San Fernando Valley State College

AN INVESTIGATION INTO THE EFFECT OF THE COMPUTER ON
THE ROLE OF THE MIDDLE MANAGER

A thesis submitted in partial satisfaction of the
requirements for the degree of Master of Science in
Business
by
Donald Theodore Sundquist

Committee in charge:

April, 1967
APPROVED by thesis committee

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major adviser

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To Mimi, Alyce, Matt, and Joel
for their waiting.
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ABSTRACT

AN INVESTIGATION INTO THE EFFECT OF THE COMPUTER ON THE ROLE OF THE MIDDLE MANAGER

by

Donald Theodore Sundquist

Master of Science in Business

April, 1967

This thesis is an investigation into how the introduction of computers and electronic data processing (EDP) have impacted the managerial functions of planning, staffing, organizing, directing, and controlling.

Four modes of investigation were used. First, two company case studies were analyzed, one with an extensive computer installation and one with a minimum installation. Second, a questionnaire was mailed to members of the American Production and Inventory Society. Third, personal interviews were conducted with members of middle management in various fields of business. Fourth, an investigation was made into what current literature says regarding the impact of the computer on management.

The closing chapter is a summary of what various authors are predicting for the future of business and management as a result of modern computer technology.
STATEMENT OF THE PROBLEM--The purpose of this thesis is to investigate what impact electronic data processing (EDP) has had on the job of the middle manager. This impact might result from a variety of conditions. A firm might be considering a new application or introduction of a computerized system. The process of operation analysis, organizational changes contemplated or planned revision of operating procedures, personnel requirements, etc. may affect the job of the middle manager. The tangible installation of a computer and the hardware involved, as well as all the changes necessary to make it operational, can further modify the job of the middle manager. The continued use of the computerized system can alter the information flow and its speed throughout an organization and, still further, have an impact on the middle manager's job.

To illustrate the initial consideration stage, one has only to review the range of questions to be answered by the management of a firm evaluating the prospects of a computer in its organization.

I. PLANNING
   A. SCOPE AND CONTENT
      1. Do plans agree with established policies? Have actual or potential areas of conflict between
1. Have the functions within the general policy framework been carefully determined and assigned?
2. Have adequate resources been allocated to these functions?
3. Is the management function adequately distributed?
4. Are all required functions allocated?
5. Are any unnecessary functions allocated?
6. Are the functions allocated so as to provide harmonious groups?
7. Are similar activities grouped closely together?
8. Are dependent functions grouped closely together?
9. Are control functions independent of operating activities?
10. Are activities which are performed in sequence placed closely together?
11. Does any one employee report to more than one boss?
12. Are the span of control and the chain of command as short as possible?
13. Is there an appropriate balance between centralization and decentralization?
14. Does the organizational structure and assignment of responsibility provide for a continuing supply of key personnel?
15. Is the organization appropriate in terms of the factors of size, membership, type of leadership, type of employee, ease of communication, etc.?
16. Does the organization reflect unity of command?
17. Does the organization provide for adequate participation at all levels?
18. Is the organizational structure designed on the basis of the needs of the program rather than on the qualification of past or present employees or executives?
19. Does the form of organization provide for ease of recruitment, selection, and training of replacements?
20. Have clear structural relationships been established so that each part is related to the others and to the whole and so the units can cooperate?
21. Are there any activities which can or should be performed elsewhere?
22. Are there any additional activities necessary?
23. Are there any activities which are duplicated elsewhere and can be eliminated?
24. Are all activities necessary for accomplishment of the functions?

B. Delegation of Authority and Assignment of Responsibility
1. Is there any duplication or overlapping of executive responsibility?
2. Are the assignments of responsibility clear and not complicating?
3. Are there any overlapping responsibilities?
4. Is there any backtracking of work, giving evidence of a lack of required authority or that authority is too high in the organization?
5. Does each person have a clear understanding of his responsibilities?
6. Does each person or organizational unit have adequate authority for fulfillment of its responsibilities?
7. Is any person required to be at the same time an assistant to and a critic of another?
8. Is authority properly secured, located, and utilized?
9. Is the work so organized and executed that it achieves the policy goals?
10. Would it be advisable to re-distribute the duties among more or fewer persons or in a different pattern?

C. Communication
1. Do communications flow readily through all channels of the organization?
2. Does the work of employees suffer from lack of knowledge of what is to be done, or of too many bosses?
3. Could lines of communication be shortened or improved by changing the assignments of responsibility?
4. Are the policies generally known, understood, and accepted as being worthwhile both within the organizational unit and externally?
5. Are plans known to and utilized by all concerned? Are they generally accepted?
6. Are official decisions clear, precise, distinct, and made sufficiently well known?
7. Do all organizational units use the information they receive?

III. Staffing
A. Employee Utilization
1. Have the duties of each position been written down and the responsibilities clearly defined?
2. Are known qualifications established for each position?
3. Is each employee being utilized at the optimum level of his abilities?
4. Are the tasks and the talents of employees reasonably well correlated?
5. Are job responsibilities and position classifications reviewed as changes occur to the persons' conditioning of jobs and jobs' conditioning of persons?
6. Are staff offices properly utilized?
7. Is there a sound opportunity for individual participation?
8. Do the most important duties consume the most time?
9. Do the higher skilled persons do the higher skilled tasks?
10. Is the workload roughly balanced?

B. Training
1. Is there an adequate training program at all levels?
2. Are the supervisory levels adequate, trained, competent?

IV. Directing
A. Internal Relations
1. Are plans being carried out despite any obstacles and in a manner satisfactory for reporting purposes?
2. Are major orders always given to subordinates through the responsible supervisor?
3. Are problems carefully defined and faced when they arise?
4. Are standard orders and regulations established where desirable but not until desirable? Are there enough? -- too many?

5. Are routing procedures followed?

6. Does the system work automatically?

7. Are there any repeated steps or cycles which suggest the possibility of duplication or overlapping?

B. **External Relations**

1. Are relations with other groups properly conducted?

C. **Physical Facilities**

1. Are the layout, the physical facilities and the work conditions adequate?

2. Does the layout keep the lines of communication to a minimum?

3. Does the layout conserve space?

4. Does it provide convenient access to the users but keep outsiders away from the operations being conducted?

5. Is the layout designed in accordance with the flow of work?

6. Is it flexible? Does it allow for expansion?

7. Does it provide for special wiring, planning, ventilation, etc. as necessary?

8. Does it provide for proximity for service units to the units being served?

9. Does it provide for proximity of related units?

10. Does it provide desirable work conditions?

11. Does it provide privacy for confidential work?

12. Is there freedom from noise and distraction?

13. Is there a facility for interviewing and for communication without distracting others?

V. **Controlling**

A. **Standards of Performance**

1. Are there performance schedules, time limitations, operating measurements? Are these not only planned but also utilized?

2. Is data output used to measure performance as a basis for decision, to reformulate policy, to execute regular affairs of business?

B. **Reports and Controls**

1. Are there measuring devices and procedures that insure individual and organizational unit compatibility?

2. Do the control or checking duties cost more than they are worth?

3. Are the established checks and controls necessary?
4. Are reports pertinent to the stated subject?
5. Are reports brief but comprehensive and complete?
6. Are reports accurate and current?
7. Are reports clear to the recipient?
8. Are reports comparative? Is the data related to known standards?
9. Is each report required?
10. Is any unnecessary information included?
11. What additional information should be included?
12. How is the information used?

C. Forms Management
1. Is the design of the form such that completing it is as easy as possible?
2. Are the items clear in their intent?
3. Is the arrangement of items related to the order of information at the source?
4. Are the common information items in a series of forms in the same format and in the same location on the individual forms in the series?
5. Is each item necessary?
6. Why is each copy needed?
7. Are other copies needed?
8. How many are filed by each organizational unit? Need they be filed?
9. Could a circulated copy be used to eliminate the need for one or more copies?
10. Does any organizational unit get more than one copy? Are they necessary?
11. Do the clearest copies go to the right person?¹

All of the foregoing questions touch upon the five basic managerial functions originally defined in Principles of Management as "planning, staffing, organizing, directing, and controlling".² This thesis will investigate within limits some of the impact of EDP on each of these functions.

Importance of the Problem—In attempting to examine the impact on the middle manager, it is desirable and important that the conclusions and experience of others be explored. The use of computers in business applications is expanding rapidly; therefore, management must prepare itself to operate in this environment. Technological breakthroughs in programming, higher printing speeds, faster and more versatile computers and accessory equipment are occurring daily. This could mean that once a system is chosen and installed, that obsolescence is a danger in that a competitor could gain a competitive advantage with a more up-to-date approach.

It will be shown that direct cost control can be improved by the use of EDP. This will improve the efficiency of direct costs, and the computer may also have a radical effect on overhead costs.

EDP can sell itself if it produces specific results such as these: . . . Dynamic inventory and material control data, permitting a 20 to 40 per cent reduction in inventory, a 35 per cent reduction in clerical personnel, immediate verification of lead times and customer delivery dates, and a 20 per cent increase in sales.1

Management to worker ratios are already changing drastically in some businesses, and, as a result, some management already has had to readjust its modus operandi in a major way. "Computers were beginning to thin the ranks of office-based management,

---

particularly factory based labor.\textsuperscript{1}

In the next decade the population increase may accelerate the computer involvement in the management field even more than at present. First, the population increase due to the high birth rate during World War II will have the effect of causing a low ratio of personnel in the 40 to 60 year old age bracket\textsuperscript{2} (considered to be the age of peak efficiency for managers).\textsuperscript{3} This could also mean that the average age of managers might decrease in order to cope with this dearth of managerial personnel. In addition, more high school graduates than ever before are starting college.\textsuperscript{4} This will increase the formal management and technical skill level of younger men. If formal technical and managerial training are requirements of management jobs in companies using EDP, then the younger man will be better qualified to fill these positions.

The executive of tomorrow \ldots will in all probability be younger when he assumes command \ldots He will have an entirely different educational background \ldots He will know more about production, lead time and the like than most presidents today who were raised in the factory.\textsuperscript{5}

\begin{enumerate}
\item[3] Rodney Luther. (This point was first made by Dr. Luther in 1963 in a class at San Fernando Valley State College in California which the author was taking from him at the time, and reconfirmed in an interview in December 1966.)
\item[5] Batten, op. cit., p. 97.
\end{enumerate}
In summary, managers are going to be competing for jobs in companies where computers are used extensively as a tool of management. In addition to being required to manage greater quantities of immediate subordinates, managers will have to use efficiently the tremendous data acquisition systems at his disposal.

However, along with these opportunities (use of computers) come certain responsibilities:
For management education in the area of total business understanding (or how to use facts once they are available).
For putting the utmost in creative thinking into approaches to business management systems.
For utilizing the resultant knowledge of a business to provide leadership. This involves allowing middle management throughout a company to use its skills for original thinking and decision making instead of checking minor details.¹

In the decision making process, the manager will be using only that data that is pertinent and meaningful to the decision at hand.

... action must be taken as dictated by the decision rules that have been built into the system. ... The computer, having simultaneous access to all data pertinent to all parts, analyzes these data in an exhaustive and consistent manner ... and indicates both a suggested action to be taken and the facts upon which the decision was based. (This is extracted from a description of a particular system installation.)²


Operation research staffs are building into the EDP controlled systems decision assisting formula way beyond the comprehension of most managers. It then becomes mandatory that the manager use the computer in this scientific decision making process.

But, management will also find, increasingly, that they are expected to know, understand, and handle new concepts of management. Increasingly, they will find that they are expected to use systematic methods of analysis and decision making, supplemented by new tools of communication, computation, and presentation, . . . but the "management sciences" - such as operations research or decision-making logic - and the new electronic tools and systems are going to make a difference, even to the manager in the small business.¹

Because of this inability to decipher all the specific detail of the decision making process, the manager must depend more than ever on the end results as judgmental criteria of his own effectiveness.

Subsequent chapters in this thesis will explore the detail impact of EDP on the management functions. In the two cases which were analyzed, and the surveys, emphasis is placed on the impact on production and inventory control management. From this analysis of the present, an attempt will be made to forecast the manager's job in the future. If this forecast is correct, and managers train and educate themselves accordingly and then properly apply this knowledge and training, they should be more successful than their counterparts in the management field who did not follow such a path.

Hypothesis--To reiterate, it is the purpose of this thesis to investigate some of the impact on the middle manager's job by the innovation of EDP in the business world. It must be emphasized that we are not here concerned with the things a computer can do, even though some examples will be cited in order to place the reader in a proper frame of reference; viz., we are interested in how the manager has been personally affected, his educational requirements, his change of managerial functions as a result of computer innovation, etc.

To obtain data, over a thousand questionnaires were mailed, ten persons were interviewed, and two cases were analyzed in detail. It is the intention to obtain support or denial of the following stated hypothesis:

IN THE OPINION OF THE MIDDLE MANAGER, EDP HAS AFFECTED HIS ROLE IN SPECIFIC ACTIVITIES IN THE LAST TEN YEARS.

Investigative Techniques--Many investigators, in attempting to support a hypothesis, will violate a fundamental rule that says, "One should never let a single set of data suggest a hypothesis and also prove it."\(^1\) In this case the hypothesis was arbitrarily stated, but this does not detract from an increased support or denial of the hypothesis if multiple analyses are used.

Four types of investigative techniques were used to test

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\(^1\)C. T. Quirmback. I had a personal interview with this man in August, 1966. He is a member of the technical staff of Litton, G/CS, Woodland Hills, and is a specialist in statistical techniques.
the hypothesis posed. First, a mailed questionnaire was used. Second, personal interviews were conducted with members of management. Third, specific cases of EDP installations in companies were analyzed. Fourth, an investigation into what current periodicals and books say the impact of EDP has been on management.

If a majority of the people who answered the questionnaire, and who were interviewed, and an analysis of the cases indicate that the managerial functions have been affected, the hypothesis has support. It must be understood that it is possible for a specific, select grouping of managers to give positive support to hypothesis and another grouping to deny support. For example, managers with ten or more people working for them could support the hypothesis and managers with zero to nine people could deny support.

The cases and questionnaire mailing were analyzed prior to starting the personal interviews. This was done so that the personal interviews could be used to study in depth any conflict that could have arisen between the first two methods of investigation. If the case study was logical, and if the questionnaire survey was accurate, then there should have been no conflict, and the personal interviews could then be used to gain more detail into what impact EDP has had on the manager's job.

Awareness of Need—In a recent speech, Dr. J. D. Couger

1J. Daniel Couger. "Implementation of a Management Information System," Proceedings of the 17th Annual Western Systems Conference, (Los Angeles, California, 1966.) This statement was made in response to a question from the floor at the end of the speech.
stated that the University of Colorado is concentrating in its Master's degree programs in the business school on the training of graduates so that they can efficiently manage in a computerized environment. Dr. Couger had completed a study of thirty-five firms that were in the process of installing computerized management information systems. In addition to this, the management oriented magazines are full of articles on the subject of computer impact on various types of business systems. We can also look at the business forecasts for the data processing industry as a whole. As early as 1957, a bright future for the data processing industry was forecast for the year 1965.

The number of large-scale computers ($1 million or more) presently planned or in use in the United States business, industry, and government is estimated at about five hundred. Medium- and small-scale machines ($50,000 or more) are presently planned or in use at an estimated level of three thousand complete systems. The dollar value of computer manufacturing replacement and service thus represented approaches $2 billion annually. The value of the activity made possible by their use, although impossible to estimate, far exceeds this figure. Estimates which appear reasonable place the total number of computers actually in use by 1965 at about fifteen thousand.¹

By the end of 1965 the actual figures were slightly ahead of this estimate as evidenced by the following quote:

The data processing industry will have its biggest year in 1965, with annual shipments reaching $1.6 billion for the first time in history. Installations of EDP systems will exceed 20,000 by the end of next year, up from 16,000 at the end of this year. Total cumulative value of installed systems will exceed $6.8 billion by the end of 1965.²

Definition of Terms--The following terms are defined for clarification of the content of this paper:

MIDDLE MANAGER: A supervisory position below that level reporting to the chief executive and above the first line supervisor. (For brevity, the word "Manager" alone is used in this paper.)

ELECTRONIC DATA PROCESSING: The automatic processing of data by a digital computer. In writings in the field and in this thesis the terms computer and EDP are often used synonymously and interchangeably.

MIDDLE MANAGER'S ROLE: The five following functions are considered to be the role of the middle manager.

PLANNING: "Planning involves selection of enterprise objectives as well as goals of departments and programs and the determination of the means of reaching them."¹

STAFFING: "Staffing is the executive function which encompasses the recruitment, selection, training, promotion, and retirement of subordinate managers."²

ORGANIZING: "... organization (is) the grouping of activities necessary to accomplish goals and plans, the assignment of these activities to appropriate departments, and the provision for authority delegation and coordination."³

DIRECTING: "To direct subordinates, a manager must motivate,

¹Koontz and O'Donnell, op. cit., p. 69.
²Ibid., p. 396.
³Ibid., p. 205.
communicate, and lead them. "Delegation of authority is a more general form of direction than the issuance of orders." \(^1\)

CONTROLLING: "Control implies measurement of accomplishment against the standard and the correction of deviations to assure attainment of objectives according to plan." \(^2\)

\(^1\)Ibid., p. 471.

\(^2\)Ibid., p. 481.

\(^3\)Ibid., p. 535.
CHAPTER II

WHAT CURRENT PERIODICALS AND BOOKS SAY THE IMPACT OF EDP HAS BEEN ON MANAGEMENT

Introduction--The purpose of this chapter will be to indicate the current thinking of representative authors in the field of business management regarding the impact of computers on the management function. For the most part, none of them have attacked the problem specifically from the viewpoint of the five basic functions of planning, staffing, directing, organizing, and controlling. Instead, the information that is available is in regard to particular examples of computer application or speculation as to the uses to which computers may be put.

The approach used here will be to quote extensively from existing works and derive from what is said what the impact on managers has been. The articles and books which were chosen were typical of writing in the field of EDP and its impact on management. The selection is intended to cover all five of the basic functions of the manager.

Managerial Objectives--Some authorities in the field draw attention to how the computer affects the formulation of objectives and plans through changing the flow of information on which such plans are based. Part of the planning function of the manager is to establish goals and objectives for the portion of
the organization over which he is responsible. John C. Postley calls attention to the way in which the installation of an EDP approach to management affects the manager's thinking.

The objectives for utilizing large-scale computers in a particular business firm must be reformulated in terms of the future. Present objectives, formulated by accepting the constraints of past or present capabilities in data processing, are not likely to be suitable...\(^1\)

The underlying idea here is that the system objectives are developed for the purpose of improving management. To the extent that they approach the ideal management system, such objectives may involve new paths of data flow and new processing procedures.\(^2\)

In other words, managers must for the purpose of performing their planning function, disregard some of their present sources of planning data and look to new and different channels. The degree to which they are successful will to a large degree determine the rate at which their presently proposed EDP system becomes obsolete in the competitive business world.

Communication—Managers spend most of their communication effort in writing or speaking to human beings. This requires the use of words and sentences. But with the computer processing information between people and with the new technological language which has developed, different techniques of communication may become important. Postley emphasizes the failing of human beings

\(^1\)John A. Postley, _op. cit._, p. 10.

\(^2\)Ibid., p. 11.
to grasp the technique of communicating between the computer program people and the managerial personnel.

Work is under way toward a universal programming system. By means of such a system, a program can be written to solve a given problem on any computer of adequate capacity. A few limited cases of this kind have been treated successfully very recently, but the lack of a general solution to this problem is probably due more to a lack of a precise definition of the problems to be solved than to any deficiency in the data processing technique. The distinction between performing the stated task and performing the desired task, easily made by humans, represents the last major barrier to all-out business data processing by a digital computer system.1

One can surmise from the following that the communication that takes place is a statement of the desire of the manager to have more complete information at hand for making a proper decision on the problem.

But, unfortunately, in a great many applications the output which occurs is concerned primarily with reproducing for human perusal the contents of the files of the machine system. Although it occasionally serves a useful purpose, this kind of output is essentially a throwback to the systems employed before modern data processing equipment and techniques were available.2

Under these conditions the control function of the manager is unaltered per se, except that decisions may tend to be more accurate and timely. A possible explanation of why a manager fails to design a proper optimum system and a definition of the problem is as follows:

1 Ibid., p. 25.
2 Ibid., p. 37.
The tendency is for business management people, lacking direct experience in data processing, to place too many of the subproblems into the first class. (previously defined as 'the objectives of the business organization clearly dominating the data processing considerations') Thus, management is likely to place excessive emphasis on the achievement of those management reports or those inquiry-response goals which appear today to be requirements of the system.¹

"... the real problem (is) whether to strive for immediate relief from current difficulties in data processing or to attempt to achieve larger benefits over a longer run."²

Managerial Decision-Making--Managers must make a continuous series of decisions in response to correcting changes that may be required as events disrupt the chain of events leading to an objective. Postley goes on to point out that many of these decisions will become unnecessary.

A computer system can usually be used more advantageously than just to produce larger and more frequent management reports. In fact, insofar as management reports serve to provide diverse information to people for the decision making which involves a straightforward application of established rules to this information, the computer system should be employed as a means for making the decisions. Under such operation, the information involved in the reports is used by the computer for this purpose, and the explicit production of the reports as such is often eliminated.³

This points out that during the planning phase of considering an EDP system installation, a great effect can be made on the eventual control function of a manager. In essence, the manager

¹Ibid., p. 46.
²Ibid., p. 90.
³Ibid., p. 13.
might have the opportunity to give up some of his heretofore
decision making powers and not just use the EDP system as a more
efficient data gathering tool; i.e., alter his control function.

The Trend Toward Total Systems--A few of the articles and
books reviewed indicated a trend toward such an expansive use of
EDP that the term "Total System" has been applied to this kind of
installation. It is in this extensive usage that all operations
of a major concern can be linked together with a computer. An
article from Business Week magazine in 1963 described such a
system where a group of managers in a central location in Nor-
thern California would be fed information by a computer and have
the capability of controlling a statewide operation. Managers
would be able to ask the computer questions about the operation
and have answers instantly available. The system would even con-
trol the ground rules of their decisions. The system described
here was the most ambitious and comprehensive use of a computer
found in the literature research.

Lockheed took a giant stride . . . when it unveiled the
latest link in its growing management information network.
The new link, which will bring to 383 the number of remote-
control input stations feeding . . . a central computer
brain, (in) . . . Sunnyvale, California. This brings Lock-
heed well on its way to wiring all its decision makers into
a total system . . . one network that delivers the latest
decision-making information to the right man at the right
time.

A plant manager, faced with a sudden critical labor
shortage in one department, will only have to push a couple
of buttons . . . and within seconds, the machine will dis-
gorge a complete rundown on all the workers in the plant.

Later, when Lockheed's total system becomes a reality,
. . . top managers sit down in a control room . . . comput-
ers programmed with company policy will take up-to-the-minute
information, organize it into chart form, run it through a slide-making machine, and flash it to the waiting managers. The computer can offer and pretest solutions before manpower and materials are committed.\(^1\)

**Changes in Control**—Foxworth's comments on control were typical of the current literature reviewed. He does discuss the impact on the management control function with a degree of detail that makes his comments most pertinent to this thesis.

Control is here defined to mean those actions taken to assure that performance conforms to plans. The specific phase of this process which has been most affected by the use of computers is that of measuring and reporting on performance, \(\ldots\) the primary interest here is in changes in control in the other (than EDP Department) activities of the business, and for this purpose the definition should serve.\(^2\)

The changes that have occurred in the control process may be summarized under three headings:

1. The nature of the control that is exercised.
2. The speed with which control information is reported.
3. The accuracy of information in the control reports.

Under the first heading two kinds of things have occurred. First, where "automatic" decisions are made by the computer, a different kind of control is needed. There is little need for continuous supervision to see that performance conforms to plans, \(\ldots\). Computers have been proved to have a very high degree of reliability of performance so that once the program is properly written there need be only such checks as are

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2James Barber Foxworth, *The Impact of Electronic Computers on Management Processes: Case Studies on Three Leading Companies*, (Ann Arbor, Michigan, University Microfilms, 1959) (This book is a PhD thesis done at Columbia University and is the one work that was found in the field which attacks the same problem as this thesis. "This study is directed at the management implications of the use of electronic computers, in terms of the impact that such use has had on the administrative processes of organization, planning, and control.")
necessary to detect the occasional mechanical troubles which do develop.¹

The second change in the nature of the control exercised was the few instances in which "management by exception" seemed to be used more often than previously.²

In connection with the speed with which control information is reported, it should be noted that this factor is mentioned in connection with practically every application described . . .³

Under the third heading, accuracy of report, there were considerable improvements noted . . . This improvement seemed to take place in two forms. First, since computers can perform a long series of related operations, less manual intervention is necessary, thus eliminating a major source of error.⁴

The other form in which this change has taken place is in the elimination of "flash" reports in some instances . . . Where the data can be processed by computer with less manual handling the first processing can be done quickly and accurately enough to serve both purposes.⁵

Organization Impact—Solomon indicates that the manager must think in terms of functional efficiency in the organization of tasks and reorganize jobs to take advantage of the efficiency which a computer offers.

When the design of a computer system emphasizes its role as a management tool, it makes use of the total system idea in two ways. First, within the limits of cost

¹ Ibid., p. 149.
² Ibid., p. 150.
³ Ibid., p. 151.
⁴ Ibid., p. 151.
⁵ Ibid., p. 152.
justification, the computer system combines naturally related functions that are performed separately in manual processing, thus approaching a total system horizontally. Second, the design of a computer system requires redefinition of the goals to be met by the function and, usually, a reassignment of tasks for more efficient operation.¹

Case studies which were done by Foxworth indicate some of the variations of organization which can occur as a result of the impact of a computer installation. The following paragraph indicates that the responsibility for doing a particular job has been transferred to the EDP department, but that the responsibility for defining the function and determining the rules of operation remain with the department who gave up the function.

One of the first organizational changes noted was the creation of new departments to handle some or all of the responsibilities involved in computer operation or planning. To the extent that changes have occurred in other departments, it is, generally speaking, because of the fact that the new department for computer work has taken over some of the clerical functions, . . . there has been some shifting of decision-making functions into these new data processing departments; in every instance the rules by which the decisions are made are still prescribed by the operating departments concerned.²

This indicates the organizational function of the manager has been affected in that he must now distribute the arrangement of "work" to be most efficiently handled by either his own people on a manual basis or by the EDP departments if it is more efficiently or comprehensively done there. If the manager does have the

²James Barber Foxworth, op. cit.; p. 141.
control of the decision making function in the EDP department as indicated, then it seems that the individual department managers would accept the new computer as a tool of their organization and it would therefore be utilized to the fullest without reservation on their part.

The change in the locus of decision-making responsibility has been a bit more subtle than the change in organization structure. For the most part it has consisted of shifting to the computer for "automatic" treatment certain kinds of decisions which were formerly made by individuals on the basis, at least partly, of judgment and experience.¹

During the feasibility study phase in one of the companies which Foxworth studied, an organizational change was made in regard to the job of Manager of Office Methods and Procedures.

It might also be pertinent to point out here another organizational change which, although it preceded installation of the computer, was continued afterward in part because of the existence of the computer. This change, which was made in the Controllers Department at Westinghouse, was designed primarily to facilitate the feasibility study. It involved breaking out a section that formerly reported through an intermediate level and increasing its authority level by direct reporting to the Controller.²

This kind of organizational change appears to be logical and perhaps would be found in many companies utilizing EDP in that the department is actually a major service function for the entire company at all levels. The EDP department's importance is thus emphasized.

¹ Ibid., p. 143.
² Ibid., p. 142.
Changes in the Planning Function--In Foxworth's discussion of the planning function he did not specifically say so but his analysis does indicate that it was affected to a greater degree than the other functions of management. The following is his analysis of the planning function and in what way EDP affected it in the companies studied.

To provide a frame work for a discussion of changes, the planning process will be considered as consisting of the following steps:
1. Definition of the problem.
2. Determination of the alternatives.
3. Collection and analysis of pertinent facts.
4. Decision.
There have been at least some changes in all four of these steps.

In the first step, problem definition, the two principal changes observed have been a broadening of the scope of given problems and more precise definition of the problem. The possibility of integrated data processing has permitted some combination of parts of the over-all planning that were formerly done separately.1

In the area of more precise definition of problems two things are involved. First, the possibility of moving a substantial part of the clerical work out of the operating departments has permitted an additional concentration on the basic function of the department.2

The increased use of mathematical and statistical techniques has forced a more careful consideration of problem definition. The successful use of many of these techniques requires a very careful definition of objectives and the factors involved.3

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1 Ibid., p. 145.
2 Ibid., p. 146.
3 Ibid., p. 147.
In the area of determining the alternatives available, the principal difference is the possibility now of examining a great many more of the alternatives available. In the past, planners have been forced by time limitations to select for further examination only those few alternatives which, on the basis of judgment and past experience, looked most promising, . . . But in some instances the "best" plan is not discovered.\(^1\)

These same techniques have resulted in two changes in the third stage, collection and analysis of pertinent facts. The first . . . is the systematic collection of more facts. In some instances this is a collection of more of the same kind of facts . . . In other instances there is a collection of different kinds of facts believed more pertinent to the problem involved.\(^2\)

It should be noted in this connection that the more complete collection of facts means that in some instances the analysis is based on facts rather than assumptions.\(^3\)

The second kind of change involved in this area is the more consistent and systematic analysis of these facts, amounting in some instances to standardization of the analysis process.\(^4\)

The changes in the preceding three steps have resulted in three changes in the fourth step - the decision. These changes are better decisions, changes in timing of decisions, and a greater flexibility in the planning process.\(^5\)

Foxworth was the only author that was found to be of the opinion that EDP added flexibility to an operation. For the most part books and articles elaborated on the fact that programming was expensive and therefore not easily changed.

\(^{1}\)Ibid., p. 147.
\(^{2}\)Ibid., p. 148.
\(^{3}\)Ibid., p. 148.
\(^{4}\)Ibid., p. 148.
\(^{5}\)Ibid., p. 148.
With respect to flexibility the possibility of deferring the decision in itself adds flexibility to the planning process. But two other aspects should also be mentioned. First, the collection of a body of basic data on magnetic tape permits a wide variety of manipulations that previously would have been both costly and time-consuming. These data can be rearranged very quickly to provide information in a more usable form, . . . Second, the availability of a rapid means of analysis permits a quick alteration of the plan to meet unexpected situations.1

EDP and the Staffing Function--For several years many of the professional society annual shows have had computerized hiring centers set up for attendees to put their name and qualifications on record. This information would then be matched against known job openings, for participating companies.

The following paragraph from an article in Business Week indicates that IBM now intends to enter this field in a big way.

IBM's new recruitment information system - IRIS - is the most sophisticated electronic machine yet for matching men and jobs . . . (it is) a system for filing away prospects for jobs and recalling them when just the right mix of experience and education qualifies them for a particular opening. . . . The concept is not unique. In fact in the past year or so, at least three service companies have sprung into being employing processing equipment to match men and jobs. . . . now that IBM is trying the system on itself, computer assisted recruiting may soon become widespread.2

Solomon indicates that not only is the staffing function of the manager affected by the innovation of EDP into the company, but the staffing function of his superiors is also affected

1Ibid., p. 149.

in that the manager himself who is in charge of the EDP activity has special qualifications in the requirements for his particular job.

When a computerized data processing system uses an off-premises computer (time shared or in batch processing), the needed personnel loading drops down to the requirements imposed by data conversion. Computer operation personnel are provided by the computer center. Systems analysts and programmers may be provided by the same source or by another supplier. In these circumstances, the administrative loading also drops, yet the need to report to the company's top level does not diminish. A company using this approach to computerized data processing can best serve its needs by assigning the administration of data processing to a top-level executive who understands the field but does not devote full time to it. As indicated earlier, most of the in-house work for this work can be supervised by a key punching (or equivalent) supervisor who reports to the top-level executive. That executive must also be able to deal with computer-operator supervisors, systems analysts, programmers, and their managers. The task, even as a secondary assignment, is not negligible. Hopefully, this book will supply the knowledge required by an executive with the acumen necessary to handle this kind of task.¹

EDP Impact in Large Corporations--An article from Steel magazine indicates the impact that the computer has had on the manager's job in big corporations such as U. S. Steel, General Electric, etc. This does not mean that smaller companies have not had similar uses of computers. However, this is an indication of the use of EDP techniques where there are large amounts of funds available for research into optimized systems. Their plans are not so grandiose as that outlined in the previously mentioned article on the Lockheed Corporation's planned use of computers. The author of this article indicates that the trend

¹Irving I. Solomon, op. cit., p. 64.
is toward optimization of decisions and in what way computers are assisting in the planning, directing, and controlling functions.

The following is an example of U. S. Steel's use of a computer in the planning function. The problem could have been solved by non-computerized techniques, but because of its complexity, large-scale simulation would only be practical on a computer.

When U. S. Steel Corporation decided to build its taconite concentration plant in Minnesota it ran a simulation of the proposed plant design on a computer to see if the proposed plant design would provide the required blending of ores.¹

The following several quotations illustrate the way in which managers view computers, that is as assistants, as if they were a superhuman being. It is perhaps this viewpoint on the part of managerial personnel that has limited the sweeping changes that some authors have predicted would come. The techniques and mathematical methods of problem solving mentioned are not restricted to just computerized solution, except that in large scale operations the quantity of variables would make it impractical to consider the use of these techniques on any basis except with a computer.

Computers are being used as super efficient "assistants to" managers in jobs ranging all the way from the computation of labor contract costs to the pinpointing of complex

production-marketing-design interrelationships. Not only that -- this is not a big company "technology". Companies of all sizes are cashing in on it.

... PERT, CPM, linear programming, statistical analysis, and simulation. With these programs, managers can handle a galaxy of daily and long range problems.

Virtually any definable problem can be solved with available hardware and computer programs. The most commonly used ones fall into two categories: Network planning, scheduling, and control techniques; and techniques based on operations research.

PERT and CPM ... is used to construct a "model" of the project. ... the techniques were used mainly to spot crucial jobs in a project and arrive at an optimum schedule. Today, however, management is also using them to determine the optimum allocation of resources and to pinpoint probable costs for each job.

The benefits of network planning techniques are many. They provide:

1. A disciplined basis for planning.
2. A clear picture of a project's scope.
3. A means of evaluating alternative approaches, strategies, and objectives.
4. A method of preventing the omission of jobs that belong in the project.
5. A way to show interrelations among jobs and determine the responsibilities among various organizations involved.
6. An aid to refining the project plan.
7. A method to specify how planning has been done and for follow up to see that it has been done that way.
8. A technique for keeping planning up to date as the work is accomplished and as conditions change.
9. A crystal ball that allows management to quickly see the impact of variations from the plan and to take corrective action in anticipation of trouble.

Of course CPM and PERT can be run on a manual basis and in many cases they are but for a large scale operation to accomplish a task in economical time the use of a computer would be mandatory.

The operations research (OR) techniques have one factor in common: They're mathematically oriented to take advantage of the computer's high speed computational capabilities in work on complex management problems. ... two of the most widely used operations research techniques (are) linear
programming ... a method of scheduling. (and) simulation -
This is a dry run exercise. Management can study in advance
the probable effect on a decision or series of decisions.

Management games are classic examples of simulation.
Strategies can be quickly evaluated, mistakes pinpointed, and
planning abilities sharpened.

A host of other computer based techniques are being
developed. Computer forecasting, says Univac's Dr. Buckland,
"where we analyze historical patterns and then add future
projections, ... We are ready to go beyond this technique;
a company's marketing projections can be continuously
monitored and new data added to the system as needed.

G. E. is working toward an "information utility concept"
where data on all company components, material, equipment,
and services are gathered and fed into the computer.

Original operations research techniques were more static
than dynamic ... The principal advance that has taken place
is in combining dynamic tools (computers) with these previous
static tools to produce over-all, more realistic, and much
more powerful techniques for management decision making.

The challenge - The tools for the creative use of the
computer are available. ... The need is for management to
take a more active role in the creation, implementation and
use of these techniques.¹

Summary--This chapter has discussed two aspects of the
impact of EDP on management. One is the "what ought to be", the
other is the "what is".

It is generally accepted that in the present state of art
in the management science, the managerial process of obtaining
efficiency is by an iterative process. Trial and error and a
continuous adjustment of the systems and organizations, etc. is
ever present to compensate for a lack of perfect planning in the
first place. Postley throughout his book, and as evidenced by

¹Ibid., p. 57.
the quoted sections, continuously takes present day management to
task for failure to properly plan for the use of EDP systems to
their fullest capability.

The total system concept discussed in the Business Week
article on the Lockheed Corporation is still in the future. The
present impact on management as indicated by this literature
search has been limited to the fundamental improvement of exist-
ing managerial technologies. The following conclusions from
Foxworth's book fairly well summarizes what the present day
impact of computers has been as indicated by all the articles
and books in this chapter.

It must, first of all, be abundantly clear that no
"revolution" in any fundamental sense has yet occurred. To
be sure, the use of computers has "economized the uses of
men's minds" as was suggested above. But in the totality of
business operations the areas within which this has happened
do not loom large. In some areas a substantial part of the
routine judgment and decision making has been transferred to
computers. In isolated instances this has freed the people
involved for greater concentration on the operating aspects
of their job, but it has not made any basic changes in these
operations.¹

¹Foxworth, op. cit., p. 153.
CHAPTER III

CASE ANALYSIS OF HOW THE MANAGER IS AFFECTED
BY COMPUTER INSTALLATIONS

Introduction--As indicated in Chapter I (p. 13), case analysis would be one of four approaches used in this thesis to gain support for the hypothesis. This chapter deals with two specific case studies which are given in detail in Appendix "A".

A brief summary of the cases will be given, followed by an analysis which will describe in what manner the cases support the hypothesis.

The LOCS Case

Summary--The LOCS system is a comprehensive "total system" that is all encompassing of the entire business operation. The salient features of the system are:

1. Data are handled only once manually.
2. A comprehensive report on any facet of the business is available on demand.
3. Remote stations are used to feed the computer.
4. Management reports are based on a status against plan.

A feasibility study type of investigation was conducted prior to any commitment of funds or other manpower for actual computer installation. This study consisted of an investigation
into what types of equipment were available, and what other companies in industry had done with EDP.

After the feasibility study, the company then analyzed their own operations. A significant finding was that they processed and reprocessed the same data many times. They developed the "capture data" concept that said that once a piece of data was entered into a computer it would never again be handled manually.

In installation of the system, input and output centers were strategically located throughout the plant. These centers could, in addition to accepting inputs manually, generate action documents of special form, and generate and accept inputs from punched cards and tape.

The system itself starts using data the first time any bit of engineering information is released. This data could be either a blueprint or advance bill of materials, etc. From this data, PERT and other follow-up systems are automatically triggered. Inventory is automatically checked, orders written and manufacturing schedules generated, all in accordance with information fed the computer as part of the plan along with the engineering information.

Various types of reports are generated automatically and delivered to the responsible personnel for action. These reports are "exception principle" in their content.

The system can also be used for modeling: to try out various plans prior to actual commitment of resources to a particular approach.
After two years of operation, the Librascope management felt that the system was a success and had already achieved their original objective.

**LOCS Case Analysis**

**Planning**—The early planning phases consisted of an investigation into what the extent of EDP use should be, what systems were available, and what the cost impact of various decisions would be. In addition, very early in the planning phase, consideration was given on how to handle the other four functions of the manager and also the extension of planning to other departments. Up to this point it appears that the only management personnel involved were top management and Industrial Engineering (IE) management.

During the second phase of Research & Development, operating managers of other departments were brought into the planning phase. It was their job to confer with the system designers to insure that the "total EDP system" would adequately fulfill their needs. At this point they undoubtedly realized that changes in organization and staff would be required in order to utilize the system to its utmost. These managers, in viewing their own operations with critical introspection as they had to at this time, would have improved the company even if no EDP would have been eventually installed. Plans to this point were in regard to the future usage of computers and were generated unassisted by EDP.

After the computer was installed it became a managerial
tool for planning. Taking the computer "off the line" and simulating (modeling) changes to production plans by production control enabled their management to predict operations and generate plans to a higher degree of accuracy than ever before attainable. The managers involved, in order to use this tool effectively, would have had to be trained themselves in the capabilities and limitations of their particular EDP systems. Actual inputs and detail generation required to work with the model would be handled by first line supervisors and employees. The using managers would not necessarily have had to take any formal training in computer usage for this phase of the operation.

Staffing--Many changes in fundamental talents and jobs throughout the company were indicated. These are listed as follows:

1. Keypunch operators.
2. Use of dispatch stations.
3. Use of input centers.
4. Handling, care and storage of punched cards and tape.
5. Flexowriter operation.
6. How does one request information from the computer?
7. How does one read the computer reports?
8. What information could be requested from the computer?
9. How to utilize "exception principle" reports rather than total information reports that are classically used. The manager must realize that what is not printed out is not important to one's own level of management.

The plan to handle the staffing function by retraining,
transfer, and attrition was excellent. Management and employee cooperation is essential to smooth implementation of any new idea.¹ The human problems exceed the technical problems in complexity and in difficulty. Failure to realize the presence and nature of these problems creates a high risk of failure for the entire undertaking. We may encounter considerable aggression on the part of individuals who are subject to change. We may find that the amount of sloppy or careless work increases. If the employees accept the new rules (laws) and concepts, then their willingness to cooperate with a change in the operation will enhance the probability of success, or as stated by Chester I. Barnard, "... authority depends on a cooperative personal attitude of individuals."²

The manager must know how to hire the talents previously mentioned. He must know what constitutes good performance in each job utilizing these talents. The manager's ability to handle these two items of the staffing function can be gained by association with peers (such as in professional societies) in other businesses already employing people with these talents, by contacts with the sellers of equipment, by experience in other departments in his own company, or by literature study.


The manager's most heroic effort in staffing was during the changeover phase. He had to keep attrition of personnel to a minimum, because to hire or transfer personnel and train them to temporarily fill a job that was to be shortly eliminated would be a wasted expense if it could be avoided.

Organizing—"The introduction of a computer makes it essential to re-think on a new basis the whole structure and operation of an organization."\(^1\) A stable, well defined organization would be essential to an advanced technology management system's efficient use, such as the LOCS system. Peter F. Drucker points out that:

The new technology will demand the understanding of the principles of production . . . it will require that the entire business be seen, understood and managed as an integrated process. . . . This process requires a maximum of stability and ability to anticipate future events.\(^2\)

If functions were to be reshuffled, and such items as the delegation of authority to perform particular functions changed, the quantity of reports and to what level of management they would be sent would be changed each time. In particular it would be necessary to change the detail contents of reports if originally certain management levels in an organization were to get reports with specific information pertaining to their job only. If


these changes are extreme they could require major reprogramming which is expensive to accomplish.\(^1\) These changes could even require the physical movement of input/output stations.

For the foregoing reason managers must carefully consider their organization structure. They must clearly define (in writing) the functions and responsibilities of each segment of their operation. In so doing they must prognosticate their modus operandi after the EDP system will be in full blown operation.

If a proper job of definition of Functions & Responsibilities has been made and personnel trained to properly respond to stimuli produced by the exception reports it would appear that a manager's span of control could be increased, at least with respect to number of functions under his control. Drucker indicates that

Traditionally a manager has been expected to know one or more functions. This will no longer be enough. The manager of tomorrow must be able to see the business as a whole and to integrate his function with it.\(^2\)

**Directing**—The nature of direction should change considerably in the Librascope company from before to after the installation of the LOCS system. In a strictly organized structure it would become possible to shift the emphasis of direction from order giving on the part of a superior to delegation as a means of direction for all of the routine repetitive

\(^1\)Frielink, *op. cit.*, p. 39-47. Data in this chapter in the book is a cost analysis of a typical reprogramming effort. Costs for major programming runs into man years.

\(^2\)Drucker, *op. cit.*, p. 373.
assignments and many of the special problems. In support of this, Koontz & O'Donnel says that, "The grouping of duties into subdivisions of the enterprise involves delegating authority to perform these duties."¹ The orders given would be the result of problems brought out by the exception principle reports.

If the action required to correct problems is within the scope of possible influence of first line workers it may be possible to delegate the authority to act directly from exception reports. This would be particularly true of control functions such as production control.

The manager would require no special training on the computer in this case. His direction function would be changed in respect only to the level of responsibility. A middle manager would probably find that his responsibility has increased as a result of the computer usage.

Controlling—In the LOCS case the greatest impact on any managerial function was on control. The changes which affected the manager from before-to-after LOCS installation are:

1. Greater amount of information available on demand.
4. Real time information.
5. Exception reports.

This information could be available to managers without

¹ Koontz & O'Donnell, op. cit., p. 56.
the use of EDP but cost would be prohibitive. Frielink states that:

In reference to manual processing, it can be said that processing costs are directly proportional to labour. . . . It clearly follows that at a certain point in time, machine processing is less expensive than manual processing.¹

Once the plans were made and fed to the computer the manager could assume that all was well unless a report was received indicating an out-of-control situation; e.g., the production manager assumed that schedule was on or ahead unless notified. The purchasing agent and his expediters would only be alerted to action by the past due material report if something were not delivered on time or if a shipment was rejected, and the accounting department could be assured budget was not being overrun unless overtly notified.

The main advantage of EDP in control operations lies in its real time reporting capability.² The manager is notified in time to take corrective action in most cases. At the very least, an out-of-control condition is flagged before it becomes excessive.

When a situation warrants it, the manager can obtain total information on any problem to allow him to dig as deeply as necessary to make an optimum decision. His decisions will be

¹Frielink, op. cit., p. 55.
inherently better because of the greater accuracy of information on which he is basing decisions.

The accuracy and volume of selective information would be of particular advantage when "after the fact" investigations are conducted by the manager in order to take preventative measures so that an out-of-control situation will not develop again.

With the selective capability of information dissemination that LOCS gives, it is most important that the manager know his system so that he may ask for all the proper information in order to prevent bias to his viewpoint. This one aspect is a disadvantage of the LOCS system. In a manual system of reporting and notification the manager, in perusing reports personally, might notice other applicable facts than the ones he was specifically looking for and use this additional information accordingly. With LOCS no such reminder exists.

Summary--The manager gets involved with the installation of an EDP system long before it is in use. Consideration during this planning phase must be given to the type and quantity of information required and to how to organize properly for optimum utilization of EDP information systems. Once in use the system is primarily used to assist the manager in his control function by supplying him exception reports (which are deviations from plans) in real time.

Job Location and Shop Order Updating with Punch Cards

Summary--This case was chosen in order to illustrate a
minimum type of EDP installation. The computer was used for little more than a glorified typewriter. However, the management of the company was able to effect a definite increase in efficiency of operation. In conclusion, they felt that their objective had been accomplished.

The use of a computer was considered in the first place because the timeliness of a monthly report was inadequate for allowing management to take action which could correct out-of-control production situations and thus preclude schedule slips. It was decided to use existing computer time (now used by accounting only) for the purpose of generating production control schedules and for shop order updating.

The production control schedules are generated by making a separate card for each lot. There are three thousand average lots in the shop. The cards are manually sorted and then run through the computer to get the schedules printed for each operating department. This is, in essence, their system.

The system was installed without any duality of a manual system. No problem was encountered during installation.

The reports now come out weekly, are about four hours old when issued, and are produced with less total manpower. In the event a set of cards is destroyed, it can be easily regenerated by referring to past reports and updating.

Shop order updating is accomplished by putting new order information as it is received on separate punched cards. The cards are filed in a follow-up file, and, as they come due, the cards are pulled and sent to the computer for listing. From
here on, the system calls for a manual comparison of this list of required dates against the actual expected dates as determined from the previously described scheduling system.

Each week the sales department provides a follow-up service for their customers and informs each customer of the status of their order.

Raybestos Division Case Analysis

Between the LOCS case and this next case, The Raybestos Division, the minimum/maximum extremes of EDP impact on the managerial functions are realized. In analyzing the Raybestos case, where these contrasts are marked they will be pointed out.

**Planning**—No basic change was made to the existing system except to break schedule into semi-weekly increments instead of days, so as to accommodate 80 columns on a punch card. Since the system was designed to merely speed up the response time of existing reports and save cost, no planning was required of management except the system implementation itself.

**Staffing**—The impact on the personnel involved was minimal. Only four people had a major change to their jobs; i.e. twelve hours each, once a month, that was previously devoted to making the monthly report. The shop order updating was a mechanization of a manual system which did not appear to change personnel's job much at all.

**Organizing**—No reason for reorganization resulted from the system's installation. This is in contrast to LOCS where it seems that such great efficiency would be gained if changes in
personal jobs were to be made that it was advisable to consider organizational changes.

**Directing**—The weekly production control follow-up meetings which were attended by department managers, department expediters and their supervision, had the result of getting high level impetus to problems. Apparently this had not occurred before.

In contrast to the LOCS case, the level of management-making decisions of certain importance appears to have moved up the ladder to a higher echelon. This shift of decision making to a higher echelon is in contrast to a fundamental objective of EDP system installation. It is normally desirable to shift decisions to the lowest possible level of management.¹

**Controlling**—The improvement of control in both the schedule tracking and shop order updating was limited to an increase in frequency of reports (once a week instead of once a month), and a reduction in the delay of the report in publication.

**Summary**—The Raybestos Division use of EDP satisfied its

¹Richard G. Canning, Electronic Data Processing for Business and Industry (New York: John Wiley and Sons, Inc., 1956) p. 4. "A broad definition of electronic data processing is: The use of electronic computers and data processing machines to aid in the following business operations:
1. Lower-level management decision-making operations;
2. Issuing the necessary paperwork to instruct the organization in accordance with those decisions;
3. Measuring the actual progress and feeding it back for management control."
requirements. The product line stability allowed the implementation of a simple minimum EDP system. The impact on planning, staffing, and organizing managerial functions was minimal with only the directing and controlling functions changing to a perceptible degree.
CHAPTER IV

MAIL QUESTIONNAIRE SURVEY

Introduction--This chapter will present the method, results, and analysis of the mail questionnaire survey. A copy of the questionnaire will be found in Appendix B; a copy of the accompanying letters and return envelope in Appendix C; a copy of the keysort card used for analysis of results in Appendix D; and a complete tabulation of results in the table of Appendix E.

The most pertinent question is number sixteen (16) which summarizes the manager's feelings regarding his five basic functions. The results to this question are presented first.

For each of the five basic managerial functions, specific questions in the questionnaire were directed toward determining in what way EDP had specifically impacted the responder. A tabulation and analysis of each function will be given separately. The reader should notice that the answers in column (10) from a negative viewpoint can be used to support the conclusions drawn in the analysis.

Contents--There are three basic types of questions in the questionnaire:
1. Questions were asked regarding the individual answering the questionnaire; e.g., his background, and present employment circumstances.
2. Questions were asked to pinpoint with a yes or no answer the various ways in which a computer had impacted the job of the individual answering the questions.

3. The third type of question was designed to allow the answerer to express in his own words how the computer had impacted his job.

The questionnaire was limited to one page front and back and for the most part questions were answered by multiple choice or one word descriptors. Those questions of lesser importance and those requiring sentence type answers were put on the back side. (Note: As it turned out this paid off, as a number of responders did not answer the reverse side even though the covering letter instructed them to.)

Recommendations as to design of questions and the questionnaire itself were used from literature study.\(^1\) Experimental sample questionnaires were tried on various personnel.

Since the questionnaire was to be anonymously answered, it was given to two people who were known quite well as to background, etc., in order to test whether others would interpret the questions the way intended. With only minor exceptions, they did answer the questionnaire with proper intent.

**Technique of the Survey**--The national office of the American Production on Inventory Control Society (APICS) was

contacted in Chicago. Their organization has about 5000 members nationally, with 300 of these members in the Los Angeles chapter.

Since they did not publish a roster, they did agree to mail the questionnaires to 1000 of their members, to be selected by taking an equal number from each of their sections. In addition to the above, 300 were mailed to all the members in the Los Angeles section.

The national survey had a letter from the president requesting their assistance and had my self-addressed envelope for their reply.

The Los Angeles section survey had just the questionnaire and a note from the head of the Los Angeles chapter requesting that the questionnaire be mailed to me giving my home address.

After receiving the answers, the reply envelopes, and original questionnaire, Royal McBee Keysort cards were cross indexed by numbering. Then the indicated answers were edge notch punched in the Keysort card for the purpose of attributes correlation. After separation into category, the individual comments by the respondents could be read by pulling the appropriate answer sheet by code number.

The questionnaire in Appendix B is presented in three pages; in reality, it was one sheet of paper front and back. The question numbers adjacent to the boxes are for coding purposes to the keysort cards. These numbers did appear on the questionnaire.

Results of the Survey—Over four hundred thirty replies to the national mailing were received. A number just returned the questionnaire unanswered and courteously explained that either
they didn't feel the questions applied to them or that they could not understand the questions.

The count of the answers was determined by measuring the height of a stack of cards in a particular category with a vernier caliper. The height of the stack was then divided by the average thickness of a single card (.0092). On a sample check the accuracy of this method was found to be within two percent.

The questions which required a written answer are not tabulated. This information was used to establish the questions which were asked during the interviews and to assist in the conclusions if possible.

The largest single category of managers answering the questionnaire were from production control. This category was selected to study in more depth because of a sufficient number of answers available. Appendix E presents the tabulated results of the survey including a breakdown into the various categories studied. In sub-categories other than that of production control managers, not all of the answers were tabulated because it was felt that they could not help in the analysis. The answers were sorted into categories which are not presented. However, the results were not significant.

Analysis of Results

Managerial Impact--A statement can be made that more managers who work in departments that use EDP feel they have been affected to a greater extent than those managers that are working in companies where other departments are the users of EDP. This
conclusion was drawn from the data sort on Question (16) of managers into various categories of computer usage. The difference was most noticeable in the controlling function and to a lesser degree in the planning function. Directing, organizing, and staffing, showed almost no difference. The following tabular results support this conclusion.

TABLE 1

Tabular Results Showing Managerial Impact by Department Usage

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question &amp; Category</th>
<th>Answer</th>
<th>Code No.</th>
<th>All Answers</th>
<th>All Managers</th>
<th>All Depths, use ERP</th>
<th>PC/ACCTg. use ERP</th>
<th>Others than PC use ERP</th>
<th>No EDp in Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>16</td>
<td>Of the following five basic functions of a manager, to what degree have computers affected/assisted you?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan</td>
<td>N/C</td>
<td>B5</td>
<td>63</td>
<td>26</td>
<td>0</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
<td>B6</td>
<td>122</td>
<td>66</td>
<td>7</td>
<td>24</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extreme</td>
<td>B7</td>
<td>175</td>
<td>98</td>
<td>4</td>
<td>44</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Staff</td>
<td>N/C</td>
<td>B8</td>
<td>154</td>
<td>76</td>
<td>4</td>
<td>29</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
<td>B9</td>
<td>150</td>
<td>85</td>
<td>6</td>
<td>36</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extreme</td>
<td>B10</td>
<td>43</td>
<td>20</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Organize</td>
<td>N/C</td>
<td>B11</td>
<td>113</td>
<td>55</td>
<td>1</td>
<td>19</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
<td>B12</td>
<td>158</td>
<td>82</td>
<td>6</td>
<td>38</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extreme</td>
<td>B13</td>
<td>78</td>
<td>43</td>
<td>4</td>
<td>16</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Direct</td>
<td>N/C</td>
<td>B14</td>
<td>75</td>
<td>32</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
<td>B15</td>
<td>156</td>
<td>81</td>
<td>6</td>
<td>36</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extreme</td>
<td>B16</td>
<td>121</td>
<td>67</td>
<td>4</td>
<td>29</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>N/C</td>
<td>B17</td>
<td>38</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
<td>B18</td>
<td>90</td>
<td>50</td>
<td>4</td>
<td>23</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extreme</td>
<td>B19</td>
<td>239</td>
<td>127</td>
<td>7</td>
<td>56</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

*Production Control Managers only
Columns (3) and (9) are the pertinent results in this case. For example, in the Planning function, a total of seventy-six answers were Production Control Managers in departments using EDP. Eleven were in departments in companies where other than their own departments used EDP. Fifty-seven percent (57%) of the managers in departments using EDP indicated that they felt an extreme impact on their job had occurred. Only twenty-seven percent (27%) in the other category felt their job had been impacted extremely by a computer. A similar analysis of the other functions would reveal like results.

Planning—Questions (19), (20), (21), (25), and (26)
supplied answers which should help in determining in what way the managerial planning function had been impacted. TABLE 2 presents these results.

The conclusions which were drawn from analyzing the answers to the questions are:

Q. 19. Most managers depend on their own EDP department to keep them abreast of computer technology.

Q. 20. In most cases the responders felt that their computer had been added to improve reporting. This could indicate a desire on the part of managerial personnel, who were responsible for the decision to add EDP, to improve their control function.

Q. 21. Most managers had taken or intend to take courses on introduction to computers. A few had taken courses in the operation of computers or had taken no schooling at all in regard to computers. Since education is one aspect of a manager's job that to a great degree he controls himself, it can be further concluded
that the manager is of the opinion that courses on the introduction to use of the computer is all he needs to know.

**TABLE 2**

Questions Which Indicate in What Way the Planning Function was Affected

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question and Category</th>
<th>Answer</th>
<th>Code No.</th>
<th>All Answers</th>
<th>All Managers</th>
<th>Production Control Managers only</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>How do you or your manager keep informed on changes in computer technology?</td>
<td>Salesman Not done EDP Dept.</td>
<td>B28 B29 B30</td>
<td>71 72 243</td>
<td>31 32 128</td>
<td>1 1 11</td>
</tr>
<tr>
<td>20</td>
<td>Why was the computer added in your case?</td>
<td>Saving Reporting Other</td>
<td>B31 B32 B33</td>
<td>109 265 90</td>
<td>54 111 22</td>
<td>6 6 3</td>
</tr>
<tr>
<td>21</td>
<td>What kind of courses have you taken or do you intend to take on computers?</td>
<td>None Operation Introduction</td>
<td>R1 R2 R3</td>
<td>81 73 231</td>
<td>35 35 149</td>
<td>0 2 8</td>
</tr>
<tr>
<td>25</td>
<td>Do you require in your own position a knowledge of computers?</td>
<td>Yes No</td>
<td>L27 L28</td>
<td>129 141</td>
<td>128 69</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>In your total experience was there ever a reverting from a computer back to a manual system?</td>
<td>Yes No</td>
<td>B26 B27</td>
<td>120 235</td>
<td>63 115</td>
<td></td>
</tr>
</tbody>
</table>
Q. 25. Most managers felt that they required a knowledge of computers in their job. This could indicate a feeling that they could in some way influence the system, hence it impacts the planning function.

Q. 26. This particular question was answered in more detail and volume than any other. The tabulation of results is shown in TABLE 3. An attempt was made to categorize the answers.

**TABLE 3**

Reasons for Reversion from an EDP to a Manual System

<table>
<thead>
<tr>
<th>Item</th>
<th>Answer Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Manual system proved to be less expensive</td>
<td>17</td>
</tr>
<tr>
<td>2.</td>
<td>EDP reports were untimely</td>
<td>21</td>
</tr>
<tr>
<td>3.</td>
<td>Inadequate planning: naive management, wrong application of EDP, inaccuracy</td>
<td>52</td>
</tr>
<tr>
<td>4.</td>
<td>Arbitrary decisions: misoneism, budget cuts</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Programming errors</td>
<td>7</td>
</tr>
<tr>
<td>6.</td>
<td>Miscellaneous: lack of flexibility, required because system was in process of change, etc.</td>
<td>18</td>
</tr>
</tbody>
</table>

The number of answers in category three indicate that in about one-third of the cases where EDP reverted to a manual system it was due to the failure of management to properly plan.

**Staffing**—Questions (13), (14), (15), and (21) can be analyzed to determine in what way managers felt their staffing function has been affected. Predominately the questions asked
in this category were meant to determine how managers viewed the personnel that they are now required to hire as a result of the innovation of EDP.

Q. 13. Managers for the most part felt that EDP has increased the education requirements of the personnel that they supervise. This would seem to indicate that computers have not tended to replace the requirement of individual workers to think and analyze.

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question and Category</th>
<th>Answer</th>
<th>Code No.</th>
<th>All Answers</th>
<th>All Managers</th>
<th>Production Control Managers only</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5) (6) (7) (8) (9) (10)</td>
</tr>
<tr>
<td>13</td>
<td>Have computers changed the education requirements of people you supervise?</td>
<td>N/C More Less</td>
<td>L24 L25 L26</td>
<td>172 204 2</td>
<td>89 106 2</td>
<td>3 9 0</td>
</tr>
<tr>
<td>14</td>
<td>Do the people working for you require a knowledge of computer programming?</td>
<td>Yes No</td>
<td>B1 B2</td>
<td>93 300</td>
<td>45 160</td>
<td>5 7</td>
</tr>
<tr>
<td>15</td>
<td>Do you have any computer trained specialists in the department?</td>
<td>Yes No</td>
<td>B3 B4</td>
<td>135 265</td>
<td>57 151</td>
<td>7 2</td>
</tr>
<tr>
<td>21</td>
<td>What kind of courses have you taken or do you intend to take on computers?</td>
<td>None Operation Introduction</td>
<td>R1 R2 R3</td>
<td>81 73 231</td>
<td>35 35 149</td>
<td>0 2 8</td>
</tr>
</tbody>
</table>

TABLE 4

Questions Pertaining to the Staffing Function
problems.

Q. 14. Most managers do not require personnel working for them to have a knowledge of computer programming. This answer connected with the results in Q. 13, would tend to indicate that the computer was being used as a tool by the responders.

Q. 15. Most managers indicated that they had no computer trained specialists in their department.

Q. 21. This question applies to this function as well as to the previous question of planning. The high number of managers who have taken courses in computer technology could indicate that it might be a requirement of his particular job. Unfortunately there is no substantiating evidence to corroborate this statement. The personal interviews did not bring out any feeling of this nature on the part of the people interviewed.

Organizing--Questions (12) and (24) applied to this function. The results are shown in TABLE 5.

Q. 12. Managers predominately indicated that there had been no change in the number of people that they supervise.

Q. 24. All categories of contact in this question indicated that for the most part managers did not have a change in the frequency of contact with personnel within the company. However, where a change has occurred it was to increase the frequency of contact with all categories of personnel.

From these particular questions it did not appear that the impact on the organization function was extensive.

Directing--Questions (12), (24), (27), and (28) pertain to the function of direction. Questions (12) and (24) are
tabulated in TABLE 5; however, questions (27) and (28) required a fair degree of written answers, and the data which was gathered was insufficient in quantity in that only a very few responders bothered to answer these questions. Those few that answered did not show any significant trends. The titles of reports were varied and impossible to correlate to one another.

TABLE 5
Questions Pertaining to Organization and Direction

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question and Category</th>
<th>Code No.</th>
<th>All Code No.</th>
<th>All Code No.</th>
<th>All Code No.</th>
<th>All Code No.</th>
<th>Production Managers only</th>
<th>Control only</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Have computers changed the number of people which you supervise?</td>
<td>N/C</td>
<td>L21 213</td>
<td>112</td>
<td>9</td>
<td>42</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
<td>L22 88</td>
<td>39</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less</td>
<td>L23 75</td>
<td>43</td>
<td>2</td>
<td>25</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>How has the computer affected the frequency of contact with the following:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subordinates</td>
<td>N/C</td>
<td>R13 186</td>
<td>102</td>
<td>6</td>
<td>47</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
<td>R14 113</td>
<td>59</td>
<td>3</td>
<td>24</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less</td>
<td>R15 43</td>
<td>19</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Peers</td>
<td>N/C</td>
<td>R16 182</td>
<td>97</td>
<td>4</td>
<td>43</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
<td>R17 130</td>
<td>70</td>
<td>5</td>
<td>29</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less</td>
<td>R18 25</td>
<td>11</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Superiors</td>
<td>N/C</td>
<td>R19 169</td>
<td>92</td>
<td>8</td>
<td>36</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
<td>R20 142</td>
<td>74</td>
<td>2</td>
<td>33</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less</td>
<td>R21 34</td>
<td>16</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Q. 12. According to the literature study which was made, the innovation of an EDP system could increase the span of control of a given manager. The answers that were given to this question should have indicated that predominately more subordinates were supervised, hence changing the mode of direction from superior to subordinate. Most managers indicated that there was no change in the number of people they supervised.

Q. 24. This question relates to direction in that it could indicate a change in the directing technique. If an extensive amount of delegation were to be substituted for direct order giving, then the contact with subordinates could be decreased. The study of the literature indicated that this is one change that could occur with the introduction of EDP. The answers to this question did not support this hypothesis.

The answers to these questions indicated that most managers thought their direction functions were impacted to a minimum. This was substantiated by the previously mentioned question number sixteen.

Controlling--Questions (17), (18), (24), (27) and (28) were in regard to this function. The following table number six presents the results of these questions.

Q. 17. Most managers indicated that the frequency of reports has increased. This tends to support the statements made by some authors which were presented in the analysis of literature on EDP, in that the predominant use of computers today was to improve on existing techniques of management. One method of improvement could be to increase reporting so that decisions made were done
with more confidence because of increased data. The answers to this question could also mean that superfluous data was now being generated.

Q. 18. The ability of the computer to assimilate large volumes of data and to print it out could again be indicated by the fact

TABLE 6
Answers Pertaining to the Manager's Control Function

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question and Category</th>
<th>Answer Code</th>
<th>All Answers</th>
<th>All Managers</th>
<th>All Deps. use EDP</th>
<th>At least PC &amp; Acctg. use EDP</th>
<th>Others than PC use EDP</th>
<th>No EDP in Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>How has the computer varied the frequency of reports?</td>
<td>Incr. B20</td>
<td>281 146 8 62 6 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decr. B21</td>
<td>30 15 2 6 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/C B22</td>
<td>63 32 2 9 6 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>How has the computer varied the detail of reports?</td>
<td>More B23</td>
<td>311 166 11 70 9 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less B24</td>
<td>33 13 1 6 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/C B25</td>
<td>31 14 0 2 3 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>How has the computer affected the frequency of contact with the following:</td>
<td>More R14</td>
<td>113 59 3 24 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less R15</td>
<td>43 19 1 8 0 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/C R16</td>
<td>186 102 6 47 9 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>More R17</td>
<td>130 70 5 29 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less R18</td>
<td>25 11 1 6 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/C R19</td>
<td>182 97 4 43 8 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>More R20</td>
<td>142 74 2 33 2 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less R21</td>
<td>34 16 0 9 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/C R19</td>
<td>169 92 8 36 8 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subordinates</td>
<td>Peers</td>
<td>Superiors</td>
<td>Production Control Managers only</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

P. 60
that most managers answered this question with an indication of greater detail in reports. To these managers it could be that more data means better control. If the data is pertinent to the question at hand then this greater amount of data can mean more timely control with the aforementioned increase in frequency and more accurate control with the increase in detail. Apparently the computer is not being used to digest the data first, and then print out only what is pertinent to the specific question at hand.

Q. 24. Analysis is similar to that for the direction function.

Questions (27) and (28) again were in the category where the answers received were inadequate in volume to draw any conclusions and also were not well enough defined in the way in which the responders wrote in their answers, to correlate results.

Further Comments to Answers to the Write-In Questions

Question Twenty-Nine--The variety of answers to this question were too numerous to categorize. The response here was better than the write-in for other questions. The answers ranged from an elaboration of why the responder answered a particular checked question the way he did, to an elaborate explanation of the entire EDP system that his company was using. In a number of cases, the answers indicated that the company the respondents were working for planned an expansion in the immediate future.

Questions Twenty-Seven & Twenty-Eight Regarding Reports--
As previously stated the answers to these questions were not specific enough to draw any correlation, nor was the response large. However, the few answers which were received can be analyzed as follows. Neither the reports which were prepared personally or which were analyzed showed any indication of being remarkably different because of the innovation of EDP. What I had hoped to find was that the use of EDP had made a significant difference in the type of reports that the individual manager might be involved with. No such difference was found.
CHAPTER V

RESULTS OF PERSONAL INTERVIEWS

This chapter will review the techniques and the findings of the personal interviews. The objective was to explore in depth the conclusions drawn from the questionnaires. The questionnaire was able to give support or denial to the hypothesis. It answered the question of to what degree the manager thought his job had been affected by EDP, but it did not tell why he thought the way he did.

In addition to the foregoing reasons, semantic differential can bias answers in the questionnaire one way or the other; e.g., a manager who has had relatively little impact on his job by EDP could answer the question on planning impact with an "extreme" answer and vice versa, a manager with extreme impact could answer the same question, "slightly". This fact was pointed out in Chapter I where it was mentioned that sample questionnaires were answered by persons personally acquainted with the author. It was known in advance what the answers should have been. In a few cases there was a difference.

Choice of Interviewees--Managers were chosen for interview considering the following factors.

1. A personal knowledge on the author's part, regarding the job, and how the computer affected that particular individual was
considered desirable.

2. A diversification of departmental responsibility was needed because the questionnaire had predominately been answered by personnel who were in some way connected with production and inventory control. (Most were members of American Production and Inventory Control Society.)

3. Interviewees were chosen for their ranging degree of computer usage by their particular department.

4. For the most part interviewees were from firms engaged in the aerospace industry.

A Typical Interview Session--Interview sessions took from one-half to one hour each and followed fairly closely this outline:

1. A brief explanation was given on the purpose of the interview. In particular it was stressed that the objective of the interview was to obtain details of EDP impact on the five basic managerial functions of planning, staffing, organizing, directing and controlling.

2. At this point a discussion ensued regarding the definitions of the terms. The interviewees were told definition in accordance with those outlined in Chapter I.

3. If a questionnaire had not been filled out, he was asked to take a few minutes to do it now.

4. The first question and discussion was always "In what way has the introduction of a computer affected your job as a manager?" The answer received was intended to establish what the general feeling of the interviewee was regarding the impact of EDP on his
job, without a cross discussion on the interviewer's part. This was to minimize a possibility of bias by the interviewer.

5. Each function was now discussed separately. Literature research into EDP impact on managers indicated what certain impacts should be (not heretofore discussed), and questions under each category were asked which should have indicated whether the particular interviewee was impacted in the way the literature said he should have been. In each category the interviewee was always asked his general feeling on EDP impact on that specific function first and allowed to fully explain his point before going into the detail questions. He was asked to elaborate on why he answered the questionnaire the way he did; i.e., no impact, slightly or extremely.

A. Planning.

(1) Do you or others use the computer to simulate or model changes to production (or other situations depending on the individual)?

(2) Is the computer used to solve problems or perform studies that prior to its availability were too complex or expensive to accomplish?

B. Staffing.

(1) Have you had to change your personal talents or education in order to maintain your present position?

(2) Do you have to know how to hire different talents?

(3) What are the detail changes in the staff which you now have as opposed to before EDP?
C. Organizing.

(1) Do you now supervise the same number of immediate subordinates as before EDP?
(2) Why did your department organization change with EDP introduction?

D. Directing.

(1) Are you now making decisions of more importance or greater magnitude than before the introduction of EDP; e.g., do you have more authority?
(2) Do you now delegate more authority to your subordinates?
(3) Do you or your subordinates now react to reports generated by a computer where before these actions were the result of overt direction from an individual?

E. Controlling.

(1) Is the accuracy of the information better than before EDP?
(2) Does it take you more or less time to analyze reports now?
(3) Does it take you more or less time to make a decision now than before?
(4) Do you have more information than before and is it more timely?

In documenting the answers to questions asked, the interviewee's answer was first repeated in his own words to be sure that what the interviewee said was clearly understood.
Results of the Interviews

General Question in Regard to EDP Impact--Invariably the persons interviewed seemed to feel that they were not a good subject in that their activity did not make enough use of EDP. In all cases the department in which they worked actually used an EDP system in some way for control or as a tool of their trade. All interviewees except one had a fairly good working knowledge of the computer and in most cases were familiar with systems that other companies had used that were more sophisticated than their own. They all felt that the computer could do more for them than it was. In about half the cases there were plans for company expansion of the usage of EDP.

In one case there was a new system in effect for only two months. It was in the realm of a total control system and the individual stressed the multitude of problems that had occurred with personnel resistance to the computer. This last case was a commercial application in the largest institutional food distribution business in the Southern California area. We spent some time discussing the details of the resistance. It became apparent that the indoctrination for all personnel had been a minimum. The help required to operate the computer and run the system were all new hires with a minimum number of the older employees of the company being used. A short briefing of the management personnel was all that had been done with respect to indoctrination. Truck drivers' routes had been changed with little explanation. It is now required to use numbers for ordering by the salesmen instead
of their previous technique of writing out the details of the items that their customers wanted. The customers were also identified by numbers. The salesmen used to spend two and one-half hours a day summarizing and writing orders. This is now done automatically. It now allows them more time to make calls and can substantially increase their income. No penalty was imposed, nor was there any change in territory. However, due to the tremendous number of mistakes in orders and deliveries because of incorrectly written orders, much trouble has developed. The president of the company feels they should take their loss and forget the venture, but lower level executive management is insisting that EDP is necessary in order to cope with problems that will arise due to a planned overall territorial business expansion. This instance was presented as a contrast to the LOCS case where an extensive selling program was done on the personnel in the business prior to the actual introduction of the system.

**Planning**—All but one of the persons interviewed had departments which supplied inputs on occasion to PERT programs. However, they did not use the output of the programs for a control tool afterward. In these companies it apparently was a contractual requirement to use PERT, but all departments did not use it as a working tool. In one company where PERT was put on the computer the manager was using it for control. However, he was using a hand updated chart rather than the computerized version. This particular manager was the most knowledgeable about computers in that he had been a computer circuit designer prior to gaining his present position. He was thoroughly familiar with programming
and different usage of computers. His primary concern was that the EDP systems the company was using were adequate. If the systems were changed he felt that EDP would be a very useful tool for the manager but at the present time it was misused. The company that he worked for had several thousand employees and used the computer extensively in all departments in their day-to-day activities. This man's attitude typifies the feeling of young, well educated managers who, because of their knowledge of what can be, are dissatisfied with the EDP supported business systems that their lesser informed superiors have foisted on them.

In two cases the computer had been used to solve complex problems that, if it had not been available, would not have been accomplished. In a case where the manager was responsible for company long range planning and forecasting he had used the computer to derive nomographs from some fairly complex formula so that the forecasting function could be performed more rapidly by hand. The nomographs were used in lieu of using the computer to perform these calculations on a day-to-day basis.

Staffing—With only one exception the managers interviewed had acquainted and trained themselves in the use of computer systems and in most cases had taken courses on the subject. None of them felt that they had personally applied their knowledge. The installation of the EDP systems in use was performed by a service department of some sort.

The talents which they had to hire had not changed, and there was no change in the staffing of their organizations. It was mentioned that they felt other departments had changed, but
that they had not.

Organizing--The opinion of the managers interviewed was that they thought that the computer was supposed to decrease the number of personnel under their direction. They believed a more efficient operation would reduce the number of personnel. This is in contrast to the literature which said that if a computer made a managerial function more efficient, it should decrease the ratio of managers to workers. When I mentioned this fact, most were mildly surprised. Obviously they had not considered a reduction in their own number.

In one instance more personnel were added, but as a result of the computer, rather than due to a reduction in the number of managers. Such personnel could gather more data for the computer to process. In this instance there was no reorganization of functions.

Directing--In general there was no change in the importance of decisions. In one instance, however, where computer derived summary reports were a major source of activity for the department, the manager had set up a system that allowed the individuals to react directly from the reports without waiting for his direction. In this case it was felt that a definite downward delegation of authority had occurred. In this manager's opinion, his decisions had not changed in importance.

Controlling--As could be predicted from the questionnaire survey, the managers felt that this function had been impacted to the greatest extent. All were affected by the accounting procedures of their companies having been computerized in the
unknown distant past. The accounting system was stable; it was accepted by employees and in no instance was giving them any trouble. Here the similarity of control impact on the managers interviewed, ended.

A production control manager in a firm with over 1200 direct line workers felt that the operation was too small to benefit from a highly computerized production control system. Their normal day-to-day tracking of status was done entirely by hand by floor personnel. The plant was compact and there was only a limited number of places to look for work in process. This firm did have a highly computerized material control system. When material was back ordered by production control they made out a computer report on this aspect of their job. In addition they did use the computer to list behind schedule jobs. There were plans for future expansion of EDP in the works, but nothing very extensive. It was felt that the long lists of tab runs were not too useful because they did not pinpoint pertinent facts which should highlight problems. This particular manager did feel that he was quite knowledgeable regarding computerized systems but indicated that he had never taken any formal education in the field.

Two cases used budgetary reports from accounting for direct control of their operations. The others felt they would like to have reports of this nature for their use. One received summary budget reports on a monthly basis but felt that he could do a better job of controlling if the reports were delivered to him weekly. He also received weekly detail tab listing of his
jobs but the reports were too difficult to use.

All felt that the information was, in general, more accurate. Reports that were similar to reports they used to receive were easier to analyze. Some of the newer long lists on tab runs were more difficult to analyze. Decisions were made more rapidly and with more confidence when they were based on computer reports. The EDP information was in greater detail and it was more timely with only one exception.

One of the comments made during the interviews is worth stressing. In one instance where different departments were required to enter data into the computer for processing and eventual use by other departments, an attitude had developed that, once the computer was fed, the job was done. There had been personal contact previously between different departmental personnel, prior to computer usage, that had resulted in mutual sympathy for each others' problems; now there was the impersonal barrier of an EDP system. Once one department's people had entered the data they did not care in the least how it was eventually used. When erroneous inputs were made no human feedback occurred, and many problems which previously had been taken care of on the working level were now in the hands of department managers because people no longer associated with each other and did not know how to resolve problems among themselves. This was an interesting managerial problem for which no solution had yet been found.

Interviewees—All interviewees were managers of varying degrees. They were from five different companies. The
departments which they represented were: Quality Control, Quality Engineering, Sales, Program Management, Production Control, Project Engineering, Planning and Control.
CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary—As stated in Chapter I, a four-barreled approach was to be used to gain support or lack of support for the hypothesis. Chapters two, three, four, and five have each taken one of the approaches, presented the findings and then analyzed the results of those findings. A statement can be made that the hypothesis as stated in Chapter One has been supported. The important point of this thesis, however, was to determine if possible the degree to which the manager thought his job had been affected, and also to determine in what way it was affected. In addition, in the next chapter some predictions as to possible future impact on the manager's job will be attempted. Following are conclusions drawn from the investigations.

First Conclusion--The only approach which gave numerical support to an objective statement of managerial impact was the questionnaire answers. From the results obtained to the answer to question sixteen it can be surmised that the five basic functions of a manager have been affected by EDP in descending order as listed:

1. Controlling
2. Planning
3. Directing
4. Organizing
5. Staffing

The other three chapters did not give an indication of order except in a general way. In Chapter Two the information presented seemed to indicate that the planning function had been affected the most. In the LOCS case a great deal of time was spent planning the eventual system. In the LOCS case, though, the objective seemed to be to gain better control of the business. The personal interviews brought out the fact that in the opinion of the people interviewed the control function was affected the greatest. From the foregoing it is seen that the analyses of the other three approaches tended to support the findings of the questionnaire in that either the Controlling or Planning function of the manager had been affected to the greatest extent, although not necessarily in the same order as listed.

There was only slight indication in the other three approaches on the order of impact of the other three managerial functions. The personal interviews did indicate that the managers interviewed had seen no impact on their own staffing function at all, but they did believe that other departments had been affected.

**Second Conclusion**--By again referring to the questionnaire answers, it can be concluded that most managers who worked in departments that use EDP felt that their job had been affected to a greater extent than those managers that are working in companies where other departments are the users of EDP. The difference was most noticeable in the controlling function and to
a lesser degree in the planning function. Directing, organizing, and staffing showed almost no difference.

The accounting department was the heaviest user of EDP in most companies, and in only one case where EDP was used in production control did the accounting department not use EDP. Although not brought out by the analysis presented in the appendix on the results of the survey, an inspection of the questionnaires indicated that managers for the most part did not state that their department was a user of EDP if they only supplied information to the accounting department. This would possibly explain why managers, in some cases, felt that their job had been affected by EDP even though they indicated that their department was not a user.

**Final Conclusion**—There are perhaps many conclusions that can be drawn from analyzing the details of the four approaches to the support of the hypothesis. However, as stated in the summary at the beginning of this chapter, the purpose was to determine the degree of impact and the way in which the manager's job had been affected. The first two conclusions were ones of degree.

In trying to summarize in what way the manager's job has been affected for a conclusion, it is felt that quotes from two of the readings would summarize a final conclusion. Foxworth states in his book that: "Probably the most important conclusion reached is that computers have not had a revolutionary impact on management processes."¹ The emphasis here should be on the word

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¹James Barber Foxworth, *op. cit.*, p. 2.
revolutionary. This conclusion is further supported by Diebold in his 1964 article in which he states, "Although computers arrived in the 1950's, executives are doing little more with automatic data processing than adding speed and economy to tasks performed with earlier equipment."\(^1\)

\(^1\) John Diebold, *op. cit.*, p. 62.
CHAPTER VII

AN EYE TO THE FUTURE

"The (Digital) Computer arrived in the 1950's."¹ Seven years later it was heralded: "... the most important development that has occurred in business management is the advent of the electronic digital computer."² Previous mention in this thesis has pointed out the rate at which the computer business is expanding. However, in the last chapter the conclusion pointed up the fact that the usage of computers so far has been to improve on techniques and rapidity of reporting.

The Computer Advantage—All management has realized so far is that computers can do existing jobs rapidly. The main advantage of a computer over the human is speed.³ The following example will be used to illustrate this. The comparative time to multiply two, ten-digit numbers together one thousand different times by different techniques is:

¹Diebold, op. cit., p. 62.


a) By hand with a pencil and paper. 1 week
b) By aid of a desk calculator. 1 day
c) By an electro-mechanical calculator with automatic read and write. 1 hour
d) By a small electrical calculator. 1 minute
e) By a digital computer. 1 second

Research for this paper uncovered many claims of the future changes that the computer was going to make on business, and claims about its capability of replacing humans in certain types of jobs. For the most part these changes are still in the future. This closing chapter will deal with these predictions.

Education—Before prognostication of the future is attempted a word should be said regarding what these predictors are saying about the educational requirements for tomorrow's managers. It must be assumed that it is not the intention of colleges to train managers for entry into a particular industry. A college graduate should be capable of entering into basic management in any field of endeavor. Most of the authors which were read assumed that tomorrow's manager will be a college graduate, trained in the basic managerial skills. Tomorrow's potential manager should not enter into a vocationally oriented program. This should be reserved for those men who intend to enter the ranks as engineers, mathematicians, operations researchers, etc. According to Mason W. Gross, President of

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1Ibid., p. 40.

... colleges ... must not ... devise a curriculum ... for managers by ... guessing now what kinds of facts or skills managers might need fifteen years from now. These managerially trained students would almost certainly join the technologically unemployable sooner or later.

This trend of the technologically unemployable managers appears to be starting already. Therefore, "to discharge tomorrow's management tasks we ... will need advanced education for people already in management." In Dr. Couger's speech he mentioned that two-thirds of his class are engineers, older than himself (36), who are going back to school to train themselves to manage in this era. The role of the university cannot be overemphasized. Lawrence A. Appley, President of the American Management Association, has stated, "The educational process is for the purpose of influencing human action. The better the information, experience, and thought, the better the judgment and the action resulting therefrom." A college degree by itself will not be enough. Tomorrow's manager will have to continue his education to keep abreast of his particular technical field of management.

1Drucker, op. cit., p. 377.

2Couger, op. cit., p. 95.

Man-Machine Relationships--The heavily computerized business enterprise of the future indicates to some people that the "only place for man in management is at the higher levels." This is somewhat borne out by the previously (Chapter I) discussed trends toward reduction in quantity of middle managers. These arguments center around the concept that data processing should not be interfered with by the human mind.

On the other hand there are arguments against the foregoing concept. "Man is a remarkable machine, ... not really costing too much in upkeep per hour, ..." Man has physical mobility, and can do physical work in conjunction with processes. He is also capable of visual recognition and analysis of previously unheard of problems with his reasoning brain. On the other hand, data storage and mental computations are done with comparative slowness and great inherent error when compared to a computer.

The result will be a division of tasks, with man and machine each assigned to perform that function for which each is best suited.

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2Ibid., p. 10.
The result of these observations is that a man-machine partnership, with the man properly assigned to that part of the total task which is suited to his peculiar combination of brain and senses, and arms and legs, and the machine taking care of those tasks for which it is best adapted.¹

This relationship will not be static. It will change with time as machine technology progresses.

On Line Systems--It has been predicted that the greatest change yet to come will be the dynamic integration of computers into the manufacturing or other business process. There will be a "... total departure from today's computerized tab run."²

A recent symposium regarding on-line computation had seven hundred attendees. Walter F. Bauer, President of Informatics, Inc., in a speech at this symposium, summarized the forecasts for on line computation as follows: "On line computing is today one percent of all computation. In five years it will be fifty percent, and in ten years it will be ninety percent of all computer activity."³ When this era arrives questions will be asked by the pushing of buttons or even simpler means. After the original inquiry the machine will suggest further questions that it could answer regarding the original subject.

The on-line systems are broken down into six categories:

¹Ibid., p. 11.
²Diebold, op. cit., p. 64.
1. Process control.
2. Special task machines.
3. On-line programming.
5. Inquiry (into status, or other applicable information).
6. On-line instrumentation, testing, etc.

This list encompasses all the functions that are performed on-line including assistance in the actual manufacture of the product itself.

Organizational Interrelationships--During the 1965 American Society for Quality Control Configuration Management Symposium, one of the speakers related an interesting fact.\(^1\) It was a requirement for his company to supply detailed information regarding the exact manufacturing history of every detail part that was to be used in a manned orbiting satellite. The purpose of this information was to help in trouble diagnosing if a failure should ever occur. One imagines the literally tons of paper required to document this type of information. Once documented, the storing, cataloging and indexing would be an equally formidable task. To solve this problem the contractor turned to the computer. The manufacturing information required during the build cycle was totally computerized for control purposes. So far nothing is unique in this anecdote. However, the vendor in

\(^1\)This information was related by one of the speakers at the August 20, 1965 West Coast Configuration Management Symposium, in response to an impromptu question from the floor.
this case convinced his customer, the U. S. Government, to put his information requirements on a tape in a computer language which was common to both their computers. This not only included the request for the information in the manner in which the government wanted it but also included the terms of the purchase order and the billing information. The vendor's computer then put the required information on another tape, and requested payment of the government in the process. This second bit of taped information was then put into the government's computer for storage for future use and automatically a check request was made out. One computer was literally talking to another.

With the fact well known about the mountains of paper required to run businesses today, this is really a remarkable case. No paper at all was required to perform this transaction. This elimination of paperwork by linking computer to computer to perform information transfer has been heralded by many authors.

"Pieces of paper will be out of date as active participants. Paper records will be for later contemplation only, not for on-line control."¹ Money will not be transferred by check as today. Computers will do it for us. Dr. Joseph McCloskey, who is in charge of the Planning and Development Department for the Security First National Bank, Los Angeles, California, also emphasized this elimination of paper work in a speech before the Western Systems Conference in 1966, by saying:

¹Ramo, op. cit., p. 9.
It is now easy to visualize the day when we can reverse the flood of paperwork that is making so difficult the task of keeping abreast of our respective fields of interest.¹

Already we are behind in defining the much needed, new, man-to-man, business-to-business, business-to-government, and government-to-government relationship in our present age.²

Satellites orbiting through the heavens will soon make possible world-wide radio and television and a quality of global telephone service never before achieved. Computers across the country will be linked up and talking with one another on a national (and someday intercontinental) communicating system.³

The American Telephone and Telegraph Company estimates that by 1970 its revenue from communication of data from one business machine to another, in different cities, will exceed its revenue from voice transmission over similar long-distance lines.⁴

Information Utility—"Information will become a public resource and utility. It will be available to everyone at very low cost. . ."⁵ In ten years it is predicted that a small appliance will be available for students to plug into the


²Ramo, op. cit., p. 9.


⁴Diebold, op. cit., p. 63.

telephone to help them in doing research for homework. In his talk Dr. McCloskey elaborated on the uses of the "Information Utility".\(^1\) Lawyers and Judges will save unbelievable amounts of time in research. Doctors in searching for the best diagnosis, and business managers who need information will be able to call on a central information service through the utility. Dr. McCloskey also mentioned that there would be some delay in the innovation of these computer usages because of the psychologically motivated human resistance to infringement of the computer on a heretofore exclusive mental process.

**Programming**--Pattern recognition of voice, face, and signature will be possible for a computer. "There is now a great need for equipment that can recognize patterns - visual and audible - and that can recognize a man's features, his handwriting, his voice."\(^2\) There will be extensive use of the input output keyboard. "By 1970 man will use voice communication and visual communication to direct computers."\(^3\)

"Programs will incorporate self correcting features."\(^4\) If the wrong program information is fed to the computer to solve the problem the computer will recognize the error and select another approach.

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\(^1\)McCloskey, *op. cit.*, p. 114.

\(^2\)Bibby, *op. cit.*, p. 120.

\(^3\)Diebold, *op. cit.*, p. 63.

\(^4\)Ibid., p. 64.
"Heueristic, or self-organizing, systems will allow machines to develop their own problem-solving methods best suited to the management analysis of the problem at hand."¹ These systems will help achieve the goal of dispensing with formal programs. Machines will literally think. Ordinary information fed into the computers by ordinary people will be correctly processed.²

_The Computers—_Capacity of computers will be exceptionally large so that many companies can use one at once.³ "Poly modular systems will be a common mode of design."⁴ There will be a compatibility between computers that will allow any computer to be tied into any other for whatever purpose that may be required.

_The Manager—_Management will never again be the same. A conceptual revolution will occur. "Probably a new management function will arise that will consult on design, installation, programming, continual re-programming, and operation of the total business system."⁵ "Entrepreneurial flair will have to be exercised to apply these new systems effectively."⁶

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¹Ibid., p. 64.
²Drucker, op. cit., p. 32.
³Ibid., p. 32.
⁴Diebold, op. cit., p. 63.
⁵Ibid., p. 64.
⁶Ibid., p. 64.
APPENDIX "A"

TWO CASE ANALYSES OF COMPUTER INSTALLATIONS

This Appendix presents two cases of computer installations that represented extremes of usage. The LOCS case was a maximum usage situation where it was the attempt of the installers to utilize the EDP capability to the utmost. The Raybestos Division case was one where a minimum usage was realized.

It will be shown that an EDP system installation can involve everything from a change in facility, to a complete revamping of organization and paperwork system of a company. These changes are probably the most difficult part of an EDP system installation. The writing of computer programs is usually the straightforward use of technical engineering labor.

Librascope's Operation Control System (LOCS)\(^1\)

The following (ten pages) is a resume of the reasons why the Librascope Company introduced a completely computerized operations control system into their plant. The approach they used is given, along with the conclusion of their management after a period of operation.

Librascope's management believed that a timely flow of pertinent information is essential for management control in modern business. Only computers with built-in memories and automatic computing talents could hope to cope with the mountains of paperwork and information needed to control this modern business, particularly in the military supply field. The Librascope LOCS system is a comprehensive system that is all encompassing of the entire business operation. It does not cover a single function or just a series of functions; instead, it ties all data and information gathered in the company into one central computer process and disseminates this data when and where needed with a minimum of effort and duplication. The features of the system are:

1. Data are handled only once manually.

2. A comprehensive report on any facet of the business is available on demand; e.g., project status, costs, history, etc.

3. The computer is fed by remote stations located throughout the company.

4. Management reports are based on a comparison of present status against an original set of standards or against an original plan or schedule.

**Need for Management Control**—With the growth in physical size of modern business it has become very necessary to establish paper-work systems of extremely complex nature to insure management control. These systems are a milieu of checks and balances with an assortment of data generated as a result. When bits and pieces of that data come to the attention of a manager on a
piecemeal basis, it is impossible for him to have the overview
needed for adequate control. A comprehensive system is needed to
assimilate and digest the information available. According to
Librascope's management, this was shown by the remarkable in-
crease in the ratio of white collar workers in the last 50 years,
450% compared to only 80% for industrial workers. An example is
one company that had annual sales of $40 million and it daily
handled over 10,000 pieces of data alone in just production and
inventory control.

With a large volume of paper Librascope did some simple
statistical analysis that indicated that with a normal system
that processes a piece of information over 30 times, if the
chance of making an error is only one part in a hundred, the
chance of the final data being correct is only one in four. When
management control is exercised from this kind of a system then
mistaken decisions are bound to occur through no fault of the
manager.

A properly designed computerized total control system
can theoretically give more accurate and timely reports per
dollar expended than any other technique known. With this
premise the Industrial Engineering Department designed and in-
stalled such a system.

**Employee Information Program**—Librascope's only use of
EDP when they started to consider the system was in payroll
accounting. Therefore, an employee education program was insti-
tuted to inform all personnel what the new system was for and
what its impact on their jobs would be. A plan of retraining,
transfer, attrition, etc., was to be used to take care of the employees who would be surplussed by the system. As a result no layoffs were planned. Without the cooperation of the employee that such a plan made possible, the smooth transition from the old manual to a completely revolutionary EDP system would not have occurred.

The System Research and Development—The effort was primarily handled by the Industrial Engineering Department with support from other line and staff departments as required. Initially they undertook two major research projects as a preparatory move before starting the exact design of the final system. A comprehensive study of all types of equipment that was available or planned on the national and international market was made. At its conclusion the company was sure that it knew the equipment it would eventually buy would be the optimum choice for the job considering all factors such as price, capability, costs of operation, etc.

A second study was done of what systems were already in existence that might be of use in whole or part in the Librascope installation. This study really paid off in time and money in that much of what was required was developed already either by private concerns, or by the equipment manufacturers themselves. They also came up with the fact that no other company had ever approached the operations control problem in the same way that Librascope was intending to.

The design of the system was predicated on three basic requirements. First, reports should be ideally suited for the
level of management for which they were intended, giving that information which is necessary for decisions as a result of the responsibility exacted and authority delegated. Second, the only data that would be fed into system would be the basic data required to accomplish the reporting function. Third, the system was to be dynamic and operate on "real-time control"... real-time control meaning that simultaneously as an event occurs the information is fed into the central computer. This information is compared against control criteria and if corrective action is necessary it is called for immediately. Reports from this system are therefore never older than the time at which information was printed out of the computer.

The basic tool used in the development of the system was the old time tried flow chart. New symbols were developed because it turned out to be the only way to attack the problem. Detail analysis showed what information was necessary and what was extraneous, where the best points to collect data were, who should get certain kinds of reports and how often.

Data Reprocessing Elimination--The investigators found that much of the data that was collected was processed and reprocessed many times. To cope with this situation a "capture data" concept was developed. Once a piece of data has been captured by the system it is never again operated on manually.

In order to simplify control of the system the company treats all items as if they were bought, whether it is an internal purchase or an external purchase. From a system standpoint then, the reports are identical for "make" as well as "buy" items.
It should be emphasized that the entire system was not installed at one point in time. Instead it was segmented and installed in phases. Old systems that were operating satisfactorily were not discarded until the new system had been put into operation and completely "debugged".

Phase I, Installation--This phase took all functions into its scope from engineering releases to shipping.

Equipment--"Dispatch stations" are strategically located throughout the plant so that data can be entered directly into the central computer. In addition "Input centers" are located at various points that are capable of automatically originating action type of documents; e.g., purchase orders and shop orders, etc. Also, the input centers generate punched cards or tape for the automatic reentry of action complete into the dispatch stations.

Engineering Release--The engineering release group starts the system in operation by making an indentured parts list (IPL) from a release of drawings from engineering. The IPL is entered into the computer file for "Master status reporting" at a later date. In addition such information as how many are used on the next assembly, PERT code, Line of Balance number, etc. is entered at this time. The computer re Sorts the data into a numerical parts list so that identical parts used on different subassemblies may be pooled for purchasing requirements. From the numerical list the following sublists are generated:

1. Purchase requirements for the project.
2. List of items in inventory that may be used for the project.
3. A list of make items for internal fabrication.

**Purchasing Cycle**--The list of purchased items is sent to the purchasing department along with a control "buy" card. The purchasing is done with the buyer giving information to the typist. By inserting the "buy" card and other cards in a flexo-writer, a perfect error-free typewritten purchase order is written. Price, date, etc. is all that is entered manually.

At the same time a purchase order is being written, the computer is automatically getting the information for a follow up file. This follow up file is used to check the status of orders and it is also used to indicate receipt of material. If the items are received damaged or miscounted the computer automatically informs the correct personnel in the plant who are required to take action. If no emergency exists on the receipt of the items the computer just tracks their progress through the various steps required to put them in stores and eventually indicates that payment is due the vendor.

**Exception Principle of Management Reports**--The operational routine is entered into the computer but here is where the routine ends. The performance is compared against the standard or plan as the case may be and if there is a variance then a "management report" is issued.

These reports are truly action type of reports. The following are a few typical examples of this type of report:

1. *Past Due Material Report*. This report is issued when material will be past the due date unless corrective action is taken. An item once entered on this report will continue to be
on the list until corrective action is taken which will alleviate the situation.

2. Vendor-Analysis Report. This report statistically analyzes each vendor's performance and is used to determine the overall performance and reliability of vendors.

3. Dollar Commitment Report. This report as its name implies is a financial report on the status of the purchasing department. It may be generated on demand at any time, for any person who has an interest in the financial details of this operation.

Manufacturing Cycle--Like the order list given to purchasing, a similar list is given to the Methods Department for generation of operation sheets for items which will be fabricated in house.

The operation sheet is similar to others generally used in industry in that it contains sequencing, standards, tooling, etc. However, when it is made up there is simultaneously generated a punched tape which is forwarded to production control for their use in control of the product.

From the punched tape and with a knowledge of quantity required work orders are generated. Information is duplicated from the operation sheet via the punched tape on the work orders. Lots size and schedule are entered manually but the standard times generated from this information are calculated by the computer automatically and entered on the work order. For each operation a work ticket, material requisitions, and tool withdrawal cards are automatically produced.

The operation sheet along with the aforementioned forms
now completes the release package. When this package is put into
work on the floor an open file in the computer is generated which
will track the progress and performance of the particular job
through the shop.

Material withdrawn, tools in use, and performance against
standards are tracked. In the process of making the part (all of
which is tracked automatically including the machine on which
operators are supposed to be working), if a variance occurs one
of the aforementioned management reports is made. If for some
special reason it is desired to determine the status of an item
that is not out of control the computer may be interrogated to
determine its status.

Manufacturing Reports--The procedure for reporting is
similar to that in the procurement cycle.
1. The Performance Report gives actual versus standard perform-
ance.
2. Work Center Scheduling Report is a fifteen day forecast of
the load for the work center. This report is the one which keeps
various foremen informed on the status of jobs in their area of
responsibility.

Master Status Report--This is the most single comprehen-
sive report published. It is a report of the status of every
single project in the entire organization in enough detail so
that the using manager knows where every component of the projects
are. This includes data from Engineering Release through
shipping of the end item. The exception principle is applied
here also in that the items on the report are only those that are
behind schedule. This report is issued to various levels of management at intervals dependent on its usage requirements. The reporting system is designed to work with all emergencies that could have been conceived in advance. It accommodates as many of the short cuts (such as partial or incomplete engineer releases on a job, etc.) that a production department could dream up in order to meet tight schedule requirements.

**System Span**--The system is fundamentally meant to encompass many firms or divisions in its eventual control. It could be used by a central military contractor and tied into its subcontractors for a master real time control of entire major projects.

**Self Policing**--If a bit of data should have been entered the fail safe features of the system make note of the missing data, and the offender is notified. If a quantity of parts passed out of receiving exceeding the number received, or if a quantity of parts passed to operation (2) exceeds the quantity shown completed in operation (1) the discrepancy is reported. If the opposite occurs a miscount by the system is possible but the error is on the side of too much inprocess inventory which is on the fail safe side from a control standpoint and in reality the quantity in work is at least the correct amount.

**Modeling**--The system is capable of simulating the effect on plant operation of various items which could change the schedule requirements such as rush orders or cancelled contracts. This ability is one of the important ways in which LOCS services the Management.
It is not the opinion of the management at Librascope that it has found a substitute for good managerial judgement. A computer system of this sort is not capable of considering all the contingencies that could occur in major decisions either short or long range. It does flag deviations from plan and indicate that a decision should be made but it cannot figure out solutions to problems. It gives management timely reports of all the available facts so that the best decision can be made.

Conclusions on the LOCS System—Two years after its installation when the article was written from which most of this description was taken it was the opinion of the management at Librascope that they had succeeded in their original objective. The problems encountered were not of the type of simplifying computations for optimization of conditions as the designers had thought their job would be when they originally embarked on the project. Instead it turned out to be a problem for development of an information system of mass storage and ready access and retrieval. The problems of installation were more mechanical than human, as was expected because of the extensive selling job done by the Industrial Engineering Department on its introduction.

It was realized of course that one of the large problems that had plagued other companies in EDP systems was the inflexibility once a major system was installed and the difficulties of adding onto an existing system. For this reason the Industrial Engineering Department dogmatically held to its stand that the system should be totally encompassing and integrated for the
entire operation. This has also shown to have paid off. The break even point was estimated at a little over two years of operation.

**Job Location and Shop Order Updating with Punch Cards - a case**

**Introduction**--The following (four pages) will describe an EDP system for keeping track of jobs in a factory. This system is not integrated with any other but was installed simply to streamline the particular operation that was presently being performed by hand. A description will also be given on how the individual Shop Orders are updated.

**Background**--The company (Raybestos Division) installing this system is a manufacturer of automotive brake lining, clutch facing, and automatic transmission plates. They supply original equipment to customers on special orders and replacement to the industry is supplied from a shelf inventory which is manufactured according to a sales forecast. The same department schedules both kinds of business to any particular department.

**The Manual System**--The production department fed back to production control the movement of jobs between departments on a daily basis. However, for the quantity of work in the factory (3000 lots) this took four people 12 hours each to compile for a monthly report. In addition, this report was issued four days

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after the close-out of inputs. The result was past due deliveries and unhappy customers.

**Solutions**—The company already had EDP for accounting, payroll, billing, and sales analysis. They reviewed all the present reports and after eliminating those that they did not consider absolutely essential, it was determined that there was enough time on the computer for production control to put out the reports that were needed.

**Punch Card System**—A punch card has 80 columns; therefore it was decided to break each week into two time periods. Personnel were indoctrinated into thinking of schedule in terms of the time periods instead of days or weeks, etc. A single card was made up for each lot of work in the factory. When a lot is moved the card is moved in central control by production control; this information is taken from the report which manufacturing still supplies to production control with daily reports of material movement. As a result a minimum demand on the tabulating department is made. The computer is used only for its ability to print rapidly. All collation and extending was accomplished by the physical implementation of the system.

The report which is issued to each department foreman shows only the work that is scheduled in his department. He can tell at a glance what is required of him. The following figure illustrates the format of the report. (Figure 1)

**System Installation**—One department at a time was converted. It took 12 man weeks of work to prepare all 3000 punched cards. The system was installed in 3 weeks without any duality
of recording. As a result the total time to install the system was cut to 50% of what the equipment manufacturer estimated it would take.

System Maintenance--The most single important feature of maintaining the system is the timeliness of information input. No delays can be tolerated. As a result a close schedule of output information is possible. At precisely the right moment the delivery of cards to EDP occurs, three hours later the report is ready, and within the hour production control personally delivers the copies to all operating personnel.

The reports are reviewed at weekly followup meetings with the department foreman and department expeditor. The general foreman and the supervisor of expediters are also in attendance at these meetings. Department progress reports of planned versus actual are presented. As a result timely high level impetus to problems is possible. In addition schedule changes are more readily installed into the system in that the coordination of all
affected personnel is much more rapidly accomplished.

**Shop Order Updating**--The following is a description of a second usage of EDP by this company's production control department. For each order received a separate punch card is made. The back of the card is used to post shipments made by the traffic department. The information is gathered from a daily tabulation by the traffic department. The sales are promised on a weekly basis so once each week the cards for past due, current week, and next week's shipments are pulled and sent to data processing for print out of three lists. This is the only usage of EDP in this portion of the system.

The expected delivery date is then determined from the control system previously described and is posted next to the order on these lists. Copies of the report are given to Shipping, Packaging, Factory Management, and Sales. Every week the sales department informs every customer of the delivery status of his order.

**Equipment Usage**--Tabulating department is used one hour per day for card punching, plus four more hours per week to run the production control report. The shop order report requires only 15 minutes a week of machine time.

Occasionally it is possible for cards to be destroyed in any EDP system. If this happens then a new set is made up by referring to the last report and updating from existing status.

**Summary**--The company feels that its goal has been accomplished. Deliveries to customers have improved to the point where past due orders are virtually non-existent.
APPENDIX "B"

THE QUESTIONNAIRE (First Half of Front)

1. Are you a:
   Worker □ First-line supervisor □ Manager □ Executive □ Staff □

2. How many people are under your direction in the organization?
   0 to 5 □ 5 to 10 □ 11 to 50 □ 51 to 100 □ 100 or more □

3. In which department do you work?
   ________________________________________________________________

4. How many years have you been managing (including first-line supervision)?
   0 to 5 □ 5 to 10 □ 10 or more □

5. How much education do you have?
   High School □ College Degree □ Advanced College Degree □

6. How many companies have you worked for in your business career?
   ________________________________________________________________

7. How many of these companies used computers?
   ________________________________________________________________

8. How many people are employed in your plant?
   Up to 100 □ 100 to 500 □ 500 to 1000 □ 1000 or more □

9. Name the departments using computers in your plant.
   None □ Accounting □ Production Control □ R & D Engineering □ Manufacturing □
   Material Control □ All □ Other □

10. What department pioneered the use of a computer in your plant?
    ______________________________________________________________

11. What Industry do you work in?
    ______________________________________________________________
12. Have computers changed the number of people which you supervise?
   No change □     More people □     Less people □

13. Have computers changed the education requirements of people you supervise?
   No change □     More education □     Less education □

14. Do the people working for you require a knowledge of computer programming? Yes □ No □

15. Do you have any computer trained specialists in the department? Yes □ No □

16. Of the following five basic functions of a Manager, to what degree have computers affected/assisted you?

   Plan □     Not at all □   Slightly □   Extremely □
   Staff □
   Organize □
   Direct □
   Control □

17. How has the computer varied the frequency of reports?
   Increased □     Decreased □     No change □

18. How has the computer varied the detail of reports?
   More detail □     Less detail □     No change □

19. How do you or your Manager keep informed on changes in computer technology?
   Salesmen □     Not done □     Central data-processing service department □

20. Why was the computer added in your case?
   To save money □     Improve reporting □     Other □
THE QUESTIONNAIRE (Continued)
(Reverse Side)

21. What kind of courses have you taken or do you intend to take on computers?
   None □   Technical Operation of □   Introduction to use □

22. How many years ago were you aware of the impact of computers on your job?
   0 to 1 □   2 to 5 □   6 to 10 □   11 or more □   not aware □

23. In what portion of the United States do you work?
   NW □   NE □   SW □   SE □

24. How has the computer affected the frequency of contact with the following?

<table>
<thead>
<tr>
<th>Subordinates</th>
<th>Peers</th>
<th>Superiors</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change □</td>
<td>□</td>
<td>□</td>
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<tr>
<td>More Contact □</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Less Contact □</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

25. Do you require in your own position a knowledge of computers? Yes □   No □
   Explain, if yes ____________________________

26. In your total experience was there ever a reverting from a computer back to a manual system? Yes □   No □   Why? ____________________________

27. List the kinds of data or reports that you personally analyze and check if processed by a computer.
   ____________________________ □   ____________________________ □   ____________________________ □

28. List reports which you prepare personally and check if subsequently processed in some way by a computer.
   ____________________________ □   ____________________________ □   ____________________________ □

29. If you have any further comments regarding the subjects covered in this questionnaire please write them below.
Dear Fellow APICS Member:

One of the base objectives of our Society is to further our field in the educational area as much as possible by participating in activities of all types which are beneficial to our Society and to the field we represent. We recently were approached by a Mr. Ted Sundquist, who is a Master's degree candidate at San Fernando Valley State College, California. Mr. Sundquist in preparing his thesis has raised the question that is germane to our field and has requested the Society's help in obtaining information from our members. We have agreed that it is to the best interest of the Society to further this study and we, therefore, granted this permission.

You have been one of the 1,000 members of our Society who were selected at random for answering this poll, and it would be appreciated if you would answer the enclosed questionnaire (both sides) with as much accuracy as possible and return it promptly in the enclosed, self-addressed envelope. As with all polls, the more detailed and accurate the answers the more reliable the results. The following paragraph was submitted by Mr. Sundquist to explain what he wants in this questionnaire in order that he can make conclusions and publish a thesis on the results of this survey.

"If you work in an organization that has not been affected by a computer, answer the questions relating to a computer by assuming that you were working in your present job five or ten years ago. Compare the present with the conditions of your job as they were then. For example: On the question regarding the quantity of people you supervise, answer "more people" if you now supervise more people than you would have five or ten years ago."

Your efforts in answering the questions and mailing the answers in the self-addressed envelope would be appreciated. When the thesis has been completed the plan is to have it published in the APICS Journal... Production and Inventory Management.

Thank you for your cooperation and help.

Sincerely,

R. W. Van Cott
International President
BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

TED SUNDQUIST
23709 Crosson Drive
Woodland Hills, Calif. 91364
Please fill out and return the enclosed Questionnaire to:

Mr. Ted Sundquist
2370 Crosson Dr.
Woodland Hills,
California
APPENDIX "E"

THE FOLLOWING PAGES CONTAIN A COPY OF
THE TOTAL TABULATION OF
RESULTS OF THE SURVEY
APPENDIX "E"
RESULTS OF THE SURVEY

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question and Category</th>
<th>Code No.</th>
<th>All Answers</th>
<th>All Managers</th>
<th>All Deps use EDP</th>
<th>At Least PC/Acctg. use EDP</th>
<th>Others than PC use EDP</th>
<th>No EXP in Company</th>
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</thead>
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<td>How many people are under your direction in the organization?</td>
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<td>4</td>
<td>How many years have you been managing?</td>
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<th>Production Control Managers only (7)</th>
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<th>Others than PC use EDP (9)</th>
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BIBLIOGRAPHY


