AMVER-participating ships are where. This then enables the SAR agency or a pilot about to

ditch his plane to pick out the most appropriate ship to render any needed emergency service such as medical services, picking up plane or ship crews and passengers, rendering fire fighting assistance, participating in man overboard searches, or tracking down an overdue ship.

Before the initiation of AMVER, SAR work performed by shore personnel had to be conducted blind by relying on radio communications alone without knowing ship locations from a surface picture of the area.

The pre-AMVER procedure for distant rescue involved radio messages to ALL SHIPS. Ships responded by return messages telling CG their positions, routes and capabilities. Rescue authorities then analyzed information provided by ships and selected "best" rescue or search units. This procedure could take hours. During this period, many ships would divert to proceed to the distress scene and, in some cases, CG units would also be sent. After analyses were completed, unneeded units could then return to normal operations.

Post-AMVER, rescue authorities may resort to ALL SHIPS broadcasts in some cases where evaluation of AMVER information suggests that "best" rescue unit should be located by means of ALL SHIPS broadcast. AMVER alone might not locate the "best" rescue unit because only locations of ships participating in AMVER are known to rescue authorities, and locations of other ships are unknown.

Expectations:

(1) Speeding up SAR procedures designed to locate "best" rescue unit.

(2) Increasing probability of successful rescue through prior position knowledge.

(3) Reducing SAR agencies' and vessel owners' costs by having prior knowledge of position of vessel reported to be in distress and by rescuing vessel without having to alert all ships in the vicinity.

(4) Achieving voluntary vessel participation of substantially all vessels of free nations. (Nations dominated by U.S.S.R. are urged to cooperate but few do.)

Assessment:

(1) AMVER operations are conducted exclusively on Governor's Island, New York where reports from an international network of nearly 100 stations and services are received and put into the AMVER data base. The AMVER center is operated by 38 Coast Guard personnel at a cost to the CG of $618,000 plus the message handling cost a portion of which is paid by the CG and the remainder by foreign radio stations.

Whether or not this expenditure actually saves other CG resources (such as CG cutters, planes, fuel, employee time) depends on CG's perception of AMVER either as a partial substitute for or as a supplement to CG's own traditional rescue operations conducted by cutter, plane or helicopter.

It seems reasonable to assume that ship owners' resources (fuel, time spent on rescue operations) can be saved by not diverting unneeded ships.

(2) Because of the voluntary nature of the AMVER program, there is a continuing need to increase the vessel participation rate through

CG awards to ship owners and to improve completeness and accuracy of information furnished by participating vessels.

(3) Since AMVER program participation is voluntary, information is provided by participating ships on the premise that it will be used for safety only. Therefore, CG does not give CG law enforcement branches--antismuggling and antipollution--access to AMVER-generated information except for the publicized secondary purpose that AMVER center automatically advises CG of impending arrival in U.S. ports of AMVER participating ships. Vessels are required by the Code of Federal Regulations to notify CG in advance of arrival.

(4) Since CG or other SAR agencies abroad may direct a specific request for assistance to a specific AMVER participating vessel, a question arises whether AMVER participation may be perceived as possibly leading to greater obligations to render aid in emergency situations. (AMVER literature stresses that participants incur no greater obligations than nonparticipants.)

(5) Coordination of AMVER vessel-tracking services with other national or international vessel-tracking services is a subject of considerable interest to the Intergovernmental Maritime Organization (IMO). Thus AMVER impacts on U.S. foreign policies.

(6) Fitting AMVER personnel into CG's military personnel policies presents problems such as (a) CG moves personnel around on ships, planes, shore installations, etc. but AMVER personnel are located exclusively on Governor's Island; (b) CG has no special rating for data processors; (c) job opportunities (in the private sector) beckon to AMVER personnel because after a tour of duty at the AMVER

Center the personnel are experienced data processors and thus attractive to industry.

Case Discussion:

With regard to information changes, the AMVER case resembles the PDM case: The needed information content (ship locations in one case and automotive parts locations in the other) is more complete, more easily accessible and its format is improved. The content is more complete in that all relevant ship locations and inventories of all dealers are available, more readily accessible in that the information is already available when help or parts are needed. The format in which the information is made available is improved in that a "picture"—computer printout—of ship locations replaces individual TELEX messages, and a computer printout or a display screen replaces oral telephone or typed TELEX messages regarding parts' availability.

Even more important, information handling processes and information flow have changed: Computers assemble, store and furnish information and flow from multiple points (ships and dealers) to a central point (computerized data banks) and back to multiple points (ships, SAR installations and dealer organizations). This process has taken the place of multiple point-to-point information flow from help-seeking ships to SAR installations and potentially helping ships as well as from parts-seeking dealers to potentially parts-supplying dealers. Furthermore, the flow occurs on an ongoing, regularly scheduled basis rather than on an emergency basis.

The AMVER case involves substantial internal organizational changes as well as external organizational changes in the Coast

Guard's relations with some classes of clients: SAR agencies, ships seeking aid and ships extending such aid.

The case suggests that the introduction of the new vessel-tracking data bank--which the Coast Guard perceives as greatly facilitating in a variety of ways the achievement of some of the organization's operational goals--can produce a number of significant internal and external organizational impacts. These impacts are likely to concern not only the policymakers and managers of that organization, but also the policymakers and managers of other organizations with which that organization has ongoing power relationships.

For example, the internal organizational problem of fitting AMVER personnel into the Coast Guard's military personnel policies is likely to be an organizational problem which may concern not only the Coast Guard's policymakers and managers but also the policymakers and managers of the Department of Transportation which exercises policy and administrative controls over the Coast Guard. The need to coordinate AMVER vessel-tracking services with international vessel-tracking services which are of interest to an international organization (IMCO) makes this aspect of AMVER a U.S. foreign policy concern. This impact then may result in policymakers and managers in the Department of State, the White House and the Congress becoming involved with Coast Guard operations to a greater extent than was the case before the Coast Guard's introduction of AMVER.

Continued support for AMVER both within and outside the CG suggests that the operational and organizational impacts, while perhaps significant, nevertheless are perceived as manageable and

worth the efforts that will have to be expended to deal with them. Most interested parties, therefore, are likely to perceive AMVER as a changed information handling process which constitutes a continuing success.

Case 5: "PERT" and the Polaris Missile System Development (PERT)

This case[2] involves the development and adoption of an innovative management control system named "PERT" (an acronym for "Program Evaluation and Review Technique) to assure the on-time development and construction of a fleet ballistic missile (FBM) system named "Polaris."

Expectations:

Admiral William F. Raborn who was in charge of the Special Projects Office (now the Strategic Systems Project Office) of the Department of the Navy was interested from the beginning of the Polaris system project in developing an innovative management system for his Office.[3] The purpose of the system was to achieve autonomy for his Office to conduct a complex and risky project without the interference of outside bureaucratic meddling.[4] Admiral Raborn hired Gordon Pehrson, a civil servant who had a deep personal interest in developing innovative management control systems, to become director of the Project's Plans and Program Division.[5] Pehrson prepared a document for Admiral Raborn stressing the need for an integrated planning and evaluation system for the entire program that would enable the Admiral "to reach down to any level of Special Projects

Office activity and find a plan and a performance report that logically and clearly can be related to the total job we have to do."[6]

To achieve these basic objectives, PERT was developed for the Polaris missile project.[7] PERT was programmed for computer usage and was aimed at scheduling the on-time development of the Polaris missile. PERT, however, had no capacity for considering dollar costs of particular activities and thus was not a very powerful tool in facilitating the reallocation of resources among project activities. To remedy this deficiency, a PERT/COST system was developed[8] somewhat later.

PERT involved the integrated evaluation of

a. "Progress to date and the progress outlook toward the objectives of the FBM program,

b. Changes in validity of the established plans for accomplishing the program's objectives, and

c. Effects of changes proposed for established plans."[9]

Assessment:

Dr. J. Sterling Livingston of the Harvard Business School, a critic of defense organization and management, stated that the Polaris program was unique among major weapon programs in terms of its managerial effectiveness.[10]

Harvey M. Sapolsky of the Department of Political Science of the Massachusetts Institute of Technology, however, concluded that the technological success of the Polaris missile could not be attributed to PERT because the management techniques described in PERT either were not applied on a significant scale or did not work or, if applied

successfully, had a purpose totally different from the purpose officially described.[11]

Sapolsky concluded that

> "...The existence of an integrated, uniquely effective management system was a myth originated by the Special Projects Office. The further removed it was from its source, the more embossed the myth tended to become. It was a myth, however, that had value. For those who wanted the FBM submarines developed, but were reluctant to place their faith completely in the men assigned the task, it gave a sense of assurance. The management system, not the men, would guarantee the scheduled development of the Polaris. For those who were developing the Polaris, it removed the necessity of justifying each development decision to a higher authority. Errors of planning or execution, after all, would be quickly revealed by the management system. For those who specialized in particular components of the management system, it meant there was a ready market for their skills. Was not the Polaris developed years in advance of the original schedule? And were not PERT, LOB, and the rest used in the Polaris development?....[12]

As Sapolsky shows in great detail, PERT received considerable publicity and attention, and the attention brought forth imitative and substitute systems as well as widespread claims of useful applications of PERT principles.[13]

Sapolsky evaluates the strategic impacts of PERT as follows:

> "The Myth in Perspective"
>
> An alchemous combination of whirling computers, brightly colored charts, and fast-talking public relations officers gave the Special Projects Office a truly effective management system. It mattered not whether the parts of the system functioned or even existed. It mattered only that certain people for a certain period of time believed that they did. Thus, a former Secretary of the Navy was convinced that the Special Projects Office never missed a scheduled commitment (it did) and a former Chief of Naval Operations and a former Assistant Secretary of Defense were certain that PERT always caught impending errors (it did not). The Special Projects Office won the battles for funds and priority. Its program was protected from the bureaucratic interference of the comptrollers and the auditors.

> The success of the technological development confirmed the effectiveness of the management system. Brief surveys by Defense Department committees had only to determine that a particular management technique was part of the Special Projects management system before commending it for department-wide adoption. Management specialists searching aerospace projects for lessons had only to note the connection with the Polaris development to be certain that a given management technique would be useful in the operation of a modern business firm.
>
> The very few that took a closer look discovered the fabrication, but also its value. The British Admiralty, for example, had to examine carefully the operations of the Special Projects Office in order to construct their own FBM force. Its representatives were initially surprised that the Special Projects Office's documented management philosophy did not match its management practice. Nevertheless, they too recommended the adoption of the entire management system as advertised since they recognized the advantages in terms of organizational independence and resource support that such a system could provide.
>
> Over the years, however, the advantages for the Special Project Office have worn thin or disappeared. Changes in the political environment and in the structure of the Department of Defense have limited the ability of weapon projects to chart their own careers. The Special Projects Office, much to its own discomfort, is now often required by fiat and reputation to apply management practices that it would happily abandon for the sake of efficiency. And the techniques that actually guided the Polaris program are ignored because they do not conform to the theories which had their origins supposedly in the very same program."[14]

Case Discussion

The PERT case involves use of a compunications resource for the purpose of achieving substantial departmental automony for the Special Projects Office, within a larger organization (the Navy Department) and within the entire Federal governmental structure.

The PERT case does not show in what particular respects the information content assembled and distributed through PERT differed from information content assembled and distributed for similar projects through more traditional management control systems. The

case suggests, however, that greater quantities of information than under traditional management control systems were assembled at a single central point within rather than outside the Special Projects Office and that the Office was in complete charge as to what information was to be passed on to whom.

The establishment of a central point of information assembly and distrubution within the Office appears to have been a major factor in achieving the managerial autonomy which Admiral Raborn sought for that office.

Furthermore, the assembling and distributing of information by personnel loyal to that office who were only too happy to toot their own horns also appears to have been a factor in securing the desired office autonomy.

The attention-catching form in which the assembled information was presented for distribution, described so vividly by Sapolsky, also may have been an important factor in achieving the autonomy effect of the PERT system.

The case is a good example of how, as Sapolsky perceives it, a compunications resource--PERT--failed to achieve the operational goals which it was designed to achieve. Yet it achieved the organizational goal of giving the Office an aura of unique managerial competence which assured an unusual degree of autonomy. This raises questions of which impacts--operational or organizational--are real. PERT served well in warding off bureaucratic interference by comptrollers, auditors and possibly others within the Department of the Navy or the

Department of Defense, or possibly still others in the White House, the Executive Branch or the Congress.

Perhaps, the answer is that a "myth" becomes a "reality" (or is the equivalent of "reality") when the individuals or groups within organizations with which the user organization has on-going power relations and toward which particular information-handling processes are directed perceive their effects as real.

Whether real or a myth, however, the level of the various organizational impacts of PERT was—as Sapolsky perceives it—not only major but excessive, much like the new cleaning technology described in Goethe's poem "The Sorcerer's Apprentice". The wet mop was replaced by a robot carrying a water pail. The robot, however, could not be kept from flooding the premises.

Thus, as Sapolsky perceives it, the on-going excessive use of the information handling process PERT had a substantially adverse impact not only on the Special Projects Office (later the Strategic Systems Projects Office) but also on the Department of the Navy and other government organizations and those organizations in the private sector which were required to be responsive to the PERT technique.

Case 6: Computerized Data in Multinational Companies (CDMC)

The expectations and assessments regarding the use of computerized data by multinational companies discussed below are those of officers of such companies who were interviewed by an author who made available his report on a confidential basis.

Expectations:

Original expectations were concerned with the use of computerized data to accomplish specific and fairly narrowly defined tasks in such areas as inventory controls, coordination of logistics and financial management, among others. As learning-by-doing progressed, use was made of the computerized transborder data for increasingly broad ranges of functions.

Assessments:

The uses for broader functions had increasingly diverse operational and organizational impacts. The operational impacts involved, for example, improved inventory management resulting in economies of working capital; purchasing economies of scale resulting from more centralized purchasing functions; and reductions in currency exchange risks.

The internal organizational impacts resulted either in increased centralization of management and reduced autonomy of affiliates--in those instances data flow toward headquarters was increased and improved--or in increased decentralization of management and increased autonomy of affiliates, as data flow toward affiliates was increased or improved. The former was true for various manufacturing firms while the latter took place in service firms such as banks.

Other organizational impacts included creation within firms of separate data processing departments, transferring labor-intensive activities to low-wage countries, or reducing transborder technology transfers to affiliates as technology centers became more accessible through use of computerized transborder data flow.

External organizational impacts resulted from increased transborder transactions among affiliates located in different countries. The transborder transactions replaced inside-borders transactions between affiliates and unaffiliated companies located in the same country. Other external impacts were twofold: Affiliates relied increasingly on exports rather than domestic markets. In addition, affiliates in some countries increased specialization by producing a limited number of products, while relying for other similar products on affiliates located in other countries. They placed operations in countries with favorable tax and regulatory laws or where compliance with other local policies was most easily achievable.

The transborder flow either involved important information which resulted from already existing commercial activities such as credit cards, airlines, international freight transport, and tourism. Or it involved strategic information which resulted in the planning and execution of new activities such as manufacturing new products or engaging in primary activities such as drilling for oil or mining for metals and minerals.

Case 7: Computerized Data in Government Departments (CDGD)

In each of the following cases involving computerized data in government departments, few details were presented, but the cases nevertheless exemplify a wide variety of computer uses by governmental organizations.[15] The operational and organizational impacts of such

uses are equally diverse. Each case sets forth expectations and assessments.

Expecting to improve welfare payment administration, a municipality adopted a client-tracking information system (UMIS) which was assessed as being valuable because it impressed Federal auditors who thought the municipality carried on an effective welfare operation--and, therefore, assured a more steady flow of Federal funds to that municipality. In fact, improvements to internal operational efficiencies were assessed as being minor or even relatively useless.[16]

A state governor sought to establish a State Attorney General's office in the expectation of establishing state-wide law enforcement policies. This was opposed by local police departments and their staffs which sought to protect their automony vis-a-vis the state government. The adoption of a state-run computerized data bank for histories of criminals and warrants, for example, which was to be placed in the new attorney general's office, helped the governor to overcome the local police departments' opposition to the new state department. The case does not give any information on the relative usefulness of the data bank.[17]

Data banks operated by local police departments were established with the expectation of giving patrolmen on the beat access within five to ten seconds to information including wanted persons, stolen property, and criminal records. The patrolmen used these data banks frequently and effectively. However, viewing the impacts of the data banks from a broader perspective, the ex-chief of the Kansas City Police Department lamented the neglect of other important police

tasks: The patrolmen were inclined to spend more time on relatively minor offenses on which the data banks were supplying information, such as locating stolen vehicles and citing minor traffic offenders. Additionally, the minor cases further clogged the already jammed courts.[18]

The cases which compare smaller and medium-sized municipalities to larger ones show that opportunities for departmental empire building are often better in the larger municipalities and that information resources can be used for empire-building purposes just like other resources.

Case studies of power losses or gains by top municipal officials in relation to their department heads as a result of computer uses suggest that in smaller and medium-sized municipalities the top officials gained power while in larger municipalities the department heads did. The explanation given was that in smaller cities, the mayors or city managers place a strong personal stamp on departmental activities while in larger cities department heads see to it that they gain most from the uses of new computer systems.[19]

Case Discussion

The client-tracking case is, in one respect, the municipal equivalent of the PERT case: The use of information resources--although the resources do not necessarily contribute materially to efficient operations--may enhance the image that the organization is efficient. The cases, differ, however, regarding objectives: autonomy in the PERT case and good relations with the federal government as the source of funds in the municipal case.

The state-run law enforcement data bank involves using an information resource as a bargaining chip in the political power plays that are carried on in political arenas of all levels--federal, state and local. In this respect information resources do not differ from other resources: capital and labor resources--appropriations and job slots--in particular.

The local data banks for police departments involve the ever-present temptation of concentrating on relatively comfortable, routine jobs and neglecting more demanding, uncomfortable ones, especially if for statistical purposes they are counted as being equivalent.

The cases which compare smaller and medium-sized municipalities to larger ones show that opportunities for departmental empire-building are often better in the larger municipalities and that information resources can be used for empire-building purposes just like other resources.

IV. SUMMARY OF FINDINGS FROM CASES RELATED TO SUGGESTED BASIC DIAGNOSTIC FRAMEWORK

Tables 1-7 summarize some of the findings from the cases in telegraphic style and relate those summarized findings to the suggested basic diagnostic framework presented in Figure 1.

The tables suggest a detailed diagnostic framework which is presented in the subsequent section.

Case 1 - CTMS

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format	----------	Internal	External
unchanged	changed: automatic replaces manual record keeping	unchanged: ink on paper	cost savings improved record keeping improved productivity information resources substituted for labor resources	reduced employment	unchanged

Case 2 - PDM

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format		Internal	External
unchanged except more complete	information access changed: access improved: all dealers' inventories replace called dealers' inventories access timing changed: regular updating replaces on demand furnishing of information flow directions changed: flow from all dealers to data bank and from data bank to inquiring dealer replaces dealer to dealer flow	changed: VDS replaces oral (telephone) or ink-on-paper teletype	cost savings by dealers (telephone and Telex bills) improved dealer efficiency: less time spent in locating parts prompter parts delivery to customers cost savings by customers: reduced equipment down-time reduction in dealer inventories possible information resources substituted for material and capital resources improved sales methods by stressing PDM	unknown	improved image vis-a-vis customers improved position vis-a-vis competitors

Case 3 - CAD

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format	----------	Internal	External
unchanged	transformation of of words, numbers, symbols into graphs, designs, etc. by computer replaces manual operations	unchanged: computer printout is still on paper just as manually executed design	improved productivity for circuit boards; unknown for other products improved quality? (no information in case) improved profitability? (no information in case)	employees: CAD system staffers constitute separate employee group perhaps replacing designers or draftsmen work shifts for CAD staff differ from other employee groups changes in supervisory relations (supervision of CAD system staff differs from supervision of draftsmen)	unknown

Case 4 - AMVER

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format		Internal	External
unchanged except more complete	information access changed: access improved: all participating ships' locations replace responding ships' location access timing changed: regular updating replaces on demand furnishing of information flow direction changed: flow from all participating ships to data bank to assistance seeking ship replaces ship to all ships flow	computer printout of ship locations replaces oral radio messages	AMVER supplements other CG resources (cutters, planes, fuel, employee time). Is it also used as a substitute for such resources? AMVER necessitates p.r. campaigns by C.G. to enlist ship participation in voluntary AMVER program AMVER is substitute for ship owners' resources (ships' time, fuel, etc.) by making unnecessary diversion of unneeded ships AMVER information has to be kept from other C.G. missions (law enforcement, antipollution)	employee relations: fitting civilian data processing personnel into military personnel organization	competition for data processing personnel with commercial organizations maintaining ongoing cooperation with ship owners AMVER impacts on U.S. foreign relations and relationships with international organizations justifying costs of AMVER in C.G.'s budget

Case 5 - PERT

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format	----------	Internal	External
probably substantially unchanged but more detailed and more accessible to parties concerned	information concentration at at central point	still ink on paper but more in chart form than words and numbers	PERT did not catch errors or assure on-time performance as it was represented to do office required to use PERT even though use inefficient	enabled office to proceed without outside interference saving employees' time which otherwise would have been spent to fight off actual or potential bureaucratic interference	PERT was perceived by outsiders as always catching errors and assuring on-time performance: image of unique managerial competence resulting in unusual degree of organizational autonomy for office

Case 6 - CDMC

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format		Internal	External
more information on diverse subjects subjects either dealt with before or new strategic information for different countries	compunications replaces or supsupplements telephone, Telex and mail, making information more accessible information flow from center to branches or in reverse	oral (telephone) and ink-on-paper (Telex, telegraph and mail) augmented by VDS and ink-on-paper (computer print-out)	improved inventory management reduced working capital more centralized purchasing reduced currency risks increased dealings with affiliates replaces dealings with outside companies	depending on direction of data flow either more centralization and reduced autonomy for affiliates or reverse separate data processing departments increased specialization of affiliates closer relations among affiliates	transfer of labor-intensive activities to low wage countries reduced technology to underdeveloped countries by centralizing in technology centers increased options regarding taxes, regulations and local policies

Case 7 - CDGD

Information Changes			Effects		
			Operational	Organizational	
Content	Handling Processes	Format	----------	Internal	External
unknown	computerized welfare client tracking system	unchanged (ink-on-paper) but VDS added	client tracking system produces minor efficiencies but is relatively useless		image of efficiency assures steady flow of Federal funds
unknown	improved access to information on criminals through State-run data bank for use of local police departments	same as above		computer uses enhance political power of municipal top officials in small and medium sized municipalities in larger municipalities department heads gain political power	data bank used as bargaining chip to establish Attorney General's office

V. DIAGNOSTIC CHECKLIST BASED ON CASE FINDINGS

On the basis of the tables presented in the preceding section, a diagnostic checklist has been developed as shown in Figure 2 which follows. The checklist can be used by managers of organizations who consider purchasing compunications facilities or contracting for compunications services. The checklist is expected to be helpful in formulating expectations and making assessments regarding effects of compunications uses. The extent to which a manager desires to anticipate the widest possible range of effects of compunications uses on the organizations using compunications will determine the degree to which he may consider the checklist helpful.

FIGURE 2 - DETAILED DIAGNOSTIC CHECKLIST
BASED ON CASE FINDINGS

Compunications Uses			Effects		
				Organizational	
Information Content	Information Handling Processes	Information Format	Operational	Internal	External
novelty	improved access to information	graphs, designs etc. replacing words, numbers, symbols	cost savings	work force size type of work supervision work shifts working conditions physical psychological	position (image) vis-a-vis customers competitors suppliers power wielders
correctness	more complete information	VDS replacing or supplementing oral (telephone) or ink-on-paper (Telex, telegraph or mail)	productivity		autonomy (external power wielders)
	prompter availability		controls	separate data processing department	bargaining chip
	greater convenience		possibility of excessive use of controls	relations with other departments	options: external transactions replacing internal
	directions of information flow		quality of services or products	centralization	power relations
	computer operations replacing manual operations		substitution of other resources	de-centralization	
			responsiveness of organization	autonomy (departments, subsidiaries)	
			buying or selling methods	bargaining chip	
			profitability	options: internal transactions replacing external	
			feedbacks	power relations	
			risks		
			information security		

VI. GENERATING AND INTERPRETING INFORMATION CONTENT

The seven illustrative cases involving compunications uses have involved primarily changes in information-handling processes and format. They have placed relatively little stress on changes in information content. However, instances of changes in information content are likely to have occurred and to occur in the future since compunications facilities and services are frequently employed to produce information content. Scanning in medicine, surveys of crops in agriculture, search for natural resources in business, and surveillance of military activities in pursuit of national security objectives are some examples of applications of compunications facilities and services for purposes of producing information content.

Before information content is put to practical use, however, it often requires interpretation. Individuals using human intelligence now perform this function. But as computers become smarter, compunications facilities and services may supplement or at least partly replace human intelligence to interpret, or to assist in the interpretation of, information content.

Another step in the direction of applying "artificial (i.e. computer) intelligence" consists of incorporating artificial intelligence into tools, machines or other devices. An example of such incorporation is an oil well measuring device introduced in 1982 by Schlumberger, Ltd., the foremost multinational oil and gas field service company. The so-called Dipmeter Adviser is connected to a computerized data base and automatically performs the interpretation functions of an engineer. This measuring device is one of a whole

line of new tools possessing artificial intelligence which Schlumberger expects to develop for oil and gas field services, and towards this end Schlumberger in 1979 acquired Fairschild Camera and Instrument Corporation, a manufacturer of semiconductors and microprocessors.[20]

It is appropriate, therefore, to focus on situations involving interpretation of information content through the interpretation function in such cases is performed without the assistance of compunications facilities or services. A case involving the allied area-wide bombing strategy employed during World War II will serve as an example.

Economist John Kenneth Galbraith, who was in charge of the overall economic assessment of the German mobilization effort and the effects thereon of the air attacks, perceived the expectations and effects as follows:

Expectations:

> ...There were indications that we might have to change our view of the German economic management during the war...The myth of ruthless Nazi competence established during the war years still endures. In reality, German management was for a long time halfhearted and incompetent.
>
> In both the American and British views at the time the German war economy was effectively and powerfully mobilized. In the American metaphor it was the 'tightly stretched drum'; in the British intelligence it was a 'taut string'. It followed that any production of almost any kind that was denied by air attack was serious. It could not be replaced by reduced civilian consumption, for that was at a minimum. It could not be compensated for by increased overall production, for that was at the maximum. There was no slack.
>
> ....The cities were [perceived by British and American air-power strategists] the ideal target; by destroying them, one would inflict irreparable damage on German war production and also, perhaps, on the German will to fight....

Assessments:

> ....at the end of July and the beginning of August 1943, the RAF came in from the North Sea and destroyed the center of Hamburg and adjacent Harburg. A terrible firestorm sweeping air and people into the maelstrom caused thousands of casualties. Destroyed also were restaurants, cabarets, specialty shops, department sotres, banks and other civilian enterprises. The factories and shipyards away from the center escaped. Before the holocaust these had been short of labor. Now waiters, bank clerks, shopkeepers, and entertainers forcibly unemployed by the bombers flocked to the war plants to find work and also get the ration cards that the Nazis thoughtfully distributed to workers there. The bombers had eased the labor shortage. We were beginning to see that we were encouraging one of the greatest, perhaps the greatest miscalculation of the war.[21]

Foreign relations expert George W. Ball, who participated prominently in the bombing survey, reached this conclusion:

> "...there were wide differences as to the interpretation of the data. Neverthrless, we...finally arrived at a compromise. The report of Ken Galbraith's group (the Overall Studies Division) would be published separately, while the Survey would publish an overall assessment of its own. In the end, our findings settled nothing; the central arguments are likely to continue for years. How large a factor was our strategic air offensive in shaping the outcome of the war? Could our resources of men and material have been better employed in other ways?[22]

Case Discussion:

If Galbraith's statements are correct, allied expectations concerning the effects of wide area strategic bombing were based on erroneous interpretations of information content relating to Nazi competence in conducting the German war effort. Actually, according to Galbraith, the management of the German war economy and essential civilian economy was halfhearted and incompetent, leaving a great deal of slack.

According to Ball's statement, information collected by British and United States study teams after the end of the war yielded largely inconclusive assessments of the effects of the allied bombing strategy on German war and essential civilian production.

The instant case constitutes an example of the difficulties encountered in correctly interpreting information content. Interpreting information content requires knowledge, judgment, or wisdom—themselves ill-defined concepts—and as compunications become smarter, they may be used at least to some extent in those areas. When they do, however, questions are likely to arise, as they did in this case, of whether available data were interpreted correctly or whether sufficient correct data were simply unavailable.

VII. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Perhaps the most striking observation that can be made from these cases is so obvious that it might escape our attention. The effects of changes in compunications resources are diverse, complex and highly dependent on individual circumstances, and in many cases the boundaries of the effects are not known. We are not dealing here with a neat system or one in which analysis, no matter how complex, can be orderly. At the present state of our knowledge, this is one of those fields in which all generalities may break down if carried too far, and black and white answers are rarely, if ever, possible.

It is also true that there is no obvious correlation between particular compunications uses and particular effects. For each of the three kinds of uses involving either changes in content, process, or format, the entire checklist of possible effects should be considered. The search for some correlation, however, is probably worthwhile.

The cases suggest that unintended or ripple effects are the rule more than the exception. Deployment of an information resource is likely to have impacts which transcend the original objectives.

We listed changes in content in only two of our cases in Section III, and in these we did not know for sure what those changes were. The cases in that section are weak on the content side. It is too early to know how much this may have been a matter of happenstance, and how much the involvement of content changes is reason for organizations to avoid scrutiny and therefore provide fewer or not-so-clean cases.

Throughout the cases in Section III, information has been treated as relatively straightforward: that is, as data-like items whose content, if not necessarily unimportant, is at least readily identified. Only in Section VI have we ventured into areas in which knowledge, judgment, or wisdom--themselves ill-defined concepts--have appeared to play a major role. In many cases of that sort, the question of how the data was understood often becomes more significant than what data is available.

This study is limited to the effects of uses of compunications resources on organizations. We suspect that the findings here can also illuminate two other segments of society: the individual and the Nation.

Directions that seem to merit further investigation, some of which is already going on within the Program, are these:

1) Collection and examination of more cases, particularly in which content plays a more visible role. We hope with such cases to expand further and refine the diagnostic checklist and to learn more about its limits.

2) The relationship between particular uses of information resources and particular effects of those changes. A presumption of this research is that the forces at work operate in both directions.

3) The effects of information resources on the individual and on society.

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APPENDIX 1

COMPUTERWORLD February 25, 1980

Saves $17,000/Mo
Telephone System Pays for Itself in One Year

by a CW Staff Writer

BOSTON - A major engineering and design firm here saved so much money as a result of installing a telephone switching system that it was able to pay off the system in about one year.

Stone & Webster Engineering Corp. formerly employed eight operators to process and ticket 50% of its outgoing toll calls. The rest of the calls were dialed directly by the extension users; the direct-dial calls had to be identified and distributed to the proper account at a later date.

The firm now employs only three operators, and the entire calling system is automated, saving the company 35%--more than $17,000/mo., according to Dean Malenfant, manager of Stone & Webster's Information Systems and Facilities Group.

Faced with a move to a new facility in 1974, the firm began searching for a computerized telephone management system that would provide the benefits of least cost routing and, more importantly, a more efficient method of distributing costs.

The firm also needed a system that could automatically identify the station from which the call was being placed and automatically accept a charge number.

A Datapoint Corp. Infoswitch/Share system was first evaluated in October 1977; Stone & Webster decided to acquire it in April 1978. It was installed five months later.

The Infoswitch system consists of a host processor, disk system, printer and, in this firm's case, an intelligent switching subsystem (referred to as LDCS) and two intelligent call metering systems (SMDR). The LDCS is used to control long distance costs, and the two SMDRs record calls according to charge number in order to distribute costs among the firm's various branches.

Easier to Handle

To place a call, a user enters a seven-digit code to identify the accounts to be billed and then dials the standard phone number. Stone & Webster felt that though it involves dialing a few more digits, the account procedure was considerably easier to handle than manually kept call logs and verification procedures used previously.

All call information is transferred to Stone & Webster's Treasury Division which bills the calls to various divisions.

Before installing the Infoswitch system, "we had a significant amount of Direct Distance Dialing [DDD], which was expensive. Now, only international calls are allowed to go DDD even at night," Malenfant said.

The firm had been spending an average of $50,000/mo. for approximately 22,000 calls. Half of the calls were DDD, while the other half were placed on Stone & Webster's 18 Wats lines.

"It would be hard to dislike something that is saving you $17,000 a month," Malenfant said. "Top management likes it and so do the people that use it every day, which I think is also an important factor."

Installation went "relatively smoothly," which the firm considers partly attributable to the fact that the it was prepared. The building was wired for the new system, and the firm was able to "cut over" to Infoswitch in a weekend.

Teething Problems

In the following two weeks, the company encountered some teething problems; notably, there was a problem in matching up the phone being used with the identity of the caller. The equipment erred by indicating a blank instead of the identifying number of the caller.

After transferring between the old and new system for a week and a half, the firm eliminated most of the quirks. The system now "works well for Stone and Webster," Malenfant said.

He added that one reason the system has been so successful is that the firm "thoroughly investigated" its own needs and chose the company that could best fill them.

"Once you have decided what is right for you, get totally ready for the installation. Make sure the site of the installation meets all requirements. This is particularly important if you have not experienced computer-related installations previously," Malenfant advised.

The computerized aspect of the telephone setup faded from most users' perspective after a few weeks. "We are reminded that things have changed only at the end of the month, when we see savings that amount to thousands of dollars and telecommunications bills that can be distributed in a matter of hours," Malenfant said.