A BEHAVIORAL STUDY OF MANAGERS
OF BUSINESS COMPUTER SYSTEMS:
WITH SPECIAL REFERENCE TO THEIR
RELATION WITH TOP MANAGEMENT

DISSERTATION

Presented in Partial Fulfillment of the
Requirements for the Degree Doctor
of Philosophy in the Graduate
School of the Ohio State
University

By
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* * * * * *

The Ohio State University
1970

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>VITA</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>PREFACE</td>
<td>xii</td>
</tr>
<tr>
<td><strong>Chapter</strong></td>
<td></td>
</tr>
<tr>
<td><strong>I. INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>The Changing Business Environment</td>
<td></td>
</tr>
<tr>
<td>Management Problems Associated</td>
<td></td>
</tr>
<tr>
<td>with Growth of Computer</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
</tr>
<tr>
<td>Frames of Reference of Operating</td>
<td></td>
</tr>
<tr>
<td>Managers and Computer Specialists</td>
<td></td>
</tr>
<tr>
<td>The Information Flow Within the</td>
<td></td>
</tr>
<tr>
<td>Business Organization</td>
<td></td>
</tr>
<tr>
<td>Definitions</td>
<td></td>
</tr>
<tr>
<td>The Role of Top Managers</td>
<td></td>
</tr>
<tr>
<td><strong>II. NATURE AND LIMITATIONS OF</strong></td>
<td>36</td>
</tr>
<tr>
<td>THE STUDY</td>
<td></td>
</tr>
<tr>
<td>Objectives of the Study</td>
<td></td>
</tr>
<tr>
<td>Significance of the Study</td>
<td></td>
</tr>
<tr>
<td>Developments in Computer Use</td>
<td></td>
</tr>
<tr>
<td>Limitations</td>
<td></td>
</tr>
<tr>
<td>List of Hypotheses</td>
<td></td>
</tr>
<tr>
<td><strong>III. RESEARCH DESIGN</strong></td>
<td>80</td>
</tr>
<tr>
<td>Method of Gathering Data</td>
<td></td>
</tr>
<tr>
<td>Data Obtained from Questionnaires</td>
<td></td>
</tr>
<tr>
<td>Composition of Sample</td>
<td></td>
</tr>
<tr>
<td>Computer Applications in</td>
<td></td>
</tr>
<tr>
<td>Respondent Firms</td>
<td></td>
</tr>
</tbody>
</table>
IV. ROLES, EXPECTATIONS OF MANAGERS .......................... 104

- Deficiencies of Early Theory
- Introduction of the Behavioralist Approach
- Definitions of Systems
- Flows Occurring Within the Systems
- Computer Technology, A Major Environmental Force Impinging on Management
- Relationships Between Participants
- Perspectives of Managers

V. CONCEPTUAL FOUNDATIONS ........ 142

- Basic Models in the Evolution of Organization Theory
- Relevant Behavioral Research
- A Model of Management Interaction

VI. HYPOTHESES, FINDINGS AND DISCUSSION ................. 172

- Explanation of Statistical Methods
- Analysis of Data
- Statements of Hypotheses

VII. CONCLUSIONS ............................................. 219

- Summary of Results
- Final Conclusions

APPENDIX A

A Copy of Questionnaire and Cover Letters Used in Top Manager Survey ................. 240

APPENDIX B

A Copy of Questionnaire and Cover Letters Used in EDP Manager Survey ................. 249
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of Computers Installed</td>
<td>9</td>
</tr>
<tr>
<td>U.S. 1955-1975</td>
<td></td>
</tr>
<tr>
<td>2. Computer Uses Reported by Top Managers Classified According to</td>
<td>51</td>
</tr>
<tr>
<td>Criteria for Use</td>
<td></td>
</tr>
<tr>
<td>3. Classification of Industries from which Members of Sample are</td>
<td>88</td>
</tr>
<tr>
<td>Drawn</td>
<td></td>
</tr>
<tr>
<td>4. Size of Companies Measured by</td>
<td>91</td>
</tr>
<tr>
<td>Number of Employees</td>
<td></td>
</tr>
<tr>
<td>5. Size of Companies Measured by</td>
<td>91</td>
</tr>
<tr>
<td>Sales Revenue 1968</td>
<td></td>
</tr>
<tr>
<td>6. Titles of Top Managers to Whom EDP Manager Reports</td>
<td>92</td>
</tr>
<tr>
<td>7. Size of Company EDP Departments</td>
<td>92</td>
</tr>
<tr>
<td>8. Membership in Professional Computer Organizations</td>
<td>97</td>
</tr>
<tr>
<td>9. Computer Applications Recorded by Data Processing Managers</td>
<td>99</td>
</tr>
<tr>
<td>10. Applications in which EDP System Has Yielded Important Benefits</td>
<td>102</td>
</tr>
<tr>
<td>11. Educational Attainment</td>
<td>176</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>12. The Association Between Age of Data Processing Managers and Number of Companies for which They Worked in EDP</td>
<td>180</td>
</tr>
<tr>
<td>13. Age of Data Processing Managers Related to Level of Education</td>
<td>181</td>
</tr>
<tr>
<td>14. Percentage of Positive Answers to Reasons Why TM May be Detached from Important EDP Problems Expressed as Percentage of Each Group</td>
<td>190</td>
</tr>
<tr>
<td>15. Frequency and Duration of Meetings Between Top Management and EDP Managers Related to Top Managements Knowledge of EDP Usage</td>
<td>193</td>
</tr>
<tr>
<td>16. Frequency and Duration of Meetings Between Top Management and EDP Managers Related to Top Managements Faith in Middle Management to Solve Computer Staff Problems</td>
<td>194</td>
</tr>
<tr>
<td>17. Mean Response of Top Managers Concerning Frequency and Duration of Meetings: Grouped According to Company Benefit from Computers</td>
<td>197</td>
</tr>
<tr>
<td>18. Mean Responses to Statements on the Top Management Questionnaire Concerning Relationships Between EDP Staff and Functional Managers. Top Management is Divided According to Estimates of Financial Benefits/Losses with Computer Systems</td>
<td>205</td>
</tr>
<tr>
<td>19. Mean Responses of Top Managers and Computer Specialists to Statements Concerning Operational Management Involvement in Computer Operations</td>
<td>208</td>
</tr>
<tr>
<td>20. Size of Firm Related to Payoff from Use of Computers</td>
<td>212</td>
</tr>
</tbody>
</table>
Table

21. Computer Applications of Small Firms for Management Information Purposes .......................... 216
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Elements of Behavior by Managers Concerned with EDP</td>
<td>13</td>
</tr>
<tr>
<td>2.</td>
<td>The Control Loop</td>
<td>18</td>
</tr>
<tr>
<td>3.</td>
<td>Subsystem for Computer Operations</td>
<td>24</td>
</tr>
<tr>
<td>4.</td>
<td>Top Management Commitment to EDP</td>
<td>26</td>
</tr>
<tr>
<td>5.</td>
<td>Developments in Computer Use 1960's</td>
<td>48</td>
</tr>
<tr>
<td>6.</td>
<td>Developments in Computer Use 1970's</td>
<td>49</td>
</tr>
<tr>
<td>7.</td>
<td>Interpretation of Least-Square Regression Line</td>
<td>69</td>
</tr>
<tr>
<td>8.</td>
<td>Computer Technology is a Major Environmental Force Impinging on Management</td>
<td>112</td>
</tr>
<tr>
<td>9.</td>
<td>The Urwick Model</td>
<td>120</td>
</tr>
<tr>
<td>10.</td>
<td>Three Dimensions of Role</td>
<td>124</td>
</tr>
<tr>
<td>11.</td>
<td>The Managerial Grid</td>
<td>156</td>
</tr>
<tr>
<td>12.</td>
<td>Model of Management Interaction Related to EDP System of a Business Organization</td>
<td>167</td>
</tr>
<tr>
<td>13.</td>
<td>Possible Causes of Disharmony in EDP Management</td>
<td>171</td>
</tr>
</tbody>
</table>
Preface

This is a study of business managers and computer experts. Its purpose is to examine the manner in which they work together and the relation of this interaction, in the judgment of managers, to the computer's contribution to the objectives of the firm.

The study is not intended to consider other aspects of computers nor of managers and computer specialists, neither the comparison of computer costs to the cost of alternative processes, nor the use of computers for otherwise unobtainable information, nor the impact of computers upon employees, stockholders, or customers, nor the potential markets and uses of computers in any industry. Rather, it is a study of the work interactions of top managers and their computer experts intended to reveal which of their behavior patterns coincide with what is regarded by them to be a congenial and effective working relationship.

Basic to the entire study is the assumption that in their interaction the effectiveness of their collaboration is affected by such factors as their respective levels and types of education, referent group identifications, nature and frequency of contacts, initiation of interaction, and the like.

The conceptual framework and language of the study is drawn largely from the behavioral sciences which conceive human behavior as role-oriented, performing according to role requirements and reacting to role expectations.
In the making of this study, questionnaire responses from 101 computer experts and 133 managers, obtained from 130 firms surveyed, are analyzed by statistical measurements for the determination of similarities and differences in the characteristics and attitudes of the two groups. The relevance of these findings to the success of their collaboration is considered.

The value of the study lies in the insights for greater effectiveness it provides all who are involved in developing and using computer data. The findings may be useful also to those who are counseling or instructing in the best use of computers.

The organization of the study is as follows:
Chapter I is introductory, showing that in the environmental change resulting from technological innovations managers have been required to adjust themselves to new work requirements and relationships.
Chapter II spells out in considerable detail the objectives of the study, drawing its several hypotheses out of consideration of uses of the computer itself and of the problems of establishing and interpreting the essential variables to be studied. Chapter III relates the technical aspects of the research, its design and implementation. Chapter IV enlarges upon the sociological concepts of roles and relationships in terms of which the data are interpreted. Chapter V continues this theoretical framework, reviewing relevant models of interpersonal behavior. Chapter VI presents an explanation of the statistical measurements employed and an analysis of the data compiled. Chapter VII summarizes the study and proposes certain conclusions.
CHAPTER I
INTRODUCTION

The purpose of this introduction is threefold. First, it explains the rise of computer technology as part of the general phenomenon of change. Since the beginning of industrialization, management has looked for ways of adjustment to rapid changes in the business environment. As the advent of computerization is a new phase of industrialization, the problem of adaptation continues and in this sense there is nothing unique about computer problems.

Second, it develops the idea that the relationships among managers are an important aspect of computer operations. Concepts from the behavioral sciences are helpful in gaining an understanding of relationships between technical specialists and operational managers. Among the sociological concepts used in the study are interaction patterns, role fulfillment or non-fulfillment, and the diversity of flows in business systems.

1
Third, it explains the key role of the top manager by reference to recent literature on the subject of management of computer systems.

Thus, in sequence, the topics included in this introductory chapter are: (1) the changing business environment, (2) management problems associated with the growth of computer installations, (3) frames of reference of operating managers and computer specialists, (4) the information flow within the business organization, (5) definitions, and (6) the role of top managers.

The Changing Business Environment

A dynamic society is one in which change occurs. Societal change resulting from major technological advances is especially evident in the United States, where new developments in such industries as electronics, automation, and aerospace have taken place in the period 1950-1970. Computer technology, a major force for change, has been associated with all of these innovations. Business methods, procedures, and capabilities alike have been affected by this new technology. Writing on the problem of coping
with change, one authority states:

"Change itself means the overthrowing of tradition, and the laying aside of patterned ways of living and working together—ways which are often just beginning to stabilize after an earlier change. The trading of predictable and secure environments for ambiguity and uncertainty is an inevitable consequence of change."

One important theory of social and economic development is based on the central significance of technological innovation. Schumpeter reasoned that the business cycle can be explained by technological innovation. Business innovation creates demand for new products and raises the level of demand for existing ones. Schumpeter made an analogy between economic activity in a free enterprise economy and the resonance of a violin. The level of activity tends to increase at a reduced rate, approach a stationary state, or decline prior to the introduction of an innovation. But new technology quickens the level of activity in the same way that plucking a violin causes an instrument to resonate. Oscillations are damped and sound fades until the strings are plucked once again. Innovations pluck

---

an economy into dynamic motion, argued Schumpeter.
The incentive for this to happen is the possibility of profitable exploitation of new technical or managerial processes.

"...in capitalist reality it is competition from the new commodity, the new technology, the new source of supply, the new type of organization—competition which commands a decisive cost or quality advantage and which strikes not at the margin of the profits and the outputs of the existing firms, but at their foundations and their very lives. This kind of competition is so important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly..."

The accession of new technology was termed the "process of creative destruction," a process whereby older traditional industries make way for new ones. But the consequences of change are more far-reaching than changes in industrial structure, levels of output, and other economic indicators. The economy is also a social institution, and technological invention means change in the relationships between people who are active in the economy.

---

Sets of relationships which have been established in order to facilitate the operation of business enterprise are no longer adequate for new circumstances.

In order for businesses to survive changing conditions, they must adapt to the environment, and the necessary adaptations have important social implications. People play many roles in society, as producers, consumers, voters, parents, members of unions or professions, and many more. Management is one of these roles and it is management's task to take decisions which will determine the capacity of the firm to adapt to a changed business environment.

This study is concerned with the relationships among managers with responsibilities for the operations of computer systems. The area chosen for investigation is the relationships between top management and managers of data processing departments.

In the foregoing discussion, the following generalizations are implicit:

1. That change is an inescapable feature of a dynamic economy.

2. That in order for business firms to survive and grow they must adapt to changes in the business environment.
3. That computer technology is an important agent of change.

4. That with the advent of the low-cost, high-speed digital computer, business managers are faced with decisions concerning how to cope with environmental change resulting from applications of computer science.

5. That the effects of computer innovations are perceived mainly as a technological phenomenon (with emphasis on cost-savings, provision of new data, organizational structure of firms, and so forth) whereas an equally important aspect of change is the way in which it affects people.

6. That one difficulty with computer operations concerns the relationships between specialists (EDP staff) and generalists (corporate executives).

7. That top management plays a key role in influencing these relationships, their attitudes toward computer operations often critically affecting computer operations.
8. That this study should examine relationships between top managers and the data processing managers in their respective firms. Accordingly, the inquiry focuses on three main issues:

a. Level of Awareness (To what extent is top management engaged or disengaged from computer problems?)
b. Level of Support (Is the attitude positive or negative, consistent or only at time of crisis?)
c. Level of Vacuity (Does top management detachment tend to create a vacuum into which the EDP staff move due to the absence of operational management?)

9. That problems of communication can be partially attributed to the fact that processing managers and top managers have different perspectives on operational problems. The term 'communication' as understood in this study is the process by which a common meaning is established between two interacting parties.
Management Problems Associated with Growth of Computer Installations

The computer is as significant for present day society as was the steam engine, electricity, and the internal combustion engine at periods in the past.

Much of present-day technology depends in large measure on operation of computer systems. High-speed third generation digital computers have achieved what is sometimes referred to as "the computer revolution." Such systems are no longer the preserve of large firms with vast capital assets; increasingly, small firms are able to share in this technological advance. It has been estimated that nearly half of all computers are used for business applications. The number of computers in present and projected use in the U.S. over a twenty year period (1955-1975) is given below:

Table 1.—Number of computers installed, U.S. 1955-1975

<table>
<thead>
<tr>
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<td>1000</td>
<td>31,000</td>
<td>60,000</td>
<td>85,000</td>
</tr>
</tbody>
</table>

Source: Survey by American Federation of Information Processing Societies

Even allowing for the slow down due to the 1970-1971 recession, growth of the industry is remarkable. While the relative rate of growth is inevitably declining the absolute increase in each quinquennial period since 1960 is 25,000-30,000 computers installed. Growth of computers as a new phenomenon in society has brought a new specialization, that of the computer expert, a specialist technician involved in all phases of computer operation. Data processing managers have acted as catalysts for the changes that have occurred in the past twenty years.

Computer systems have not been introduced without a number of attendant difficulties. One of these is that the technical capabilities of the current hardware have now outpaced the management skills necessary to make full utilization of the
new equipment. Thus there has been increasing attention to developing machines and machine instructions for software, that is to say the devices which control computer operation.\textsuperscript{4} Without better use of the third generation hardware increased expenditures are not being matched by better economic returns.

Development of software systems introduced further problems. On the one hand the quality and quantity of technical skills needs to be increased. More managers, analysts, and programmers are required with greater knowledge and improved skills. On the other hand operating management has greater difficulty in comprehending new computer systems, which many corporate executives consider to be an esoteric matter. The functional manager, however, is the major user of management systems which utilize computers. Thus the roles played by the manager

\textsuperscript{4}"Software means the methods and techniques of conversing with computers and instructing them in programming the tasks desired—the programs and instructions. The hardware of data processing systems ordinarily consists of a combination of units including input, storage or memory, processing or calculating ability, and output." Bartow Hodge and Robert M. Hodgson, Management and the Computer in Information and Control Systems, (New York: McGraw-Hill, 1969.), p. 4.
as user, and by the computer specialist as initiator and implementer of systems, have come to be understood as centrally important to the better employment of contemporary computer systems. Understanding between data processing management and operating management is a necessary pre-requisite to effective utilization of systems. Each group has a different frame of reference and tends to see problems in a different perspective.

A number of business analysts and practicing consultants have suggested that the separation between users and specialists can only be successfully bridged by the initiative of top management. On many of the issues pertaining to computers top managers share much the same viewpoint as middle managers. Compared to the middle manager, however, they are less restricted by departmental considerations. The middle manager operates—makes decisions—in an environment related to his function in the firm, i.e., production, sales, finance, etc.; this environment imposes certain constraints on his thinking. The top manager is better able to perceive the interaction
between all the elements in the system, takes a broader viewpoint, and attempts to maximize effectiveness in a larger area of decision-making. Thus while there are significant similarities there are also important differences between the two levels of management. The activities, interactions, and attitudes of the three management levels concerned with EDP are briefly summarized in Figure 1.

Frames of Reference of Operating Managers and Computer Specialists

The traditional manager has become increasingly reliant on a new breed of staff specialist who is trained in a technology which provides information. As previously stated, clear understanding and rapport between operating management and data processing managers appears to be hindered by differing characteristics prevalent within each group. The qualities of a representative member of each group are commonly portrayed as follows:

A corporate executive must be an effective generalist who has developed beyond the confines of any one profession, such as accounting or
<table>
<thead>
<tr>
<th>LEVEL OF MANAGEMENT</th>
<th>ACTIVITIES</th>
<th>INTERACTION</th>
<th>ATTITUDES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP MANAGEMENT</td>
<td>Decision making on EDP: a. Selection</td>
<td>Extent of involvement in computer</td>
<td>Positive or Negative: results in</td>
</tr>
<tr>
<td></td>
<td>b. Implementation/ application</td>
<td>affairs reflected by interaction</td>
<td>support or lack of support for</td>
</tr>
<tr>
<td></td>
<td>c. Scope of operations</td>
<td>with data processing manager</td>
<td>EDP activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The perceived outcome of EDP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>operations</td>
</tr>
<tr>
<td>MIDDLE MANAGEMENT</td>
<td>EDP Use (&quot;Customer&quot; of EDP service)</td>
<td>Concern for operational results</td>
<td>Pragmatic: has application aided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediary for TM; more direct</td>
<td>functional performance?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>interaction with CS</td>
<td></td>
</tr>
<tr>
<td>COMPUTER SPECIALISTS</td>
<td>EDP Service (Supplier to functional departments)</td>
<td>Measures of interaction with MM and</td>
<td>Possible bias against lack of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TM may correlate with perceived</td>
<td>precision in business</td>
</tr>
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<td></td>
<td></td>
<td>performance</td>
<td>Concern for technological advance</td>
</tr>
</tbody>
</table>

Figure 1---Elements Of Behavior By Managers Concerned With EDP
marketing. He needs skill in interpersonal relations, sensitivity to corporate politics, ability to persuade others in the organization to accept certain programs or policies, or reject other programs. He plans, coordinates and controls by interaction and communication with other people.

The corporate manager is generally more senior in age, less concerned with professional interests, and owes his advancement to successful performance within the company. The background and training of the line managers in most companies is focused on traditional activities such as sales, accounting, or engineering. Practitioners in these fields communicate in concise, non-technical language unless there is special reason for not doing so (e.g., a technical document).

A computer specialist develops in a markedly different environment from that of the corporate executive. His formal education is likely to be in the physical sciences, statistics, physics, engineering, etc., with little attention paid to the social sciences. The college and business training of the computer technologist requires logical
analysis and precision is results. He is responsible for developing and maintaining systems which are fast, consistent, and accurate.

When the frames of reference of corporate executives and computer executives are juxtaposed, they present a contrast. Members of groups perform according to different criteria. The systems expert achieves his position by virtue of technical ability, evidenced by technical skills. Due to the recent growth of the computer industry such skills are in short supply. This scarcity of computer personnel diminishes the need for individuals to be committed to their current employer. As a result the expected career pattern of a data processing manager would be characterized by high mobility, high income at an early age, and a professional orientation.

Data processing specialists communicate in languages which use a large vocabulary of new technical words (currently estimated at approximately 5,000 words and likely to increase considerably in the next decade). Given the infancy of computer technology, the present vocabulary can be expected to greatly increase. The corporate executive may feel isolated from the jargon of the technician and develop
fears concerning the technology which is rapidly gaining such an important place in the organizational structure.

There are, therefore, a number of causes of misunderstanding which would adversely affect communication and interaction between technicians and corporate managers. Expectations concerning their relationships are likely to be frustrated due to divergent backgrounds and training, environmental experience and the qualities necessary to maintain their respective positions. Members of each group may bring into a situation attitudes towards the solution of corporate problems which are conducive to friction or disharmony. The degree of disharmony may be reduced by a number of approaches aimed at the technicians and the operating manager.

The Information Flow Within the Business Organization

The applications of management science necessary for conducting a business enterprise depend on flows of accurate, timely, and comprehensive information.
The computer system provides a flow of facts and the manager uses his intelligence, experience, and judgment to draw conclusions from the data supplied. Hence it is misleading to refer to "computer controlled business," as implying that human intelligence is no longer necessary. The necessity for human control is shown in Figure 2. This shows that a business system, a set of physical components, receives the electronic controls of the computer via programming supervised by management. The manager requires at least two broad categories of information:

1) Internal intelligence
   \{ \begin{align*}
   & \text{production plans} \\
   & \text{inventory levels} \\
   & \text{supplies of inputs}
   \end{align*} \}

2) External intelligence
   \{ \begin{align*}
   & \text{sales analysis} \\
   & \text{strategies of competitors} \\
   & \text{market trends} \\
   & \text{market simulation}
   \end{align*} \}

Computer systems are increasingly being applied to supplying the flow of information necessary to satisfy both internal and external requirements.

The significance of the flow concepts for extra-organizational activity has long been recognized by marketing scholars. They observed the flow of commodities from one entity to another in
Figure 2.—The Control Loop
a typical channel of distribution, with inventories of products at various points, which acted as pools or reservoirs. A similar process occurs in the flow of information in a business hierarchy. Information gathered at lower levels is ordered, classified, and condensed, then passed up to a higher level. At this level information is collated, condensed, and refined before being passed on to the next higher level. In this way top management does not have to face a plethora of information; the flow is so organized that the information is aggregated and summarized prior to its being received at the highest levels in the hierarchy. Thus the flow of information parallels the flow of authority which flows in the opposite direction, as reflected in the conventional organization chart. Of course an efficient organization has many information flows from both formal and informal sources. The point being made here is that there is a significant process of reduction in the upward direction in order that information is received in a manageable form.
Arch Shaw understood business as being importantly concerned with flows. He reasoned that business activities are essentially "matter in motion"; that it is possible to distinguish three basic motions:

1) motions changing form (production)
2) motions changing place and ownership (distribution)
3) motions of administration (purchasing, facilitating functions, accounting, etc.)

Reavis Cox further developed commodity flow theory with a macro-economic approach to aggregate flows within the system of distribution. A significant development in business analysis occurred when it was recognized that the physical product or commodity sometimes flowed in a different route from the title to the product, i.e., the right to ownership. This allowed the possibility of

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7 For a good example of Reavis Cox's approach see Distribution in a High Level Economy, (Englewood Cliffs, N.J.: Prentice-Hall, 1965).
recognition of a variety of other flows: credit, information, orders, payments, and so forth. Thus, between business systems there is a complex of interactions and activities with a variety of flows taking place. The diversity of flows occurring with business systems take place not only between firms, but also within them, from one level of operation to another. Thus one can conceptualize a total system, with various sub-systems, and flows taking place throughout. Traditional boundaries between one department and another, and one firm and another, are bridged by various forms of interaction.

Communication is important in bridging the separations between producer and consumer, and between employer and employee. McInnes conceptualized the separations of the market as having spatial, temporal, perceptual, ownership, and valuation aspects.  

Bartels also analyses the separations which determine the tasks for marketing institutions.

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and the functions which must be performed. Bartels' explanation is similar to that of McInnes but includes an additional facet, that of functional separation. Producers and consumers have different skills and abilities and are linked by various intermediaries, or middlemen.

The concepts contributed by the writers noted above have some relevance to the sub-systems within firms concerned with data processing. Consider the two groups, top management and data processing management. The separations which need to be bridged for effective communication between the groups are functional, informational, and spatial. Functional separation is inevitable because of the special skills required in each role and is increased by lack of knowledge of what is required of a person in the other role. Writers in data processing journals frequently cite the need for users of EDP systems to gain knowledge of computer concepts and procedures, and for computer specialists to gain more understanding of business operations. Too

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many specialists, say the critics, are content with technical feasibility rather than relevance to the real needs of business, when planning business EDP systems. If some degree of functional separation is unavoidable, the gap can be minimized by increased mutual understanding of function. Also, the transfer of more data processing personnel into top management will reduce difficulties arising from the fact that each group speaks a different language. The semantic "barrier" between users and specialists is an obstacle to improved communication. For informational separations to be overcome, managers need a degree of bilingual ability. In many businesses physical separation of EDP facilities from plant or head office poses a barrier to interaction between operational management and EDP staff. Interaction is more likely to occur if the EDP personnel are not physically remote.

Recognition of work flows taking place within the business permits study of the role positions necessary for such flows to occur. There are, of course, many management roles to be played in contemporary business, requiring functional,
professional, and geographical knowledge. The emphasis of this enquiry is on a relatively small sub-system illustrated in Figure 3.

![Diagram of EDP system]

**Figure 3.** Sub-system for Computer Operations

One is here concerned with the way in which managers participate in the work of providing a flow of information via a data processing system. Intra-organizational communication, e.g., management accounting data concerning production, and extra-organizational communication (sales analysis, market simulation, etc.) depend on effective performance of the EDP system.
The participants have expectations concerning how the roles should be fulfilled. There may not, however, be consensus regarding what constitutes adequate performance. Disharmony occurs when the participants have mutually discrepant expectations, that is to say, when expectations cannot be met; or when the roles are not considered to be fulfilled satisfactorily. Such situations are likely to arise when the participants view a common problem from very different perspectives. An individual's viewpoint is influenced by various factors; prominent among them are: position in the organization, previous business experience, duration and nature of education, personal values and attitudes, and many other variables. It is possible to ascertain the extent to which individuals have contrasting or complementary values and expectations by study of their patterns of action and interaction, and measures of their attitudes toward mutual problems. It may be possible to discern the degree of involvement in business functions. It is clear, for instance, that where there are computer systems in operation, senior managers in the firms concerned
have overall responsibility for such systems, but
the degree of commitment to this task can vary over
a wide spectrum as shown in Figure 4.

\[ \text{NOMINAL} \quad \text{MEDIUM BAND} \quad \text{VERY}
\]
\[ \text{delegation of} \quad \text{POSITIVE} \quad \text{high level support,}
\]
\[ \text{responsibility} \quad \text{personal involvement,} \quad \text{wider range of}
\]
\[ \text{where possible} \quad \text{applications} \]

Figure 4. Top Management Commitment to EDP

It would be of benefit to top managers to determine
where they are placed in this broad spectrum.

A question may be raised concerning the
situations or characteristics which influence the
extent of commitment. Sociological concepts con-
cerning initiative, cooperation, conflict, leader-
ship, and so forth, are helpful in understanding
this phenomenon. Such concepts are used in this
study in the attempt to explain the relationships
among the role positions within that segment of
management which has direct responsibility for data
processing. However, the approach is not limited
to the interactions and involvement of people in
in different roles but in the same sub-system, i.e., a firm's EDP department. At some points in the analysis we consider the activities, interactions, and attitudes of people in the same role but in different systems, e.g., a comparison between top managers in large firms and top managers in small firms.

**Definitions**

The following terms, frequently used throughout the paper, are intended to be understood as follows:

**Top Management**—Vice-Presidents and above, Secretaries, Treasurers, Comptrollers, General Managers, senior executive management responsible for authorizing the procurement of data processing systems and approving policies governing their use. (For titles or position of top management respondents see Table 6).

**Middle Management**—Corporate executives at the level of department manager or assistant, superintendents of plant, office managers, functional managers (e.g., purchasing, production, etc.), line managers who are responsible for implementing top
management policy, users of EDP services who interact with computer staffs concerning operation of systems. Their strategic position in the hierarchy gives them knowledge of what is required of an operational business system.

Data Processing Managers--Heads of computer staffs in the respondent firms; excludes those not responsible for administering EDP staff, such as systems analysts, programmers, etc. For information concerning size of EDP departments included in this study see Table 7 (p.92).

Computer Generations

It is possible to distinguish three generations of computers, mainly on the basis of technological developments. The first generation of equipment dates from the early nineteen fifties. These computers relied on vacuum tubes for conduction of electronic pulses. From 1955-1960 transistors progressively took the place of vacuum tubes, introducing what is termed solid state equipment. This is the second generation phase. Speed of operation was faster and programming facilities were more flexible. Manufacturers, notably IBM, supplied programming systems to users.
Third generation equipment dates from the middle nineteen sixties. It is characterized by the development of high speed, digital computers which utilize smaller transistors and miniaturized components. Capacities have greatly increased and costs have been decreased. In the 1960's a greater variety of low cost medium and small size computers was available. There were important developments in programming systems (software). Improvements in computer equipment and systems are continuous and incremental such that it is increasingly difficult to distinguish "watershed" changes. Three likely developments in the early 1970's are:

(a) Higher computational operating speeds
(b) Improved performance and watching of the units which make up the configuration of a given system.
(c) Further developments in software.

The terms EDP and ADP synonymously as referring to electronic or automatic data processing systems.

For further explanation of terms used in the study see Glossary, following the Bibliography.
The Role of Top Managers

Business consultants and writers of official reports have frequently criticized top management's seeming lack of commitment to computer operations. Hence, the conclusions of a Presidential Report:

"Almost no single action that can be taken would provide equal return in agency operations improvement than for top officials to adopt a direct favorable position toward ADP use and ADP training. Other ADP actions will be ineffective or even unsuccessful if such top management support is not forthcoming."

Rodney H. Brady, a Vice-President with Hughes Tool Company, made a review of the extent to which computers are affecting top level decision making. He interviewed more than 100 top managers and studied the decision-making process involved in manufacturing and research. He concluded:

"In many areas (of decision making) managers are not making maximum use of the computer, for reasons such as:

\[\text{References}\]


1. Lack of appreciation (or even education) on the part of many top and middle managers regarding the ways computers and computer information can be used in making decisions.
2. A defensive attitude on the part of some top managers regarding the threat that the computer presents to their decision-making functions and to their prerogatives of exercising "managerial judgement".
3. A lag in the development of currently practicable systems which are geared primarily to assisting top managers in making decisions.
4. A hesitancy on the part of some top managers to formally identify the criteria which they wish used in the decision making.
5. A tendency for top executives to wait for other firms to incur the expense and risk of pioneering and testing new areas of computer applications.

A British study (1967) of the roles and characteristics of thirty data processing managers posed the following question to the sample of EDP managers:

"What do you feel are the main problems encountered in introducing the idea of computer usage to (operational) management and staff and in getting proposals accepted?"12

The EDP managers were asked to evaluate eleven factors which may have aided or impeded development

of computer usage and method by scoring the answers on a 1 to 5 scale. The factor which scored the highest, i.e., was rated the most important, was "Relationships between systems staff and user management." This choice was followed closely by "Support and direction from top management." Hence, the British study confirms the importance of relationships between managers as having a strong influence on the effective development of EDP. Furthermore, involvement by top management is considered necessary for the user roles to be fulfilled according to the expectations of the specialists.

An important study of profitability of computer use was made by McKinsey and Co. (1968). A sample of 36 large U.S. and European companies, representing 13 industries, agreed to interviews for both staff and line executives. They were mostly large firms, 25 of the 36 companies had sales revenues exceeding $500 million in 1968. The McKinsey report is so replete with constructive analysis as to defy brief summary. However, two points emerge

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which are relevant to this study:

1. Examples are given to illustrate the gap in communication which was found to exist between computer staff and operating management. Computer specialists tended to "take refuge in refining the internal operating efficiency of the computer department."\(^{14}\)

2. The report emphasizes the issue of top management involvement: "If any one man can be said to hold the key to the computer's profit potential it is probably the chief executive. He has a very definite responsibility for the success of the computer development effort, and it is not a responsibility that he can safely delegate."\(^{15}\)

The above excerpts, taken from four leading studies of computer systems, have been given in order to show that the role of top management has received serious attention from business analysts. To date, however, analysis has been confined to providing evidence to show that there is a problem, rather than suggesting ways of solving it. For the solution to this question management analysts find

\(^{14}\)Ibid., p. 22.

\(^{15}\)Ibid., p. 37.
themselves equipped with the wrong set of tools. They are trained in the analysis of organizational structure, cost-benefit analysis, returns on investment, and other matters which are the technology of business. Roles and relationships between managers of computer systems require study by the industrial sociologist rather than the technologist. There is surprisingly little journal material which adopts a behavioral approach to the data processing industry.

A further deficiency of existing sources concerns the position of the medium to small company. Companies with sales revenue of $20-100 millions are seldom included in the analyses. Yet these companies are increasingly concerned with the operation of computer systems and are likely to be the growth segment of the industry in future years. Third generation hardware enables the smaller company to develop sophisticated systems and gives them many of the same options as the large company. The larger business consulting groups tend to have large companies as clients; thus the research studies focus on the problems of such firms. It is
in the management hierarchy of the big companies that the interviews and surveys take place. Companies in the Fortune 500 and leading European companies are commonly studied, but generalizations applicable to them may not hold for the different operating environment of the small company.
CHAPTER II

THE NATURE AND LIMITATIONS
OF THE STUDY

This chapter commences with a statement of the objectives of the study. In order to attain these objectives ten hypotheses have been formulated. The hypotheses are stated at the end of the chapter.

The significance of the study is explained by contrasting the important growth of computers in the economy with the disappointing results experienced by many users of computers. The need for increasing attention to the human aspect of computer management can be attributed to the greater complexity of computer applications. More advanced applications require greater involvement by operational management.

The next section is a discussion of the empirical and statistical limitations of the study. This topic includes discussion of methods of sampling,
the problem of securing adequate representation, the effects of nonrespondents, and the special problems of field studies as compared with controlled experiments. Additional discussion of statistical methods used in the analysis of data is provided in Appendix D. The Appendix is an important complement to what is given in this Chapter. The final part of the Chapter lists specific hypotheses concerning the problems of computer management.

Thus, the sequence of development of the second chapter is: (1) the objectives of the study, (2) the significance of the study, (3) developments in computer use, (4) limitations of the investigation, and (5) list of hypotheses.

Objectives of the Study

As stated in the introduction this study is concerned with the relationships among managers who have responsibilities for operating computer systems. The special area for investigation is the relationships among top managers and data processing managers. The specific objectives are as follows:

1. To compare the personal characteristics of top managers and data processing managers. The
rationale for this objective is that similar personal characteristics may cause decision makers, when placed in the same decision situation, to make the same decision. It is contended that similar background factors will influence managers toward choosing the same policies or courses of action. That is to say, similarity in certain personal characteristics suggests compatibility among managers.

2. To test the extent to which top management is involved in computer problems.

3. To compare the understanding of each group concerning the degree of support which top management is giving to the corporate computer effort.

4. To test whether the amount of interaction between top managers and data processing managers is associated with the perceived success of a computer system. Perceived success in this context is the measure of profitability of computer systems made by top management respondents.

5. To examine the viewpoint of each group on the role of functional managers in the operation and development of corporate computer systems. The term functional manager refers to general corporate executives, sometimes termed line management.
6. To note the effects of size of companies as a factor affecting successful operation of computer systems.

7. To contrast the performances of the large and small firms included in the sample, regarding the nature and number of their computer applications.

The initial step is to group certain demographic variables which it is contended would cause each group to have different perspectives on computer problems. The frame of reference thought to be appropriate to each group includes nature of education, age, career background and interest in professional associations (hyp. 1, p.77). Strong divergence in personal characteristics would be one possible initial explanation for detachment by top managers from the problems of the computer manager. Such significant differences would help to explain the role expectations of each group of managers.

When discussing the role of top management in relations to computer problems, the terms support, involvement, commitment, or extent of engagement, are used synonymously. Greater involvement is taken to imply greater support for the computer specialists.

Involvement or support by higher-level managers can be understood in a number of different ways.
Use of those terms in this study implies the following:

(a) Setting explicit objectives for the corporate computer effort. Stating the priorities for the resources allocated to data processing. Specifying those areas, critical to the operation of a business, which may not be clearly comprehended by computer specialists, or systems planners.

(b) Giving approval to systems development plans, or plans to procure computer equipment.

(c) Taking overall responsibility for coordination and integration of computer activities within the company.

Top managers with specific responsibility for computer activities will be more closely concerned with the above, and in addition should engage in auditing the performance of computer systems.

Possible reasons for top management detachment from computer problems are investigated in the preliminary hypotheses (nos. 2, 3).

A further objective is to measure the amount of interaction among technical specialists and top managers. This measurement is then used to determine whether there is any association between management interaction and successful performance of computer systems (hyp. 4). Measures of successful performance
or poor performance, as used in this study, are the financial estimates of profitability resulting from computer use, estimated by responding top managers.

For the purpose of determining the degree of support given by the higher level senior managers to the middle level computer specialists, each group answered identical questions, the replies to which are used to test hypothesis 5. Hypothesis 6 is a corollary of the preceding one, namely, a statement concerning the degree of dependence by top managers on their data processing staff.

The importance of the role of functional managers is investigated in hypotheses 7,8. Many factors affect performance of systems. A number of variables have been previously advanced; demographic factors, extent of interaction and the frames of reference of managers. It is submitted that a further important influence could be size of companies. Therefore, a further purpose of this study is to investigate the effects of size on the profitable operation of a computer system. If larger companies employ more sophisticated computer systems, and are able to do so more profitably, size would appear to be a more significant factor than those mentioned above (hyp. 9,10).
Significance of Study

The significance of this subject becomes apparent if the following points are considered:

1. Computer technology is a major innovation in which American industry is making an increasing investment. It is estimated that the equivalent of ten per cent of new investment spending is devoted to electronic data processing equipment.\(^1\) This amounted to $6 billion in 1967, and represented a tenfold increase over the $600 million worth of computers and equipment shipped in the U.S. in 1963.

2. Third-generation computers now in use are more complex and have greatly increased capability of performance per dollar expended. The much increased capability of the hardware has enabled new systems to be developed which significantly extend the range of computer applications. The performance/price ratio increases at about a factor every two years as an industry average.\(^2\) However, the technological advances represented by


the new hardware (see glossary for explanation of terms used in this paper) have not yielded the results anticipated. As one writer states:

"Computer technology can claim to have made possible a number of fantastic accomplishments. But, despite certain exceptions, there has been a disappointing lack of demonstrable results."\(^3\)

Another writer states:

"In terms of technological achievement the computer revolution in the U.S. business is outrunning expectations. In terms of economic payoff on new applications, it is rapidly losing momentum."\(^4\)

In the attempt to explain the disappointing performance of many of the computer systems, increasing attention is being paid to the non-technical aspects of computer systems. These include problems of communication and understanding between various groups of people who are concerned with computer systems; the roles which they play and the way in which these roles are perceived by others; the interaction between individuals and between groups; the determinants of attitudes which


\(^4\)Conclusion of the study by McKinsey and Company of 36 major companies in 1968.
influence acceptance of new technology, and so forth. In short, there is now greater readiness to admit behavioral factors as an important facet of the operation of computer technology.

3. Major studies of the computer industry have been made by Booz, Allen, and Hamilton (1965, 1968); McKinsey and Company (1963, 1968); Diebold Research Group (1964, 1965, 1968). These leading research groups have cited the "gap" between top management and computer specialists as a major factor which may explain the variation in performance of computer systems.

McKinsey and Company concluded that the "more successful" computer users were those where top managers showed a strong constructive interest in the operation and development of computer projects. This study included 36 companies of which 25 had an annual sales in excess of $500 million. A study made by British business consultants also concludes that detachment of top management from computer affairs is a central cause of poor performance. This blunt conclusion appears in a booklet published by Bishops Associates, Middlesex, England:
"Lack of top and middle management involvement is one of the prime causes of ineffective computer systems."\(^5\)

Major studies of the use of computers carried out in recent years concentrated on very large national corporations which are major users of computers. Little information has been gathered concerning the position of medium and small companies, where a gap between top management and computer systems specialists may also be present. The important point concerning the smaller companies is that the capability of the third generation low-cost computers is such that they are able to extend their range of applications. There is a need for research into the situation of the medium and small firms\(^6\) which were previously neglected because of the limited range of their computer activity. This study includes 130 firms, mainly medium and small in size, though some very large firms are included. Such research would be helpful in yielding information on the range


\(^6\)For clarification of these terms see Table 5.
of applications which the smaller firms employ, the interaction between executives, and perception of the roles played by individuals in other groups.

Evolution of Computer Systems

It has been suggested by Diebold that it is possible to distinguish three main stages in the development of computer systems.

First, the application of computer technology to routine administrative tasks. Computers are programmed to reduce the clerical and manual labor involved in such activities as payroll, orders and invoices, and so forth.

The second phase extends the range of applications to include systems for the control of production and marketing processes, some of which operate automatically.

Finally, more varied and complex systems are designed to provide a flow of information for management decision-making. Diebold contends that advances in technology have outstripped the ability to use computers as an aid to business decision-making. The capacity of third generation computers is not being fully utilized. Greater utilization
is necessary if business is to succeed in improving techniques for matching resources against future needs. Such applications as sales forecasting, financial planning, and production planning, are expected to be added in the third stage.

Figures 5 and 6 explain succinctly the changing role of the computer as suggested by Diebold. Whereas the emphasis in the early 1960's was on better performance of administrative tasks, it is beginning to shift to the provision of information for managerial decision-making. There are two important aspects to this change:

1. It involves a higher level of abstraction such that the old criterion of costs vs. benefits is more difficult to apply, and in some circumstances, explicit costs may be a misleading yardstick.

2. The time dimension had changed because information systems for management require planning and forecasting in the months and years ahead. Supervisory and administrative information is concerned with results in the present or immediate future. It is therefore important that senior
Figure 5.--Developments in Computer Use, 1960's

Source: John Diebold Report
CRITERIA FOR USE IN EARLY 1970's: Information for Management

- Consumer and Demographic Data
- Marketing - Determining Marketing Mix, New Products
- Knowledge of Consumer Behavior
- Economic Intelligence
- Money Market Conditions
- Inventory-Indicators
- Finance-Capital Budgeting & Finance Management
- Distribution-Route Optimization
- Production Scheduling & Control
- Purchasing-Vendor Selection
- Personnel-Forecasts of Future Needs

Management Information Systems

MAIN EFFECTS: MORE EMPHASIS ON SHORT AND LONG RANGE PLANNING, AVAILABILITY OF EXTERNAL DATA TO ASSIST DECISION-MAKING

Source: John Diebold Report

Figure 6.—Developments in Computer Use, 1970's
management should evaluate the performance of the newer equipment according to changed criteria and not on the narrower basis of reduced administrative costs.\textsuperscript{7}

The evolution of computer technology toward management information systems has increased the attention directed toward the "people-problems" of management. Operational management now interact more frequently with computer specialists.

A questionnaire was addressed to top managers asking them to list the computer applications considered to be most important. Space on the questionnaire provided for nine possible entries; the typical respondent listed six. The data was coded and aggregated under the classification suggested by Diebold. The results indicate that administrative applications are the most important. Listings for administrative applications outnumbered supervisory applications by almost two to one and management information by four to one (Table 2).

<table>
<thead>
<tr>
<th>Administration</th>
<th>Supervision</th>
<th>Management Information</th>
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<td>Application</td>
<td>Number of companies reporting this use</td>
<td>Application</td>
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<td>Sales analysis</td>
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<td>Cost accounting and analysis</td>
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<td>Order acknowledgement</td>
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<td>Purchase order processing</td>
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<td>Price analysis</td>
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<td>Machine loading schedules</td>
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<th>SUPERVISION</th>
<th>MANAGEMENT INFORMATION</th>
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<td>Application</td>
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<td>Number of companies reporting this use</td>
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<td>Lease and rental accounting</td>
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<td>Maintenance and repairs</td>
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Management information systems have not been designed and implemented to the point where they form a substantial fraction of the total number of applications (14% of applications are classified as M.I.S.). Of the M.I.S. applications, market research and management strategy analysis are considered by top management to be the most important flow of management information. In a three-way division of this nature, it is possible to question the suitability of the grouping for some of the applications. Some applications do not fall neatly into either the supervision or M.I.S. classification, or may be easily placed in both. Nevertheless, though there may be marginal changes in the aggregates, the general picture would remain unchanged.

**Limitations**

Difficulties and possible shortcomings experienced in this study may be grouped into four broad categories:

1. Problems experienced in survey research
2. Those peculiar to the computer industry
3. Problems due to the behavioral nature of the study

4. Difficulties of identifying and distinguishing relationships between variables. More specifically, determining what degree of association exists between variables, what inferences may be legitimately drawn, and whether causal analysis is possible.

Problems of Survey Research

Some problems to be considered were:

(a) the method of sampling to be adopted
(b) the question of securing an adequate representation of businesses
(c) the effect of nonresponse
(d) the limitations imposed by a field study

As previously mentioned, all firms which met the specified criteria in the cities of Cleveland, Cincinnati, Columbus, and Indianapolis comprised the sample. This type of sampling procedure is closely akin to area sampling. The only difference is that the area was not selected at random. The resources available for this study, a personally conducted project, prohibited selecting an area at random. For the same reason it was impossible to
select firms throughout the country which met the stated criteria.

Given the sample procedure, the question arises: is the sample distribution representative of the entire population (the United States)? Whether or not the sample distribution is representative of the whole country would need to be confirmed by further studies. The important thing to remember is that care should be taken in interpreting and applying these results to another area. It is likely that the distribution of firms in another area is different. Furthermore, even if it is felt that the distribution of firms is similar for another area, the group characteristics within the distributions must be considered. It is possible that social characteristics, etc., are different enough to make the results not applicable.

(b) Securing a wide representation of businesses did not prove to be as difficult as anticipated. Despite the elimination of some firms because of failure to meet minimum size or because they were non-profit organizations, a diverse sample was obtained as is shown in Table 3 (p. 88).
The diversity of manufacturing in Ohio and Indiana is reflected in the list of manufacturing industries. Wholesaling is well represented in the total of non-manufacturing industries. This is an important activity in cities such as Columbus and Indianapolis where the location favors such a specialization. Retailing is important in each of the major cities in the area.

(c) Nonrespondents pose a difficulty for researchers. Response is more likely if it is possible to obtain interviews with the persons included in the sample. However, a study conducted by one person involving several hundred executives (N = 390), working in one hundred and thirty businesses, made this approach impracticable. It was therefore necessary to survey most of them by mail. Seldom, if ever, does everybody reply to such a survey. Thus nonresponse gives rise to a potential source of error when the characteristics of those individuals who did not respond are significantly different from those who did. Clearly, the larger the number of nonrespondents the greater the potential error. As one authority states:
"... the nonresponse error is magnified by the fact that the direction of the error is often unknown, and the magnitude cannot be estimated reliably except at the extremes."

To overcome the problem of nonresponse bias, telephone calls were made to nonrespondents. They were asked reasons for nonresponse and questions from the appropriate questionnaire were put to them. Results were then tabulated to see whether they diverged significantly from the main body of respondents. There was no significant difference.

(d) Two contrasting methods for obtaining information about relationships between variables are the field survey and the experiment.

The experimental approach is popular because it has some clear advantages over the survey. The researcher concerned with causal analysis is able to manipulate one or more of the independent variables and note changes in the dependent variables. The experiment can be carefully controlled regarding the selection of sample and conditions under which the experiment is carried out.

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The survey is concerned with real-life situations, and in reality it is not possible to manipulate variables and observe the response. It may, however, be possible to closely simulate the real world. An example of this is a test marketing procedure which sells the same product at different prices in two similar but separate markets. By manipulating price in one situation it is possible to note changes in demand, using the other market as a control group. In such a manner it may be possible to determine the functional relationship between the independent variable price and the dependent variable quantity, while attempting to hold other conditions surrounding the sales constant.

In a real-world situation there may be several independent variables which cause changes in a dependent variable and it is not possible to determine which one is having a particular effect. In the laboratory it is possible to hold some factors constant and by varying one or more other variables, attribute changes to particular variables.\(^9\)

\(^9\) A difficulty which will be discussed later is that there may be interaction or interdependence between variables.
An advantage of a well conducted field study is that it brings the researcher closer to the reality of the phenomenon under investigation. Suppose one is studying, for example, the solution to problems chosen by business executives under varying conditions. The results will have more validity if the problems are attempted by actual executives rather than by college students in a laboratory. However, management is a scarce resource, and managers are reluctant to participate in controlled experiments which may appear to have little relevance to their problems. In this study the magnitude of response from management has enabled data to be gathered in actual business situations, as opposed to simulated conditions. In view of the many pressures on their time, top managers were especially cooperative in responding to the survey.

The Nature of the Computer Industry

Developments are taking place at such speed that information and comment which was pertinent four or five years ago may be of little use to the contemporary researcher. As the range of
applications has increased this has greatly expanded the boundaries of analysis. Published texts form the best source of information on most subjects, because their authors have had sufficient time in which to distill and integrate their knowledge of the subject matter. With the computer industry a lag of several years (which is inevitable in this process) causes careful analysis to be overtaken by current developments. Hence there has to be greater reliance on journal articles which are more fragmentary and which focus on specific empirical problems. The conceptual or theoretical underpinnings for analysis presented in the journals is implicit, or vaguely alluded to, but not clearly stated. This is in part due to the fact that journals concerned with computer technology are trade-oriented and predominantly technical in content, with non-technical articles a peripheral matter.\(^\text{10}\) There is also the recent origin of the journals, publishing in a field which is little-known to established academicians.

\(^{10}\) See list of consulted journals attached to Bibliography.
Problems Due to the Behavioral Nature of the Study

What is important for the operation of a business enterprise is the way people act in the different roles which they occupy. This study does not examine how people actually behave but rather how they say they behave, or how they feel towards others in the organization. The data record the subjective estimates of managers, which, it is to be hoped, are accurate indicators of the circumstances within the firm. Some of the information appears to be objective (e.g., the period of time per month that top managers spend with computer executives) but may be inaccurate due to lack of knowledge of the respondent, and to conscious or unconscious bias.

For a knowledge of actual relationships existing within a given system direct observation of interaction is necessary. Reliance on data from a survey provides compilation and measurement of individual responses, that is to say, the subjective answers of those being interviewed. A useful conceptual scheme for the purposes of this study
is one which recognizes three important behavioral elements: activities, interaction, and attitudes. The three elements are in mutual dependence with each other and are related to environmental forces.

Explanation of behavior within a given management system requires knowledge of changes in interactions and activities, and the way in which such changes affect attitudes. Conversely, information which changes attitudes may bring about changes in interactions and activities between managers.

The questionnaire is a useful device for revealing how managers perceive relationships. It focuses attention on the attitudes of the participants in the system. But it cannot disclose what is actually happening. For gaining accurate knowledge of business relationships interview and questionnaire methods may be seriously deficient. It is possible, however, to make informed inferences about what is actually happening within a firm, and accurate inferences may correspond with the true situation.
Recognizing the Relationships Between Variables

Data gathered in this study fall into three groups:

1. Socio-economic information, e.g., levels of education, age, and so forth

2. Factual business data, e.g., the purposes for which a business firm uses a computer system

3. Attitudinal information, i.e., measures of attitude and strength of feelings.

The first two groups can be expected to have a high degree of accuracy because they deal with objective phenomena. However, there is a problem of reliability with information in the third category.

As previously stated, estimates may not accord with reality, and individuals are likely to attempt to justify their own decisions. For example, senior business executives may give misleading answers to questions concerning financial benefits derived from use of computer systems because they may feel that absence of benefits reflects poorly on their judgment. This could be so, despite the
fact that cost-saving is only one possible criterion for installing computers. It is also a reason which becomes less significant as business applications reach higher levels of sophistication (note Figure 6.) Furthermore, there is the question of whether the respondent has knowledge of the matter under investigation. Many firms do not have the financial controls to permit their executives to pinpoint the cost of computer systems. Nevertheless, such questions may be answered as inspired guesses rather than as factual replies.

Socio-economic data provide a useful description of managers. We can attempt to compile a profile of representative top managers and make comparisons with the same characteristics recorded by data processing managers. Thus differences or similarities may be revealed. Descriptive research is useful because it provides the foundation for further analysis and is a necessary preliminary to the formation of refined hypotheses. Some myths can be dispelled at an early stage by such initial investigation. For example, writers of articles on EDP affairs hold to a stereotype of a data
processing manager who possesses attributes of youth, mobility, and a college science degree. This view does not accord with the background data on EDP managers gathered in this study. The representative manager, as assessed by the Ohio State survey, is more mature, less educated and less mobile than many writers have assumed. The data did, however, support the belief that EDP managers are strongly profession-oriented (see findings discussed in Chapter VI).

To be valuable, a research study must move from the level of description to a higher level of explanation. The researcher then encounters the difficulty of recognizing the true relationships between variables. Is there an association between variables: Does phenomenon X cause phenomenon Y? However, it is often difficult to assume a relationship between two variables which is consistently maintained. In many instances in this study the variables are not clearly identifiable as independent or dependent, but rather interdependent. There is an interaction between the variables such that simple causation is not ascertainable. In such
circumstances, prediction, the important objective of an explanatory model, is not possible. For example, one clear reason for lack of communication between top managers and data processing managers could be that the top managers know very little about data processing. It is therefore reasonable to assume a relationship between the two variables whereby lack of knowledge of data processing is the cause of poor consultation between the two groups. It is also plausible to state the proposition in reverse; infrequent meetings by top managers with their data processing managers causes them to be inadequately informed on EDP matters. Thus, instead of \( X \rightarrow Y \), we have \( X \leftarrow Y \). In the latter case the two variables may be reinforcing, i.e., a low degree of understanding of EDP may be associated with a low level of communication. Conversely, good familiarity with EDP usage and understanding of computer concepts may be associated with a high degree of communication between the two groups.
Use of Correlation Coefficient

In a correlation problem a sample is taken from a population, observing measurements on each individual in the sample. The measurements or data are then analyzed to determine the strength of the relationship between variables.

In this study the simple correlation coefficient (r) is used as a measure of the degree of linear association between two variables. The data gathered concerning the two variables can be plotted on a scatter diagram. With this in mind, the simple correlation coefficient is determined.

The range of r is from -1 to 1. The sign of r represents the slope of the regression line. If all the observations fall directly on the regression line then r equals unity. Positive unity indicates there is a strictly positive relationship between the two variables such that all the variance is completely explained by the regression line.

\[1\text{The least square line is the line where the sum of the vertical deviations of observations from this line is smaller than the sum of squares of deviations from any other line for a particular set of data.}\]
Negative unity indicates a strictly inverse relationship between the two variables. When $r$ equals zero then there is no relationship at all between the two variables. Any other value of $r$ means the regression line does not fully explain the variance of the observed data about the regression line.

Statistically speaking, it is more difficult to interpret values of $r$ other than unity or zero. It is a mistake to interpret a correlation of $r = 0.50$ as being twice as good or twice as strong as a correlation of $r = 0.25$. The relationship between two $r$ values for similar sets of datum is dependent upon the total variation of observed data and chance variation of observed data for each set of data.\(^2\)

Problems Associated With The Interpretation of the Simple Correlation Coefficient

As stated earlier, $r$ is a measure of the degree of linear association between two variables.

The important thing to keep in mind is that $r$ represents a linear relationship. This fact is often forgotten. Hence, when interpreting the relationship between two variables, $X$ and $Y$, this relationship is only in linear terms. The importance of this fact is illuminated by the following example.

The following graph represents a scatter diagram and the corresponding least square regression line. It is obvious from examining the graph

![Graph](image)

**Figure 7.**

that $r$ is low. A low $r$ might cause the researcher to conclude there is no or little relationship between variables $X$ and $Y$. This would be wrong. All that can be said is that there is no or little linear relationship between $X$ and $Y$. As can be seen by the dashed line there is a strong relationship between $X$ and $Y$, except that it is a nonlinear relationship.
Another problem associated with correlation analysis concerns causation. Often a high r value is considered to imply a cause and effect relationship between X and Y, but this is not necessarily so, because correlation analysis does not tell anything about the nature of a relationship. Courts has noted several reasons why correlation analysis taken alone can not be used to establish a causal relationship between two variables. First, correlation analysis does not identify direction of causation. Is the variation in X caused by the variation in Y or is the variation in Y caused by the variation in X? For example, is lack of communication between top management and EDP managers caused by infrequent meetings of small time duration, or are infrequent meetings of small time duration caused by lack of communication? Second, variation in X and Y may be caused by some other variable(s). Maybe educational background causes both a lack of communication and infrequent meetings of small time duration between top management and EDP managers. Lastly, variation in X and Y may only be partially causally related, such that, the observed correlation
between X and Y may be dependent upon other variables. And, these other variables may be causally related to X and Y. For example, lack of communication between top management and EDP managers may be causally related to infrequent meetings of small time duration, but this in turn might be affected by the educational backgrounds or ages of top managers and EDP managers. If either the educational backgrounds or ages of either group change, this may affect the causal relationship between lack of communication and infrequent meetings of small time duration.

Courts states that:

"...statistical method provides a useful and necessary tool for quantitative inductive inference, but uncritical use of statistics may, and often does, lead to preposterous conclusions." ³

The question then arises, how does one critically use correlation analysis to lead to sound cause and effect conclusions? There is no one acceptable answer to this question, but Simon presents a very

acceptable approach to answering this question for social science purposes.\(^4\)

Causality

The key to determining causality is developing an operational definition of causality, where the function of the definition is to specify appropriate tests which a relationship must pass before it is considered a causal relationship. Simon offers the following operational definition:

"A statement shall be called 'causal' if the relationship is close enough to be useful or interesting; if it does not require so many statements of side conditions as to gut its generality and importance; if enough possible third factor variables have been tried to provide some assurance that the relationship is not spurious; and if the relationship can be deductively connected to a larger body of theory or (less satisfactorily) be supported by a set of auxiliary propositions that explain the mechanism by which the relationship works."

In order to understand the meaning of causality and the role correlation plays in causality it is necessary to examine what is meant by the above definition.

To begin with, what is meant by a "useful or interesting" relationship? The criteria used in determining a "useful or interesting" relationship is observed association or correlation or relationship between two variables. The terms association, correlation, and relationship are considered synonymous. An association is apparent when it can be displayed Y is more likely to occur when X is present than when X is not present. The association has to be strong enough that the researcher feels it has predictive power of interest or use. Seldom if ever is the correlation unity. There is no set of formula for determining which values of correlation are of interest between zero and unity. This is something the individual researcher must determine in light of past experience, knowledge of the problem under study, and human judgment.

Causal relationships are a subclass of associations. This is to say that all causal relationships imply association, but not all associations imply a causal relationship. The reasons for this have already been stated. Given that an
association has been established, the problem then is to determine which associations are within the subclass of causal statements.

The first criterion for judging whether or not a causal relation exists is the side conditions needed to support the relationship. The greater the number of side conditions the less useful is the relationship because each side condition limits the number of instances in which it is applicable. For example, if lack of communication between top management and EDP managers is caused by infrequent meetings of small time duration only for specified education, age, industry, and area levels, then the causal relationship is only of limited use as compared to the situation when no side conditions need to be specified.

A second criterion which implies causality is the lack of third factor variables that affect the relationship. This is determined by considering the effect of other variables on the causally related variables. It is reasonable to call X the real cause of Y if X is always apparent when Y is caused. On the other hand, if X always causes Y
and Z always causes Y even when X is not apparent. Then Z is said to be the more real cause of Y, provided they both have the same side conditions. X is then termed a spurious cause of Y. The more variables examined without disturbing a relationship the more likely it is a causal relationship. Hopefully, all the relevant variables are examined.

Finally, if a relationship is compatible with a body of theory, the more likely it is a causal relationship. This is because a theory has been extensively tested in the past and has managed to survive over a period of time. Hence, a relationship which is identified with a theory is supported by the stronger framework of the theory. For example, consider the relationships between price and quantity demanded. In general, as the price of a product rises, the less is demanded. This relationship is consistent with the theory of marginal utility and as such it has become a causal relationship.

Except for economics, the social sciences do not have well developed bodies of theory. This makes it much more difficult to use the above criterion as a test of causality. Instead, the
social sciences use a weaker criterion to indicate causality, this being the consideration of other statements of relationships. Hopefully, a relationship will be supported by other relationships which appear to explain the same system.

The discussion above may be summarized as follows. The starting point for determining a causal relationship is association. Given a useful association, the next step is to determine whether or not it is a causal relationship. This is done by evaluating the relationship with regard to side conditions, third factor variables, and related theory or statements. Whether or not the relationship meets these criteria is a matter of human judgment, past experience, and knowledge of the situation.

In conclusion, it must be pointed out that in defining such a complex concept such as cause and effect it is impossible to give a perfect or absolute definition. The test of a good definition lies in the ability of the majority of the people using it to accept and interpret it in the same way. This writer feels that the operational definition of causality already presented meets this test.
List of Hypotheses

The preceding discussion has explained some of the problems of management relationships in companies utilizing computers. The major difficulties to be experienced when investigating this subject have also been explained. It is then possible to formulate a number of hypotheses which may be empirically tested.

Hypothesis 1

Data processing managers and top corporate managers differ significantly in such personal characteristics as:

(a) Level of education
(b) Career patterns
(c) Age
(d) Support for membership of professional organizations

Hypothesis 2

Insufficient knowledge of data processing by top managers decreases their interaction with computer specialists.
Hypothesis 3

Reliance on middle management is a major factor causing top managers to be detached from computer problems.

Hypothesis 4

The greater the interaction between top management and computer specialists, the higher the perceived success of a computer system.

Hypothesis 5

Computer specialists and top managers have different perceptions of the level of support given to the corporate computer system.

Hypothesis 6

From the viewpoint of the data processing manager, top management does not strongly depend on the EDP staff for suggestions and advice concerning important data processing problems.

Hypothesis 7

The greater the profitability of a computer system the greater the degree of involvement of functional managers in the operation of the system.
Hypothesis 8

Top managers and computer specialists differ significantly concerning the role of functional managers in the installation and operation of computer systems.

Hypothesis 9

Large companies are more profitable users of computer systems than small companies.

Hypothesis 10

The larger the company the more sophisticated is the use of the computer system.
CHAPTER III

RESEARCH DESIGN AND DESCRIPTION OF SAMPLE

This chapter includes a discussion of (1) the process of gathering the data (2) the nature of the data (3) a preliminary description of the sample being investigated.

The first section explains the methods used, the construction of questionnaires and the response rates obtained.

The latter part of the chapter provides an initial description of the data derived from the questionnaires. The intention at this stage is to provide the basic facts concerning:

(a) the geographic area covered
(b) which industries are represented
(c) size of companies
(d) internal organization concerning EDP
(e) purposes for which the companies included in the study use their computer systems.

Thus it is hoped to furnish a map for the more
detailed analysis which follows in subsequent chapters.

Method of Gathering Data

The sample is drawn from a list of organizations in the Indianapolis, Cincinnati, Cleveland and Columbus areas.\(^1\) All of the organizations use computer systems leased or rented from nationally known equipment manufacturers. There was no attempt made to confine the study to customers of any particular manufacturer. Criteria used for selection of the firms included in the study are:

(1) Exclusion of non-profit organizations such as government departments, universities, trade of professional associations, research institutes, etc.

(2) Exclusion of small firms which do not achieve annual sales revenue in excess of $20 million per year and employ more than 200 employees.

As a consequence of following these procedures, 130 firms were selected for survey. The name and title of the data processing manager for each firm was listed and a code number assigned.

\(^1\)The list is a comprehensive record of all makes of equipment used by companies in the Ohio and Indiana region. It was supplied by the National Cash Register Company, Dayton, Ohio.
Dun and Bradstreet Directory 1969 was used to obtain names of top corporate officials and two officers from each firm were selected as respondents. The sample of top managers attempts to include primarily those who have regular interaction with data processing managers, but at the time of preparation of the sample the reporting relationships within the firms were not known. The term "top manager" as used in this study refers to Vice Presidents and above, or senior corporate officers such as Treasurer, Secretary, or Controller.

Questionnaires were mailed to 130 data processing managers and 260 top managers. The procedure of sending two questionnaires to the corporate executives for every one to the EDP managers was adopted for two reasons:
(1) Top managers were considered less likely to cooperate, due to pressure of work, more frequent appeals to reply to surveys, etc.
(2) Addressing the questionnaires to persons carrying various titles (e.g. Vice-President of Planning and Development, Vice-President of Merchandising) insured a wider view of top management involvement in data processing than that pro-
vided if the study were restricted to Controllers or Vice-Presidents of Finance.

It was hoped to obtain a pair of responses from each company, one from the EDP manager and one from a representative top manager. In some cases the top managers are remote from the place of work of the data processing manager. A typical case is one in which a company has a branch plant in Indianapolis and corporate headquarters in New York or Chicago. In these circumstances it is not possible to get measures of face-to-face interaction, though both parties are perceiving the operation of computer systems in the same firm. Clearly, the larger the firms, the less tenable are studies concerned with interpersonal perceptions and relationships.

In addition to the first letter and questionnaire, a follow-up letter and questionnaire were addressed to those who did not respond initially. The EDP managers' response was good, with 55% responding to the first letter, and 22% after the second. The final position is an overall response of 77% for the data processing managers (101 usable returns).
Top management response was 23.5% for the first letter and an additional 27.5% after the second. The overall response for the 260 top managers was 51% (133 usable returns). If response is considered by firms rather than by individuals, top manager replies comprise a similar percentage to that obtained from the EDP managers. From the replies of top managers and EDP managers, the responses were paired by firm, such that a final sample of 88 matched pairs was obtained. The firms which provided replies from both EDP managers and top managers comprised 68% of the 130 firms surveyed.

For some of the calculations it was possible to utilize all replies from both groups without requiring matched pairs from each firm. This is the case in attempting to obtain a profile of a group according to general characteristics: age, education, professional affiliation, etc.

The methodological problem of nonresponse was resolved by telephoning a small random sample of twenty, in order to determine whether there are significantly different characteristics between respondents and non-respondents. This follow-up did not reveal any marked difference in the circum-
stances or attitudes of the non-respondents which would cause them to differ from the respondent groups.

**Data Obtained from Questionnaires**

A separate questionnaire was designed for top managers (with 52 questions) and for EDP specialists (with 43 questions). Twenty-four of the questions in each type of questionnaire are identical and the initial tabulation compares the responses of the two groups to these questions. The remaining questions are worded to be more meaningful to the members of the two groups. The questions differ because there is some useful information which a top manager can provide which cannot be obtained from a data processing manager. Similarly, on questions concerning the use of computer systems, the EDP executives are better informed than top management.

The questionnaires attempted to elicit the following information from top management:
1. The degree of top management's face-to-face interaction with data processing managers by way of interviews and meetings.
2. The purpose for which the computer system is utilized.

3. The extent to which computerized information systems aid decision-making by providing more categories of information, greater range of alternatives, and faster access to marketing/economic intelligence.

4. The top manager's perception of his role in relation to the EDP system.

5. Objective personal data: education, age, business background.

   Questionnaires for EDP managers are designed to elicit information on:

1. Professional qualifications, career patterns, age, education.

2. Professional affiliations.

3. The extent of interaction with top management.

4. The size of the EDP staff and reporting relationships with top management.

5. Computer applications.

6. The EDP manager's perception of the role in relation to top management.
Representation of Industries

Data processing managers were asked to indicate which industry classification was appropriate for their firm or organization (Question 1, EDP Questionnaire, Appendix A). Where a firm operated in several industries they were requested to indicate the primary industry based on sales revenue. Of a total EDP response of 101 there were 96 usable returns. Table 3 gives the returns classified as manufacturing and non-manufacturing activities. There are two important points to be considered regarding the distribution of companies included in the study:

1. The representation of industries.

2. The regional nature of such a study. There is a wide distribution of private business firms representing a wide spectrum of industries. Of major importance are the metals, machinery and chemical industries. Wholesaling and retailing are the major non-manufacturing activities, with banking also of major significance. The sample
TABLE 3

CLASSIFICATION OF INDUSTRIES FROM WHICH MEMBERS OF SAMPLE ARE DRAWN

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufactured</td>
<td></td>
</tr>
<tr>
<td>Fabricated metals</td>
<td>13</td>
</tr>
<tr>
<td>Machinery</td>
<td>12</td>
</tr>
<tr>
<td>Chemicals</td>
<td>7</td>
</tr>
<tr>
<td>Foods or beverages</td>
<td>7</td>
</tr>
<tr>
<td>Textiles, apparel or leather</td>
<td>5</td>
</tr>
<tr>
<td>Paper or paper products</td>
<td>4</td>
</tr>
<tr>
<td>Primary metals</td>
<td>4</td>
</tr>
<tr>
<td>Rubber or plastic products</td>
<td>4</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>3</td>
</tr>
<tr>
<td>Electrical control</td>
<td>2</td>
</tr>
<tr>
<td>Heat and air conditioning</td>
<td>2</td>
</tr>
<tr>
<td>Instruments, optical goods, etc.</td>
<td>2</td>
</tr>
<tr>
<td>Aerospace</td>
<td>1</td>
</tr>
<tr>
<td>Auto controls</td>
<td>1</td>
</tr>
<tr>
<td>Electrical lighting fixtures</td>
<td>1</td>
</tr>
<tr>
<td>Personal care products</td>
<td>1</td>
</tr>
<tr>
<td>Printing and publishing</td>
<td>1</td>
</tr>
<tr>
<td>Shoe dye and polish</td>
<td>1</td>
</tr>
<tr>
<td>Stone, clay or glass</td>
<td>1</td>
</tr>
<tr>
<td>Non-manufactured</td>
<td></td>
</tr>
<tr>
<td>Wholesale or retailing</td>
<td>12</td>
</tr>
<tr>
<td>Banking</td>
<td>7</td>
</tr>
<tr>
<td>Transportation</td>
<td>2</td>
</tr>
<tr>
<td>Construction</td>
<td>1</td>
</tr>
<tr>
<td>Printing</td>
<td>1</td>
</tr>
<tr>
<td>Public utilities</td>
<td>1</td>
</tr>
</tbody>
</table>
avoids the problem which would have been created by too narrow a spectrum of activities. Use of a small sample covering certain industries, e.g. retail stores or banks, would seriously weaken the general applicability of conclusions. It is possible that management characteristics vary significantly from one industry to another in such matters as job mobility, professional affiliation, and so forth. Newer industries, for example, where innovations are taking place and mobility of personnel is rapid, are likely to vary from more traditional industries.

In this study aerospace and electronics industries are not strongly represented. By contrast the more stable machine tools (classified as 'engineering') and chemical industries are well represented, as are the distributive trades. The sample of 130 firms represents the pattern of industry in Ohio, which would undoubtedly differ from, say, a Californian sample.
Size of Companies

Tables 4 and 5 show size of companies measured by number of employees and sales revenue (both Tables refer to 1968). It can be seen that the firms are widely distributed across a spectrum from very large to small. However, representation is weighted toward the medium and small companies rather than big ones. By the criteria of sales revenue, only 13.6% of the companies are large (> $500 millions), whereas 19.0% are small ($20-50 millions). This spread of firms is very satisfactory from the point of view of analysis because it includes sufficient large companies to allow the researcher to make meaningful comparisons (18 corporations) while giving emphasis to the position of the smaller firms.

Internal Organization Concerning EDP: Reporting Relationships

The titles of the top managers to whom the EDP manager reports are listed in Table 6. The primary use of computers for financial administration is reflected in the preponderance of top
TABLE 4
SIZE OF FIRMS INCLUDED IN SAMPLE MEASURED BY NUMBER OF EMPLOYEES

<table>
<thead>
<tr>
<th>Number of Employees</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 105</td>
<td></td>
</tr>
<tr>
<td>Under 1000</td>
<td>26</td>
</tr>
<tr>
<td>1000 - 1999</td>
<td>20</td>
</tr>
<tr>
<td>2000 - 2999</td>
<td>16</td>
</tr>
<tr>
<td>3000 - 9999</td>
<td>28</td>
</tr>
<tr>
<td>10,000 - 19,999</td>
<td>8</td>
</tr>
<tr>
<td>20,000 - 39,999</td>
<td>3</td>
</tr>
<tr>
<td>Over 40,000</td>
<td>4</td>
</tr>
</tbody>
</table>

TABLE 5
SIZE OF FIRMS BY SALES REVENUE IN 1968

<table>
<thead>
<tr>
<th>Size of Firms</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (&gt; $50 millions)</td>
<td>25</td>
</tr>
<tr>
<td>Medium-Small ($50-199 millions)</td>
<td>52</td>
</tr>
<tr>
<td>Medium-Large ($200-499 millions)</td>
<td>29</td>
</tr>
<tr>
<td>Large ($500-749 millions)</td>
<td>5</td>
</tr>
<tr>
<td>Very large (&gt; $750 millions)</td>
<td>13</td>
</tr>
<tr>
<td>Unknown</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
</tr>
</tbody>
</table>
### TABLE 6

**TOP MANAGER TO WHOM DATA PROCESSING MANAGER REPORTS**

<table>
<thead>
<tr>
<th>Title of Top Manager</th>
<th>Number Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>42</td>
</tr>
<tr>
<td>Vice-President Finance</td>
<td>20</td>
</tr>
<tr>
<td>Executive Vice President</td>
<td>16</td>
</tr>
<tr>
<td>Treasurer</td>
<td>13</td>
</tr>
<tr>
<td>President</td>
<td>10</td>
</tr>
<tr>
<td>Vice President Planning</td>
<td>9</td>
</tr>
<tr>
<td>Vice President Data Processing</td>
<td>8</td>
</tr>
<tr>
<td>Vice President Administration</td>
<td>4</td>
</tr>
<tr>
<td>Secretary</td>
<td>3</td>
</tr>
<tr>
<td>Administrative Assistant to President</td>
<td>1</td>
</tr>
<tr>
<td>Other Top Management</td>
<td>3</td>
</tr>
</tbody>
</table>

**N = 129**

### TABLE 7

**NUMBER OF EMPLOYEES SUPERVISED BY DATA PROCESSING MANAGER**

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 10</td>
<td>17</td>
</tr>
<tr>
<td>10 - 19</td>
<td>28</td>
</tr>
<tr>
<td>20 - 29</td>
<td>21</td>
</tr>
<tr>
<td>30 - 39</td>
<td>5</td>
</tr>
<tr>
<td>40 - 49</td>
<td>7</td>
</tr>
<tr>
<td>50 - 99</td>
<td>13</td>
</tr>
<tr>
<td>100 - 199</td>
<td>8</td>
</tr>
</tbody>
</table>
managers concerned with finance and accounting. If numbers in the categories of Controller, Vice-President Finance and Treasurer are aggregated they comprise 75 out of 129 returns (58%). Evolution of computer use to provide information for management control systems (planning, forecasting, simulation of market conditions, etc.) would increase the representation of other top management titles. In 1970, it is evident that few firms have a Vice President solely responsible for data processing.

Size of EDP Departments

Data processing has introduced a variety of skills unknown fifteen years ago. Within each department there is a hierarchy of managers, senior analysts, analysts, programmers, and other specializations. Size of the EDP departments of the companies participating in this study is given in Table 7. At this point it is helpful to discuss the role of EDP managers as reflected in some of the difficulties and problems of maintaining and developing data processing departments.
Data processing is too new a field to have developed traditional methods of training. Standards of achievement in data processing have not yet reached the point where there is acceptance of common standards. If, for example, one wishes to become an accountant or an engineer, there are established procedures for doing so. National bodies have formulated educational and professional standards. Within a company, specializations, such as engineering or accounting, have been practiced over a long time period so that the roles of these specialists are clearly defined. By contrast data processing is a new specialization, one which is just emerging as a distinctive profession. The main features that distinguish a profession may be briefly stated as follows:

(1) A systematic body of knowledge, sometimes referred to as "principles."

(2) Generally acknowledged entry standards.

(3) Regional and national professional organizations for the purpose of: a) advancing the economic and social welfare of members, b) bringing members together, to read papers and discuss matters of common interest.
(4) The right to exclude non-professionals from its ranks.

(5) A code of ethics, designed to influence behavior such that the member is prepared to go beyond the dictates of narrow professional or commercial interest.

Data processing has rapidly acquired a body of knowledge such that the first requirement is adequately met. For the other features however, the group has yet to develop and jell into what may be clearly discerned as a profession.

Of course, not all the members of an EDP department are doing work of a professional nature; there are skilled clerical personnel who prepare data by way of punched cards or paper tape. Such workers make up approximately two thirds of a typical department. The remaining one third is comprised by manager(s), systems analysts, programmers and computer operators. It is from these categories that the professionals will be drawn. They are mostly younger males, aged 25-35, with expectation of a working career for thirty to forty years in the future. By contrast, the staff
concerned with data preparation is mostly female, with short run career interests.

Most of the data processing managers belong to a professional organization. The major organization is the Data Processing Managers Association (DPMA). The second largest professional body is the Systems and Procedures Association. Members of computer staffs in the analyst and programmer category make up the bulk of the membership of the SPA. There are several additional computer associations.

Percentage of data processing managers who belong to professional organizations is given below. This data is contrasted with that given in a recent Wall Street Journal study. The comparison is interesting because the respondents to the Wall Street Journal were mostly top managers (53.2%) with responsibilities for procuring EDP equipment. Of the Wall Street

respondents, 68% had policymaking responsibilities, and 33% serve on their company's board of directors. In both the Ohio State University and the Wall St. Journal study the same question was put: "Do you belong to a professional association related to data processing?" The replies are tabulated below:

<table>
<thead>
<tr>
<th>Replies to Question on Professional Membership</th>
<th>Wall St. Journal 1969</th>
<th>Ohio State Univ. 1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9%</td>
<td>65%</td>
</tr>
<tr>
<td>No</td>
<td>87%</td>
<td>34%</td>
</tr>
<tr>
<td>Not Stated</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

N = 634                                           N = 101

The Ohio State University study asked a further question; "Do you attend professional meetings and subscribe to journals concerned with developments in EDP?" A very high percentage gave an affirmative

3Ibid. p. 5.
answer to this question (94%). These figures are evidence of a high degree of professional interest on the part of data processing managers.

Use of Computer Systems

Data processing managers were asked; "For which business processing does your company use the computer system?" (Question 2, EDP Questionnaire) The replies to that question are as shown in Table 9. Accounting and payroll are the areas of greatest concentration, followed by inventory and sales analysis. An interesting feature of the table is that management information systems are listed more frequently than production or process control. This is a measure of the growing importance of M.I.S. as compared to the more conventional applications.

Top managers were asked to list applications which had yielded important benefits, and given space for a possible nine entries. (Question j and k, p. 3, TM Questionnaire) Accounting and inventory control are again considered the most
<table>
<thead>
<tr>
<th>Nature of Application</th>
<th>Number of Times Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts payable or receivable</td>
<td>61</td>
</tr>
<tr>
<td>Payroll</td>
<td>58</td>
</tr>
<tr>
<td>Inventory control</td>
<td>54</td>
</tr>
<tr>
<td>Sales analysis</td>
<td>54</td>
</tr>
<tr>
<td>Cost control</td>
<td>44</td>
</tr>
<tr>
<td>Management information systems</td>
<td>38</td>
</tr>
<tr>
<td>Financial analysis</td>
<td>37</td>
</tr>
<tr>
<td>Production or process control</td>
<td>36</td>
</tr>
<tr>
<td>Debugging business programs</td>
<td>35</td>
</tr>
<tr>
<td>Market or marketing research</td>
<td>30</td>
</tr>
<tr>
<td>Purchasing</td>
<td>28</td>
</tr>
<tr>
<td>Physical distribution-routing of deliveries</td>
<td>15</td>
</tr>
<tr>
<td>Personnel planning or scheduling</td>
<td>14</td>
</tr>
<tr>
<td>Banking</td>
<td>8</td>
</tr>
<tr>
<td>Actuarial</td>
<td>6</td>
</tr>
<tr>
<td>Ordering</td>
<td>6</td>
</tr>
<tr>
<td>Product design and development</td>
<td>3</td>
</tr>
<tr>
<td>Management planning</td>
<td>2</td>
</tr>
<tr>
<td>Merchandising</td>
<td>2</td>
</tr>
</tbody>
</table>
important areas. Sales and marketing applications are ranked ahead of production control or clerical operations. M.I.S. applications are grouped under management strategy. Top management does not consider M.I.S. to be as significant in yielding benefits as the functional areas of accounting, sales, inventory, production and general operational management.

Top managers also commented on the contribution which computer use had made to effective performance in their organizations (Question k, TM Questionnaire). A frequently mentioned benefit, not listed as a specific application, was speed and timeliness of computer service. They also referred to the capability of obtaining information which it was previously impractical to obtain. Cited here were such activities as production and sales planning, or pricing policies, which require considerable computational work. These are benefits which become more evident after companies gain experience with computer systems. Initially the company tends to be attracted to EDP systems because
of the benefits of clerical cost reduction. Subsequently, after experience with more simple payroll and accounting applications, the greater benefits of provision of managerial data are perceived.

Top managers were also asked whether use of computers had been profitable for their company (Question h, p. 2, TM Questionnaire). From a total of 133 respondents 20 (15%) reported slight or significant deficits. A further 33 (25%) estimated little change and 80 (60%) thought there had been significant financial benefits as a consequence of using computers.
### Table 10

APPLICATIONS IN WHICH EDP SYSTEM HAS YIELDED IMPORTANT BENEFITS
TOP MANAGERS RESPONSES*

#### I. ACCOUNTING AND FINANCE:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting - including receivables</td>
<td>12</td>
</tr>
<tr>
<td>and payables</td>
<td>96</td>
</tr>
<tr>
<td>General ledger accounting</td>
<td>43</td>
</tr>
<tr>
<td>Billing and invoices</td>
<td>32</td>
</tr>
<tr>
<td>Budgeting</td>
<td>18</td>
</tr>
<tr>
<td>Lease and rental accounting</td>
<td>1</td>
</tr>
<tr>
<td>Correspondence: personal letters</td>
<td>2</td>
</tr>
<tr>
<td>to delinquent accounts</td>
<td>2</td>
</tr>
<tr>
<td>Cost accounting and analysis</td>
<td>32</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1</td>
</tr>
<tr>
<td>Expense analysis</td>
<td>5</td>
</tr>
<tr>
<td>Payroll computation and payment</td>
<td>44</td>
</tr>
<tr>
<td>Equipment trust accounting</td>
<td>1</td>
</tr>
<tr>
<td>Investment analysis</td>
<td>15</td>
</tr>
<tr>
<td>Claims</td>
<td>2</td>
</tr>
<tr>
<td>Commutation column calculations</td>
<td>2</td>
</tr>
</tbody>
</table>

#### II. SALES AND MARKETING:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecasting - including sales</td>
<td>10</td>
</tr>
<tr>
<td>Market research: studies</td>
<td>25</td>
</tr>
<tr>
<td>Order acknowledgement</td>
<td>25</td>
</tr>
<tr>
<td>Order analysis</td>
<td>16</td>
</tr>
<tr>
<td>Sales commissions</td>
<td>1</td>
</tr>
<tr>
<td>Price analysis</td>
<td>8</td>
</tr>
<tr>
<td>Sales analysis</td>
<td>54</td>
</tr>
<tr>
<td>Sales area distribution</td>
<td>10</td>
</tr>
<tr>
<td>Sales quota calculations</td>
<td>1</td>
</tr>
<tr>
<td>Transportation optimization</td>
<td>3</td>
</tr>
<tr>
<td>Warehousing and stocking: records, analysis</td>
<td>1</td>
</tr>
<tr>
<td>Merchandising</td>
<td>7</td>
</tr>
<tr>
<td>Customer service</td>
<td>2</td>
</tr>
<tr>
<td>Product development</td>
<td>7</td>
</tr>
<tr>
<td>Policy issuance and writing</td>
<td>4</td>
</tr>
<tr>
<td>Valuation calculations</td>
<td>1</td>
</tr>
</tbody>
</table>

* Respondents were asked to state the areas in which use of computer has yielded significant benefits, N = 133.
### TABLE 10—(continued)

<table>
<thead>
<tr>
<th>III. INVENTORY CONTROL:</th>
<th>103</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory control----86</td>
<td></td>
</tr>
<tr>
<td>Production forecasting-6</td>
<td></td>
</tr>
<tr>
<td>Purchase order processing-8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV. PRODUCTION CONTROL:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatching - including shipping-10</td>
</tr>
<tr>
<td>Production control--29</td>
</tr>
<tr>
<td>General Plant and production-6</td>
</tr>
<tr>
<td>Assembly-line balancing-1</td>
</tr>
<tr>
<td>Factory operation simulation-1</td>
</tr>
<tr>
<td>Labor distribution-5</td>
</tr>
<tr>
<td>Machine loading schedules-5</td>
</tr>
<tr>
<td>Numerical control (production)-9</td>
</tr>
<tr>
<td>Materials and parts: requirements, allocations, scheduling, control procurement-7</td>
</tr>
<tr>
<td>Quality control-2</td>
</tr>
<tr>
<td>Shop scheduling production, optimum-17</td>
</tr>
<tr>
<td>Shipping and deliveries: scheduling, control-4</td>
</tr>
<tr>
<td>Inspection-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V. MANAGEMENT STRATEGY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management simulation-8</td>
</tr>
<tr>
<td>Management statistics-13</td>
</tr>
<tr>
<td>Management strategy analysis-16</td>
</tr>
<tr>
<td>Operations research management-11</td>
</tr>
<tr>
<td>Systems analysis operation-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI. OPERATIONAL MANAGEMENT—CLERICAL OPERATIONS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>File maintenance-8</td>
</tr>
<tr>
<td>File operations-10</td>
</tr>
<tr>
<td>Information retrieval-24</td>
</tr>
<tr>
<td>Management reports-19</td>
</tr>
<tr>
<td>Performance evaluation-15</td>
</tr>
<tr>
<td>Data processing service for number of organizations in same industry-4</td>
</tr>
<tr>
<td>Maintenance &amp; repairs: scheduling, records, analysis-1</td>
</tr>
<tr>
<td>Process control-7</td>
</tr>
<tr>
<td>Labor performance-1</td>
</tr>
<tr>
<td>Policy registers-1</td>
</tr>
<tr>
<td>Personnel administration-7</td>
</tr>
<tr>
<td>Service bureau data - processing operations-2</td>
</tr>
</tbody>
</table>
CHAPTER IV

ROLES, EXPECTATIONS OF MANAGERS

This chapter introduces important concepts drawn from sociology. These concepts are useful for gaining an understanding of relationships between managers in a business system.

The first section defines the term "system" and relates the business system to the wider economic and social environment. Computer technology is described as an important environmental force impinging on management. Management is conceptualized as a social process in which the participants have expectations concerning the behavior of others. This view is contrasted with that of the early writers on the subject of management who emphasized business technology.

The final section discusses the significance of roles, with particular reference to top managerial and data processing managers. It is contended that the absence of a clearly defined role structure creates difficulties for an interfunctional group, such as the data processing staff. The strong drive for professionalism...
exhibited by senior EDP staff may be related to the uncertain position of a new type of specialist.

Thus, the progression of topics for the chapter is (1) definition of systems, (2) environmental forces, (3) managers and system participants, (4) deficiencies of early theory which emphasized technology, and (5) managerial roles.

Definitions of Systems

A system may be abstractly defined as the structure for interaction of a set of elements. Systems can be classified as closed or open; natural or man-made.

A closed system specifies the boundaries within which the elements and their interactions are contained. When exchanges take place across the boundaries of a closed system, it is said to be an open system. For example, consider domestic activity within an economy; the relationships between the component parts of the economy, private sector, government sector, and so forth, are established within a closed system. When international trade occurs, and exports and imports are included, the system becomes "open".
A natural system is one which occurs in nature, such as biological systems, physical or molecular systems. A man-made system is the result of applied science, e.g., an engineering system, transportation system, communications and so forth. A business organization is a man-made system devised for the purpose of fulfilling the social needs of people, i.e., goods and services.

The distinction between natural and man-made systems lies in the fact that the former do not involve performance criteria, while the latter do require such criteria. Man-made systems usually optimize certain parameters such as cost, efficiency, size or reliability. The criteria adopted reflect adaptation to the external environment. The surrounding environment imposes certain conditions or values upon the man-made system. Thus, political, economic, technological or legal factors impose constraints upon the man-made system, and influence its values. The performance criteria chosen for the

man-made system will be those considered to be optimum in relation to the values imposed by the external system. Due to scarcity of resources, there is likely to be a trade-off between several desirable goals which the system could possibly attain. For example, a business organization makes adjustment between the parameters of cost, quality of output, support given to re-sellers, and so forth.

Webster's Dictionary states that the word system is built from two ancient words: (1) syn, meaning with or together, (2) histanai, to cause to stand. Relevant devised meanings include, "a regularity interacting or interdependent group of items forming a unified whole," and "an organized or established procedure." A system also makes "harmonious arrangement or pattern: order out of confusion." ²

The Oxford Dictionary defines a system as follows:

A set or assemblage of things connected, associated, or interdependent, so as to form

a complex unity; a whole composed of parts in orderly arrangement according to some scheme or plan; rarely applied to a simple or small assemblage of things.\(^3\)

From the above definition three features of a system may be noted:

(a) The existence of a set of components or elements.

(b) That the components interact.

(c) Such interaction establishes relationships so that the elements are interdependent.

References to systems can be found in many branches of the physical and social sciences. The systems approach to analysis of problems has become very popular in recent years.

There are several reasons for this:

1. Recognition of the interrelatedness of elements in a system means that it is possible to study relevant relationships, rather than the elements in isolation. Thus, it is necessary for thorough investigation.

2. Increasing complexity of phenomena has contributed towards the adoption of a systems

approach. More complex systems involve an increasing number of interactions of elements. Within business, for example, there is greater specialization of functions, increasing use of more sophisticated machinery, increased speed of operations, more complicated devices for communication and transportation, and so forth. No single academic discipline, such as engineering or mathematics, is sufficient in itself to enable comprehension of such systems. Therefore, an interdisciplinary team of analysts, drawn from different areas, is likely to be employed in systems analysis.

Use of systems concepts does not imply that investigators need to attempt to understand all possible relationships in any given system. Certain parts can be demarcated, and a limited number of relationships can be studied. It is not necessary to describe every element in a system; particular subsystems can be studied against the background of the larger system. It is always possible to perceive different subsystems in a hierarchy of systems.

A business organization is composed of many interrelated systems. Leavitt states that an organization "can be thought of as lively sets of
interrelated systems designed to perform complicated tasks." Leavitt selects three main dimensions of these systems: people, technology, and organizational structure. Changes in any one of the three major variables affect the other.\textsuperscript{4}

Environmental Forces

Accompanying the increasing complexity of systems, there has been considerable change in the environment within which a business system functions. The environment of a particular system includes, "all factors external to the system which affect it and which are affected by it; the environment has in fact determined all its properties."\textsuperscript{5} The environment includes not only economic and social factors, level of technology, political and legal systems, but also religious influences, natural resources, physical conditions, and other surrounding circumstances. Some key environmental forces which impinge on business


Managers are given in Figure 8. In recent years computer technology has had a significant impact on business operations. This is so regardless of whether or not particular businesses become involved in operating computers. In fact the impact, as measured by changes in competitive conditions, may be greater for those companies that do not procure EDP systems. There has been considerable environmental change in recent decades as a result of rapidly accumulated research knowledge and major expansions in science. However, growing technology has not been accompanied by knowledge of how to adapt it to social needs. There has been an inclination to choose technological, clearly attainable objectives, e.g., manned space flight, instead of facing more intractable human problems. There is therefore the paradox of major thrusts in technological progress with worsening conditions in the social sphere, e.g., urban environment, education, air traffic control, etc.

The tendency for new technology to outstrip its applications is observable in business computer operations. While this poses difficulties for management, it also presents greater opportunities. Use of more sophisticated applications,
Figure 8.

Computer Technology Is A Major Environmental Force Impinging On Management
such as management information systems, enables the company to adapt more easily to environmental change. This is true irrespective of company size. Managers of small firms sometimes argue that their problems are local and unique, and that problems of adaptation are more the concern of the large undertaking. The small company usually has small resources, functions in a narrow segment of the market and is seriously affected by economic fluctuations. The activities of the small firm are not as standardized as those of the large firm. Non-routine situations, such as winning orders from individual customers, are more important for the small company. Flexible pricing, rush orders, special deliveries, batch production to customers specifications, these are some of the factors which make up the differential advantage of the small company. Low fixed capital commitments vis-à-vis the large company, give the small company a flexibility not possible for large volume out-puts. Quick changes in management strategy call for non-standard operating procedures. However, the

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special problems of the small company do not preclude computerization.

Industry experts agree that the economics of computer systems have changed to such a marked extent that small businesses can avail themselves of the advantages which such systems offer. The benefits of low-cost high-speed computational capability are explained by Blumberg as follows:

The minimum size necessary for efficient computer application has been dropping rapidly, and today, the economics of computers are now such that any firm employing 50 to 100 people should be seriously considering some form of data processing automation as an integral part of its business operations. This will be required in order to remain competitive.

The observable impact of this revolution in computer economics will undoubtedly mean greater sophistication and responsiveness in smaller firms than ever possible before. In addition, because of the normally limited staff functions in small organizations, the advent of the technological innovation should have a major impact on the quality and nature of staff services offered. Market research, design analysis, advanced scheduling and planning are only a few of the functions usually found only in large firms which can now be offered through the application of computational services in the smaller firm.

The appearance of time-shared services also will have a definite impact on the smaller firm in that it provides a whole new pathway for the development of an integrated computer system.

A variety of applications for small businesses have recently been developed, including machine tool control systems, design and product analysis,
preparation of proposals, specifications and quotations, inventory coordination and control scheduling and planning assignments analysis, purchasing and specification analysis, as well as other applications. 7

System Participation

Management is essentially a human process that occurs within the business hierarchy. Managers practice what they feel to be appropriate customs and norms when dealing with others. Relationships between participants in the process are governed by relative rank and status, as assigned by the top corporate authority. Within any business system the participants have expectations concerning the behavior of others. Underlying how people behave is the basic strata of attitude, "the feeling, the confidence or lack of confidence, the friendliness or enmity, the agreement of conflict, the like or dislike, which provide the environment and the atmosphere surrounding our dealings." 8 Those who


are responsible for planning and controlling enterprises are inevitably concerned with the technical aspects of business performance, such as cash flows, facts of competition, investment planning, and so forth. This is the technology of management which varies with particular functions under consideration, e.g. production, accounting, marketing. Business studies, especially in the early years, are predominantly concerned with explanations of technical processes. The importance of behavioral processes has come to be recognized in recent decades with the growth of the disciplines of social psychology and sociology. A business firm can be regarded as a system with participants at various layers, or strata, having expectations which are satisfied or frustrated as a result of the actions of others. The individuals within the management hierarchy are the components of the system; they represent various roles and interact in a network of relationships. Between departments and between persons within any given organization, forces of control, conflict, and cooperation are present in various degrees.

The recognition that management was more than a technical or economic activity and that it is better
understood as a social process opened up new fields of study. The early models of business systems and of the market place wherein they operate, were derived from classical economic theory. The participants in these systems were assumed to be "rational economic men," who maximized gains and minimized losses. Their dominant goal was pecuniary gain, and personal and social values of a non-economic character were assumed to be of little importance. Rational economic man was postulated to be intelligent, well-informed, intellectually curious, committed to technological improvements, consistent, and capable of making detailed calculations in order to advance his own welfare. The validity of this model was weakened insofar as the behavior of people in business situations varied from the assumptions of the model.

In order to explain a world inhabited by people who did not behave as the classical economists suggested, it was necessary to go beyond to early economic models. As Robert Bartels states,

As the scientific study of management practice developed, attention turned from public to private economic problems, but management theory was unconcerned with distributive activity. There remained, therefore, a gap in theoretical explanation as social and economic conditions
departed increasingly from the assumptions concerning the market on which existing theory was built.⁹

An important basic assumption in orthodox economic theory was that "individuals respond to economic incentives as isolated individuals."¹⁰ It was held that social influences were irrelevant. Thus theories were propounded where individual differences were ignored, but which were relevant to most of the people. It is reasonable to postulate that most people prefer to pay a lower rather than a higher price for the same product, and that most business executives prefer higher rather than lower profits for the same use of resources. To the extent that people are motivated to act this way, it is possible to predict the general direction of their actions.

Economics and psychology are complementary in the sense that while economics is concerned with the probability that a significant proportion of any

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given group of people will act in a certain way, psychology analyzes individual conduct. To be able to judge probabilities it is not necessary that people are consistent, well-informed, and "rational" in each and every case. In this regard, much of the criticism of "economic man" is irrelevant. Economists have long been aware that human conduct is affected by social influences; self-denial, power seeking, altruism, desire for prestige, and many other motives. The behavioral scientists, however, pointed out that individual gain may not be such a crucially significant variable as economists proposed. Mayo and Roethlisberger of the Harvard Research group discovered that in the Hawthorne Project that the goals of the individual are often subordinate to the norms of the work group. These norms are derived from the cultural values of the particular society in which the group functions.

Thus, within a business system, individuals are motivated to increase or restrict productivity not solely in response to pecuniary incentives but in response to social values. Management is concerned not only with providing traditional incentives to which individuals will respond (salary, rank, etc.)
but also recognition of group influences.

Urwick has proposed a simple model which admits both individual and social concerns. Four items are given as ordinates and from these ordinates a simple matrix is constructed showing the content of management.

These ordinates are as follows:

1. Things or work (the technology)
2. People and their patterns of behavior
3. As individuals
4. As members of social groups

Figure 9.--The Urwick Model

<table>
<thead>
<tr>
<th>Management is Concerned with:</th>
<th>A. Individuals</th>
<th>B. Social Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Things (Work) &quot;mechanics&quot;</td>
<td>1A. Analyzing, measuring or setting up tasks</td>
<td>1B. Arranging and correlating tasks</td>
</tr>
<tr>
<td>2. People &quot;dynamics&quot;</td>
<td>2A. Adjusting the individual to his/her task; motivating the individual</td>
<td>2B. Motivating or integrating groups</td>
</tr>
</tbody>
</table>

1A. F. W. Taylor, Fayol, et al.
1B, 2A. R. C. Davis
Introduction of Behavioralist Approach

The orthodox school of the 1930's prescribed management principles in a framework of 1B and 2A. It was a normative approach stressing structure and organization. This approach was deficient in explaining problems of restriction of output and lack of motivation in what appeared to ideal working situations.

The orthodox management theories of the 1930's emphasized mechanistic variables and neglected behavioral considerations. The satisfactions which workers obtained from meeting the norms of informal groups countered the assumption that workers and management shared the same objectives. Mayo, Roethlisberger, Dixon, Bakke and Homans laid the foundation upon which the later behavioralists built.¹¹ Mayo exposed the weakness of models derived from orthodox economic theory which emphasized money as a motivating force. He showed the incongruity between man's basic social needs and the prevailing principles of management.

Later researchers followed the path taken by the Harvard School and devised more rigorous empirical tests. Whyte in *Money and Motivation* examined the centrality of monetary incentives and attempted to synthesize the traditional economic approach and the newly emerging sociological explanations advanced by the behavioral school.

Business organization theory thus gradually evolved away from the model proposed by Taylor, Fayol, Follett et al., towards a model which incorporated socio-psychological considerations. The behavioral researchers made studies which provided evidence that what had hitherto been considered "non-rational" motives could have considerable significance for the operation of a firm. They provided a more complex structure of human motivations which included values and attitudes, feelings, habits, perception, and other important influences on human behavior. Group norms were found to be more important determinants of behavior than the maxim of rational behavior.

**Definition and Topology of Role**

Role can be defined as: "a collection of activities peculiar to a position or function in
society at large, a community, a formal organization, a social club." Individuals occupy a diversity of roles in society. Roles carry rights, duties, obligations, which are borne by the individual occupying a given role. Role implies status. Status may be objective, i.e. derived from the formal structure of an organization, or subjective, the result of a private evaluation. Objective status applies to a position regardless of the person who occupies the position, e.g., the captain of a ship. The crew, however, will make subjective status judgments as a result of which the captain's position in the social system will be affected. In a business hierarchy, positions are ordered and objective status is conferred on those who occupy the various positions. Top management decides what the ranking will be and what specific obligations and rewards are attached to the various status positions.

Levinson distinguished three dimensions of role. They can be simply explained by the following figure:

Figure 10.—Three Dimensions of Role

The first dimension describes role as a set of pressures which cause an individual to act in a certain way. The role is well structured, and the individual is supported in decisions that he takes. Outside pressures direct the way in which duties are performed and obligations are met.

Aspect two emphasizes the individual's personal conception of the part he should play in the organization. Important in this approach is the individual's evaluation of the way he has fulfilled the expectations of the role.
The third dimension is a compromise of the previous two. It includes both the influences which society places upon the individual and the converse. There is a reciprocal process expressing the interaction of the outside group with the role occupant.

Social psychologists and management theorists such as Homans, Bakke and Bates have studied small work groups in which the individual has to adjust his values and adapt his behavior such that it is acceptable to the group. The price of not doing so is ostracism or isolation from the group. But the individuals can also influence the values and norms held by the group. Bakke referred to the synthesis of the relationship between individual and group as the fusion process. This process is the result of mutual adjustment and compromise. Such adjustment forges "work bonds" between the members of small groups. Scott proposes the simple topology of the role concept given above. He comments that different disciplines tend to be devotees of a certain approach.13

13 Ibid., pp. 194-195.
The sociologist or anthropologist stresses the importance of social pressures on the individual. Psychologists lean towards the particularistic approach. Social psychologists tend to prefer an explanation of role as a result of a two-way adjustment and compromise between the person and the group.

Significance of Role for This Study

Literature on data processing is heavily technical; articles on human relationships are very scarce. Nevertheless, the small proportion of articles which do cover this subject contain some interesting references to the role occupied by data processing managers. Such references can be grouped under the following headings:

1. Ambiguity of roles
2. Interfunctional misunderstanding or conflict
3. Inadequate recognition by top management

Ambiguity of Roles

The role of the EDP specialist is best understood by following a particularistic approach.

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14 Journals perused were Datamation, Computers and Automation, Systems & Procedures Journal, and Computer Digest.
Absence of clearly structured content means that the data processing manager, or senior analyst, is required to decide what activities are special to his position and to evaluate his performance in relation to his own perception of the role. Words such as "undetermined", "nebulous", "undefined", are used in the journals to describe the role of the systems specialist. One writer states:

... the systems man often enters his projects with little or no idea of what is expected of him, or of what he may be able to do with a project. He is truly a pioneer in many companies. This fluid role often causes him undue anxiety, simply because his role is "free-floating" and undefined, or unattached to any foundation. He is left with his own sense of personal identity as the only terra firma in his domain--his only security is the fact that he knows who he is.  

The computer specialist is a phenomenon of the last fifteen years, the latest addition to a corporate structure, many of whose personnel have been established for centuries. Engineers, for example, grew as a profession with industrialization and bookkeepers (accountants) were present in the earliest civilizations. It is therefore not surprising that accountants and engineers have a well

defined role. By contrast, the aspiring computer specialist is admitted to a group whose role is relatively unstructured. He operates in a complex area of business concerned with design and development of systems which generate and maintain flows of information for widely divergent purposes. The boundaries of his subject are uncertain, and in the process of devising systems he interacts with a diversity of functional departments. The computer specialist is not able to use time-honored established procedures to solve his problems. The basic techniques of well established disciplines, such as engineering or accounting, can be taught before the would-be practitioner is on the job. The EDP systems man has to devise his own mode of operation, using basic concepts to guide his decisions. Thus, there is good reason to anticipate that the systems specialist suffers anxiety and conflict due to the ambiguity of his role.

Role uncertainty is also experienced by top managers in their relationships with senior data processing staff. The newness of the specialization means that there are no proven methods of relating to information systems, as is the case
for production or finance. The top manager is aware that computer systems improve his intellectual capability but they also downgrade the premium placed upon years of experience. To the extent that judgment, acquired over the years, can be replaced by quantitative facts or estimates, the importance of traditional managerial know-how is diminished. Top management finds it difficult to define the task requirements for data processing.

Interfunctional Misunderstanding or Conflict

The data processing department operates outside of the functional departments yet at the same time is a vital link in their work. Due to the esoteric nature of systems analysis, members of other departments react in varied ways; awe, mystery, defense, possibly covert hostility, but rarely indifference. As an interfunctional group, with an overview of operations, the EDP staff is in a powerful position. Because of the sense of being outside and apart, there is a problem of integrating EDP staff into the business organization.

As members of an innovating group, it is essential that they should be accepted by, and be able to communicate with, other staff. Yet they may feel a stronger association and rapport with members of other computer groups outside
the organization than with staff inside it. It is certainly a challenge to the EDP manager to develop a sense of affinity with the organization and to overcome communication barriers between his staff and others.\(^{16}\)

A report on the impact of computers on small and medium-sized banks also comments on the question of inter-functional rivalry:

"Tension between computer staff and other officers is more likely to exist when "outsiders" are brought in to manage the EDP operations. Where such tensions exist, it seems, in part at least, the fault of the computer personnel who consider themselves different from others in the bank and consequently help create a gap in communication between themselves and other personnel.\(^{17}\)"

Simple analysis has projected the business organization as being composed of many different departments all striving toward a common objective. In distributive channels, it was recognized that the different elements in a channel of distribution would be good cause for conflict as well as cooperation. Eventually intraorganizational analysts come to recognize that conflict is also an aspect of inter-departmental relationships. Thus we can


isolate three main threads running through the fabric of the organization: cooperation, control and conflict. A company can be regarded as a political entity with struggles for power between competing groups. Each group tries to shape company policy to suit its own interest and reconciles this with the company interest as viewed from a particular frame of reference. For example, production personnel tend to enhance the role of production relative to that of other departments such as merchandising or research. They are able to do so with the genuine conviction that this is in the best company interest, because for them production is the heart of the enterprise. Their perspective of company problems is that of the production department.

There is a natural tendency to form groups along functional lines; research engineers share common interests with other research engineers; and so it is for other skills and specializations. Each group attempts to promote its own interests and to improve its status within the organization. Such behavior may lead to interfunctional conflict within a business organization. This is as true of data processing as of other departments.
Members of EDP staffs speak a different language, a technical systems language which puts a "semantic wall" between them and the generalists. This is partly a question of educational lag. While most persons are familiar with basic terminology of traditional specialists, they are not schooled in computer systems terminology. For instance, few people outside the accounting profession comprehend accounting techniques, but there is a general familiarity with such terms as: profit and loss statements, trial balances, balance sheets, etc. Regardless of whether or not such concepts are understood, terms used have a reassuring familiarity. Oncoming generations will have high school introduction to computer concepts and will be as familiar with them as older generations are familiar with the concepts of accounting or production engineering. In the meanwhile, the generational knowledge gap exists.

Furthermore, the knowledge explosion is such that there is no basic unchanging set of computer principles. Technological changes between generations of computers are more fundamental than is true for the traditional specializations, e.g. thermionic tubes $\rightarrow$ transistors $\rightarrow$ silicon
components, magnetic cores, etc. Quantum jumps in technology involve new approaches to pro-
gramming and analysis, such that some specialists are not able to move forward to the next generation of equipment. That is to say, skills become obso-
lete as the equipment becomes obsolete. This is true of all specializations, but rate of obsoles-
cence of scientific knowledge appears to be accelerating.

Thus the EDP specialist lives in a different world from that of the other personnel, practicing skills which few of them comprehend. The sense of separateness and exclusivity is strengthened by the limited understanding possessed by most operational managers. The circumstances are conducive to remoteness and a degree of interfunctional friction.

The formal qualifications of EDP staff at the senior levels are poor compared to those of other well regarded specializations.18 There is

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18Evidence to support this, and other propositions tentatively mentioned in this chapter, is offered in detail in Chapter VI where the full results of this study are explained.
therefore the paradox of demanding high-level roles occupied by individuals with relatively low formal education. In such circumstances computer specialists may experience role anxiety which weakens effectiveness. The position of the EDP man is that of an interfunctional specialist, frequently interacting with better qualified personnel, without a clearly structured role, with no clear boundaries of operation, having to rely greatly on his own self-resources. The position is likely to induce a strong interest in professionalism as a way of securing foundations to offset the uncertainties of the role. An accepted professional base would serve to strengthen the computer specialist in inter-departmental disputes or in gaining the attention of top management. The interest in professionalism is evident in the journal literature. A writer on the difficult role of the systems specialist in the corporate structure writes:

... confusion is emerging in the concept of systems and procedures as a "profession." Although glibly used by many to bolster their own sense of importance, one wonders if those same persons recognize their own responsibility to help bring some depth to the general understanding of what the professional systems man is all about. A good workable definition of a
professional person is "one who operates according to principles, not haphazardly and not by the seat of his pants." Surely, then, as one who brings order out of confusion, the systems man cannot remain forever immune to his responsibility for clarifying and formulating the principles which will in reality bolster the real significance of systems and procedures.  

Strong educational programs to establish formal standards of entry to the group are stressed by some contributors:

In its recommendations for academic programs in computer science, at the undergraduate and graduate levels, the ACM Curriculum Committee on Computer Science strongly emphasized the "science" aspect of computer science, as it should have done according to its charter. Relatively little of the recommended curriculum, however, offers much to the graduate who intends to apply computer technology to business problems. Without attempting to debate the academic content of the curriculum, I would suggest that substantial skills in a variety of technical and human disciplines are needed to successfully implement large-scale systems in business.

Fortunately, some very capable people have been working to define these skills and to recommend an appropriate curriculum for the business data processing professional.  

The example of the medical and dental professions is cited; groups that from an organizational and entrepreneurial viewpoint, form an elite in the professions.


... every man needs to build a relationship of mutual trust with at least one member of his own profession. This has been practiced by the medical profession for many years. In such a relationship, sympathetic understanding and objective evaluations will help each man develop a more realistic perspective of his role. Moreover, each man will learn from the other's techniques for handling similar situations.

... every maturing profession must develop people for technical support. The dentist used to do all the work himself. He now has dental technicians or nurses to handle the routine part of his work. This industry needs to develop a logical work structure that enables high school graduates, college graduates, the Ph.D's, each to concentrate on the area of work where they can make their greatest contribution. The DPMA has done much work to insure proper accreditation and helped sponsor and assist private business computer training programs. A massive educational approach is long overdue.22

It was stated in the early part of this chapter that in order for a group to be designated a "profession" certain criteria should be satisfied. We have seen that the EDP group appears to meet some of the criteria but not all. In the present phase of evolution, it could be legitimately termed a marginal profession. The role anxieties of computer specialists are somewhat analogous to those of the purchasing agent. There are some similarities


between the roles played by each group and also major differences. To state the differences first, the purchasing agent is in a much weaker position as regards the knowledge considered necessary for his job when compared to the computer specialist. The body of knowledge concerning computer concepts and systems, the most recent scientific ideas applied to computer operations, have no equivalent for the purchasing agent. Whereas the tasks undertaken by the EDP specialist evoke respect and a sense of mystery in other corporate executives, the purchasing role is perceived as fairly simple.

The average executive may be awed by the arcane mysteries of accounting, law, engineering. But purchasing men claim that this same executive looks upon purchasing as something pretty simple, something which even his wife can do.\(^\text{23}\)

Strauss concludes that purchasing agents have an uphill task convincing others that purchasing requires mastering a formal body of knowledge which would justify professional standing. The PA suffers anxiety as a consequence of his poor image and lack

of status in the organization. He is mostly a receiver of orders from other functional departments (engineering, manufacturing, marketing) rather than an initiator of orders. The flow of orders is in one direction, instead of being both ways. This frustrates the PA's who feel they should be consulted at the inception of projects; this would allow their skills to set in motion a reciprocal flow of ideas. Clearly, this is not a difficulty experienced by computer specialists. If anything, the reverse is true. Functional managers tend to abdicate their roles in favor of the EDP man, who too frequently moves into a vacuum. The computer specialist is not frustrated due to the unfair denial of his initiative and skills.

The similarity of the two groups resides in the fact that each group, for different reasons, experiences status anxiety, and that this stimulates a strong drive for professionalism. The computer specialist is "free-floating," unsure of his role, expected to cope with a myriad of complex systems problems. The PA feels that his contribution is undervalued through being placed in a subordinate role to traditionally established professions.
(primarily engineering). The response by both groups is to seek security of status by forming strong professional bodies and emphasizing lengthy educational requirements. PA's would like to see universities establish courses in "purchasing science". NAPA has set up a Committee for Professional Development which seeks to "improve our relationships with colleges and universities to the end that purchasing will be a profession in fact." Strauss concludes that PA's believe formal education will compensate for the disadvantages when dealing with engineers. A strong purchasing profession will be a means of equating their status with the traditional business professions. In the Strauss study of 144 PA's, 55% reported that they did not receive a college degree. In this study, with replies from 101 data processing managers, 49% reported no college degree. This should be compared with almost one hundred per cent for formally recognized engineers. The top managers in this study (N=133) included only 6% who did not receive

24 Ibid., p. 483.

college degrees. Nearly 60% of the top managers in the Ohio State study had experience of graduate study or graduate degrees. Therefore in the case of both EDP specialists and PA's, there is a clear imbalance between their qualifications and the qualifications of the groups with whom they are interacting.

To briefly summarize the foregoing:

1. EDP managers and senior computer staff, occupy an unstructured role, best understood by a particularistic approach. Each individual has wide latitude in defining the role expected of him. His satisfaction is achieved by fulfilling the expectations of that role.

2. The role is difficult because he attempts to systematize formerly "confused" areas of business, i.e., non-systematic from a scientific viewpoint. He should ideally understand many aspects of company operation and the interrelationships between the component parts of the organization. He is required to devise systems, using basic knowledge, rather than following established procedures to solve common problems.

3. Semantic problems place a barrier between computer specialist and computer user. Breaking
down the barrier requires adjustments in the attitudes of each group.

4. Lack of role definition and an ill defined structure create ambiguity and uncertainty.

5. A reaction to this uncertainty can be seen in the strong interest in professionalism.

6. A strong profession, with educational standards maintained by colleges and universities, is perceived to be a compensation for the frustrations of an uncertain role.

7. Ambiguity of role is also experienced by top managers, who are not as decisive in assigning tasks and regulating the expenditures of EDP as they are in more traditional areas, e.g., production or sales. Accountability for expenditures on EDP is looser than for other areas due to the difficulty of applying yardsticks for computer operations performance.

8. Inadequate recognition from top managers contributes towards role uncertainty of data processing managers. Of 101 data processing managers responding to this study, 67% felt that top manager support and understanding should be considerably increased.
CHAPTER V

CONCEPTUAL FOUNDATIONS

Every empirical investigation proceeds on the basis of some theory or group of concepts, explicit or implicit. J.M Keynes, in a preface to a monetary treatise, said that monetary cranks, dictators, madmen, and frenzied scribblers who see visions and hear voices in the night are all slaves to the ideas of some defunct economist. Theorists, in whatever field they write, provide a valuable conceptual foundation on which the empirical building blocks of others can be erected. Seldom, however, can such edifices be erected on a neatly prepared, directly relevant foundation.¹ For the purposes of this study it was not possible to draw upon any single existing theoretical construct.

¹Instances of simple hypotheses which are fairly simple to test are contained in Keynes' macroeconomic theories. For example, the proposition that consumption is a function of income generated a considerable amount of empirical research.
Nevertheless, the work of a number of writers\(^2\) in the field of organizational behavior was useful in stimulating ideas. The contributions of five researchers are briefly explained in this chapter with comments on their relevance to the study of management relationships in the field of data processing.

The chapter commences with the brief description of three basic models which explain the development of the theory of business organizations. The exposition is intended to convey an accumulation and synthesis of ideas and not a rejection of old ideas in favor of new ones. The third fundamental approach, that of the industrial-sociological model, introduces the ideas of Simon, March and Cyert, and the behavioralist writers Likert, Whyte, et al. Regrettably, in such short discussion, many of the contributors whose work formed the foundation for others have been omitted (e.g., the underlying ideas for Whyte's interaction model were supplied by Homans, Freed Bales and Chapple). Though some of the ideas are only partially relevant to this study it was

\(^2\)It would be more appropriate to say "schools of research," since those named represent ideas developed at the following institutions: Michigan, Cornell, Carnegie, Chicago, and Western Reserve.
decided to give a complete statement of the sources drawn upon.

The concluding section explains the conceptual schemes put forward by W.F. Whyte.

Finally, a simple model of management interaction is suggested, relevant to the problems of data processing management. This is an adaptation of the Whyte approach. Such a model reveals some possible causes of friction and disharmony, as presented in the final table.

Three Basic Models

It is possible to distinguish three approaches to the development of theory concerning business organization:

1. The mechanistic model
2. The socio-psychological model
3. The industrial-sociological model

These models represent stages in the evolution of organization theory, from Taylor's scientific management\(^3\) to the "human relations" school\(^4\)


in the 1950's and later. The Taylor approach was mechanistic in that the employees were regarded as "instruments," described in fairly simple physiological terms, and analyzed as economic factors of production. The more recent models recognize that participants in the business system have values and attitudes, feelings and motives, which will affect their behavior.

The mechanistic approach can be contrasted with that of a business sociologist:

"The human actor is a multidimensional phenomenon subject to the influences of a great many variables. The range of differences in aptitude is great, and the learned behavior patterns (considering mankind as a whole) is quite diverse. Neither we nor organizations have the data or the calculus to understand organization members in their full complexity, and the requirements of complicated technologies in complicated task environments cannot be met if the full range of human variables comes into play within the organization."  

The notion that people were susceptible to scientific planning accorded with the prevailing classical economic theory in which labor was regarded as an input to a mix of productive factors. Such theory rested on the assumption of rational

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economic men who would act so as to maximize utility and minimize disutility.

It is not proposed to make further explanation of this approach because it is not closely relevant to this study. The important point is that the early model ignored the human problems of business, which were later recognized to be a crucial factor affecting overall performance.

The Socio-Psychological Model

The early traditional approach viewed employees as simple machines, and paid little attention to the effects which environment has on an individual in an organization. The barriers to better performance were thought to be capacities, speeds, durability, and costs of labor. The behavioral approach rejected such simplicity, abandoned the rationality maxim, and constructed theories which included as variables: values, and attitudes, group norms, habits and motives. Writers of this school recognized the importance of small informal groups as an influence on human behavior.6 Romans noted

that frequency of interaction between members was a criterion of the influence of the groups upon them.\(^7\) March and Simon list a number of theorems concerning group pressures: uniformity of opinion, range of control over environment, and cohesion.\(^8\) The greater the interaction between group members the greater the similarity of viewpoint. If there is strong identification with the group, there will be strong group pressures. In some cases where the roles played by the participants in the group are clearly defined, a specific behavior pattern is anticipated. Such groups tend to stabilize behaviors such that the interrelationship of the formal organization and the small informal group is more readily perceived. The importance of the small informal groups is stressed in the socio-psychological explanations of business behavior. Albach summarizes the socio-psychological model as follows:


"The aptitude and efficiency of the worker in the enterprise will be affected by his complex behavior structure. The behavior structure of the human being is not governed by the rationality maxim, but depends on group norms. The informal groups as a spontaneous association of people bound by a close relationship is the independent variable to which the formal organization must be oriented."\(^9\)

The activities of the informal group can be harmonized with the goals of organization such that it exerts a positive influence on the members. Conversely, informal group influences can hamper good performance and be reflected in output, absenteeism, and various other shortcomings. Sound organizational policy attempts to make allowances for informal groups such that they blend harmoniously with the formal organization and tend to further its objectives.\(^{10}\)

**The Industrial-Sociological Model**

Modern organization theory attempts to synthesize and carry forward the work of the traditionalists and the innovations of the social psychologists. The studies carried out at Carnegie


by Simon, Cyert, and March, et al., exemplify this approach. Simon proposed:

"...a theory of human choice or decision-making that aims to be sufficiently broad and realistic to accommodate both those rational aspects of choice that have been the principal concern of the economist, and those properties and limitations of the human decision-making mechanisms that have attracted the attention of psychologists and practical decision makers."

Simon studied decision making in administrative organizations and developed principles applicable to a wide range of organizations: municipal authorities, hospitals, business firms, etc.

He rejected the notion of the organization as commonly depicted in charts and manuals, which stress lines of authority:

"In the pages of this book, the term organization refers to the complex pattern of communications and other relations in a group of human beings. This pattern provides to each member of the group much of the information, assumptions, goals, and attitudes that enter into his decisions, and provides him also with a set of stable and comprehensible expectations as to what the other members of the group are doing and how they will react to what he says and does. The sociologist calls this pattern a 'role system'; to most of us it is more familiarly known as an 'organization'."


12 Herbert A. Simon, Ibid., p. xvi.
The Carnegie school in their initial studies of the process of decision-making, demonstrated the shortcomings of both the economic and psychological approaches. If man is not perfectly rational, neither is he as non-rational as the Freudians proposed. The March and Simon model uses the concept of "limited rationality" which recognizes that people are limited in their capacities, knowledge, and skills and thus restricted in their ability to solve problems. These authors explain that there are cognitive limits on rationality which constrain an individual when making a choice between alternative courses of action.\textsuperscript{13}

An outline of the later developments of the Simon-March model will be given later in this section. By combining their knowledge of administrative theory with current sociological concepts, this approach has had a considerable influence on the theory of organizations.

A useful conceptual framework used by contemporary sociologists is to study human behavior

\textsuperscript{13}James G. March and Herbert A. Simon, Organizations, (New York: John Wiley and Sons, 1953), pp. 135-42.
as it emerges as a result of the interaction of the individual and a situation. The individual brings a set of values, standards, aspirations, and beliefs to a situation which presents opportunities bounded by constraints.\textsuperscript{14} It is assumed that a purposive individual will attempt to take advantage of opportunities and will act in consistence with his aspirations. Such action will be guided by standards and values acquired by the individual in the past. The limits to his action will be imposed by the constraints of the particular situation. Thus the sociological framework allows analysis in two directions, and includes both the individual and his environment. The researcher tries to establish behavior patterns by studying possible sources of similarity or difference. For example, in a situation where individuals brought "similar aspirations, beliefs, and standards into situations appearing to offer similar opportunities and constraints, we can expect to find similarities of patterns on the ensuing action."\textsuperscript{15}


\textsuperscript{15}James D. Thompson, Ibid., p. 102.
Recent Behavioral Research Relevant to the Study

The conceptual schemes of most value in formulating the hypotheses for this study are those put forward by Herzberg, 16 Likert, 17 Simon, March and Cyert, 18 Blake and Mouton, 19 and Whyte. 20

The Herzberg model is helpful because it explains that the significance of wage and salary incentives may be over-emphasized. There is a tendency for firms employing computer specialists to rely heavily on money as a motivator. 21

categorizes salary as one of a number of "hygienic" factors which may cause discontent due to their inadequacy but do not motivate employees to improve their performance.

Managers of data processing systems are well paid compared to men of similar qualifications and experience in other departments. Scarcity of skills inevitably results in the payment of above-average incomes (quasi-rent), but tests of the Herzberg model have shown that professional men are more stimulated by challenge, and possibilities of achievement, than raises in salary.\(^{22}\)

Rensis Likert has provided a conceptual framework for testing degrees of participation in management.\(^{23}\) This is very useful for studies concerning scalar relationships in a business organization. Likert found that organizations tend to be authoritative in organizational structure, rather than participative. He argues for changes in leadership styles so that more participation is

\(^{22}\text{Scott Myers' tests of occupational groups at Texas Instruments, 1958-1964.}\)

\(^{23}\text{Likert, Op. cit.}\)
possible at lower levels. Sharing decision-making with subordinates releases creative abilities and improves overall performance. Encouraging initiative at lower levels increases the flow of information upwards. The extent to which the Likert model can be helpful in this study is limited. It is true that greater participation between the managers concerned with data processing systems is desirable, and that such cooperation can best be initiated by top managers. However, the fact that EDP is a specialist role, outside of the functional departments, weakens the relevance of models concerned with scalar relationships. The Likert approach is more helpful in cases where line managers are interacting with supervisors and shop floor workers.

In order to change attitudes towards management, some writers have advocated retraining methods. The following methods have been tried:

(a) seminars in which the experience of other companies is discussed (which may be conducted by professional or academic consultants)

(b) laboratory sessions using training group
methods conducted by a trainer who is responsible for triggering the discussion

(c) in-company programs of various types
(d) the managerial grid

The last named device is a helpful way of conceptualizing the management need to consider both the technical and human aspects of business management. Blake and Mouton (1964)\textsuperscript{24} set up a matrix which shows the necessity of compromising concern for productivity and concern for people. Degrees of concern are expressed on a scale from 1 to 9, with the 9,9 style indicating maximum concern for both. In order to achieve this, Blake and Mouton suggest ways to reduce or modify conflict between groups within the organizations and ways of arriving at compromises without damaging the ego of the participants.

Perhaps the major effect of the grid method of training would be to make the managers more aware of how they behave, and the effects of their interaction with others. The authors suggest that greater awareness increases interpersonal competence and by

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<tr>
<th>High Concern for People</th>
<th>1,9 Management</th>
<th>9,9 Management</th>
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<tbody>
<tr>
<td>Thoughtful attention to needs of people for satisfying relationships leads to a comfortable friendly atmosphere and work tempo.</td>
<td>Work accomplishment is from committed people; interdependence through a &quot;common stake&quot; in organization purpose leads to relationships of trust and respect.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5,5 Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate organization performance is possible through balancing the necessity to produce work with maintaining a satisfactory level of morale.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1,1 Management</th>
<th>9,1 Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exertion of minimum effort to get required work done is appropriate to sustain organization membership.</td>
<td>Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low Concern for Production</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
</table>

**Figure 11 -- THE MANAGERIAL GRID**

so doing improves the organizational environment. The fact that computer specialists are often found to be deficient in interpersonal relationships, due to their strong task-orientation, has been commented on in recent journal articles. Writers on this subject have explained that there is a need for systems managers to understand and respect the frailties and dignities of people. Keller (1968) suggests that the systems man is in large measure responsible for the gap between himself and top management.

"Systems power will eventually decide many of the competitive battles in the business community. Assuming that the systems professional understands this power better than anyone else—and he should—his task is to communicate this understanding to management. If properly approached, management will listen. And if properly sold, management will buy. The consulting profession has already proved this."


The Simon-March-Cyert Model

The Carnegie theorists have developed a behavioral model of the organization which has proved very fruitful in generating further research. Their efforts stem from dissatisfaction with the rigidity and over-simplification of the economic theory of the firm. In contradistinction to the orthodox theory, which ignored the roles played by individuals within the firm, the Carnegie model proposes that theorists should consider the various conflicting interests which affect business decisions. Cyert and March hold that organizations have the following characteristics:

1. They include individual participants with widely varying preference orderings. These individuals comprise a coalition of managers, stockholders, workers, suppliers, customers, etc.

2. That through bargaining and side payments the participants in the organization enter into a coalition agreement for purposes of the game. This agreement specified a joint preference ordering (or organizational objective) for the coalition.

3. That thereafter the coalition can be treated as a single strategist or entrepreneur.
Cyert and March explain their conception of the organization as follows:

"Since a formulation permits us to move immediately to statistical decision theory and its elaborations, it has been an important part of recent developments in normative organization theory. In our view, however, a joint preference ordering is not a particularly good description of actual organization goals. Studies of organizational objectives suggest that to the extent to which there is agreement on objectives, it is agreement on highly ambiguous goals. Such agreement is undoubtedly important to choice within the organization, but it is a far cry from a clear preference ordering. The studies suggest further that behind this agreement of rather vague objectives there is considerable disagreement and uncertainty about subgoals; that organizations appear to be pursuing one goal at one time and another (partially inconsistent) goal at another; and that different parts of the organization appear to be pursuing different goals at the same time. Finally, the studies suggest that most organizational objectives take the form of an aspiration level rather than an imperative to 'maximize' or 'minimize' and that the aspiration level changes in response to experience."

The Cyert-March behavioral theory of the organization is process-oriented, and attempts to show the process by which organizations make decisions. Hence the attention paid to formation of coalitions, bargaining, and compromise between participants.

The general model is comprehensive and lends itself well to the questions posed in the dissertation.

The participants in the business process are viewed as seekers of "satisfactory" solutions to their problems. The maximization assumption is rejected on the grounds that optimal solutions are too difficult to determine:

"To optimize requires processes several orders of magnitude more complex than those required to satisfy. An example is the difference between searching a haystack to find the sharpest needle in it and searching to find in the haystack a needle sharp enough to sew with."  

The goals of the organization are attainable subject to the choice of satisfactory alternatives and adequate performance by the participants in the system. Due, however, to the diverse interests represented by the coalition of individuals who form the organization, there is potential for internal conflict. Relevant to this problem, Cyert and March offer four propositions:

1. Goals are independent constraints. In their framework organizational goals are a sequence

of independent constraints imposed on the organization by members of the coalition.

"Conflict is assumed to be resolved by local rationality, acceptable decision rules, and sequential attention to goals." 29

2. "Local rationality" is one method of resolving conflict. Each organization has problems and with reference to these, different members of the organization assume responsibility for devising satisfactory solutions.

3. Rather than optimization, acceptable-level decision rules are practiced by organizations.

4. The model recognizes conflict among goals and these are resolved in time-sequence, attaining one goal at a time.

The Cyert-March formulation contains two further constructs which aid analysis in this dissertation:

1. The strategy of the organization in overcoming uncertainty.

2. The process by which the organization learns (i.e., adapts to environmental changes over time).

On the question of uncertainty, management tends to skirt this problem by avoiding long-run predictions. Organizations develop feedback procedures which are short-run in nature.

"They emphasize short-run reaction to short-run feedback...they solve pressing problems rather than develop long-run strategies."  

Management attempts to reduce long-run uncertainty by controlling the business environment within which it operates.

Adaptation by the organization is necessary if it is to survive and grow. A similar analysis has been offered by Alderson in regard to participants in the marketing process.  

March and Cyert propose three concepts to explain the adaptation process:

(a) Adaptation of goals over time is a function of the previous period's organizational goals. It is also influenced by the recent history of comparable organizations.

(b) Organizations learn that it is beneficial


to "attend to some criteria and ignore others. . . pay attention to some parts of the environment and ignore others."32

(c) Search procedures will be changed as a result of favorable or unfavorable experience in the past. The decision-makers will turn more readily to consideration of those alternatives which have resulted in a successful outcome on previous occasions.

**Whyte's Interaction Approach**

W.F. Whyte has devised a simple model which has some relevance to this study. It includes three major concepts: interaction, activities, and sentiments. These elements can be perceived in any organization; they are so mutually dependent such that a change in any one affects the other two. All of these elements of the business system are affected by changes in the external environment. Interaction means interpersonal contact; observed and measured by frequency and duration. The researcher records

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who initiates the interaction, and for what time periods. What proportion of interactions does A initiate for B, and vice versa? Where interaction concerns two people it is a paired event.

Whyte's approach has been used in this study, which measures the interaction of 88 pairs of managers, (1 EDP, 1 top manager) with each pair being employed by the same firm. This has enabled statistical analysis in order to test the differences and similarities between the two groups on a number of questions related to data processing. A limitation on the use of interaction methods, as they could be applied to this study, is the impracticality of first-hand observation. The methods, as used by Whyte and others, involved field studies where they actually perceived interaction and attempted to evaluate the nature of the interaction. To cover a large sample, this requires a team of observers and personal involvement in the industrial process. Information concerning interaction is gathered in this study is through recorded estimates by the respondents of the frequency and duration of interaction. There has been no attempt to assess nature or quality
of interaction. It is therefore conceded that the yardstick used is somewhat crude. We were not able to include the effects of spatial relationships, physical movements, social interaction, or many other factors which could be measures of management interaction. The factor which has been selected as having an important influence on the men included in each pair is the shared experience of working for the same business organization.

The terms sentiments, activities, and interaction are defined by Whyte as follows:

Sentiments have three elements:

1. An individual's ideas about events or persons
2. Emotional content, affective influences
3. The recurrence of sentiments through association with symbols which evoke past sentiments

Activities are physical actions. In business the results of activity can be measured by indices such as level of output, sales achieved, systems installed, etc.

Interaction has both micro and macro aspects.

To a social scientist micro-interaction is an interviewer-interviewee relationship, such as may be

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found in a clinical or experimental situation. Macro-interaction is the field research situation, where interaction takes place in a work setting. Whyte uses the term in the macro-sense, and that is the way in which it is applicable to this study of data processing. The assumption of those who believe in the interaction approach is that it is possible to make quantitative estimates of the initiation, duration, and frequency of interaction. Furthermore, changes in the quantities, i.e., different amounts or levels of interaction, are significant indicators of the nature of the relationship existing between people. Thus, it is contended, that it is possible to understand, possibly predict, behavior as a result of studies of patterns of interaction.

A simple interaction model relevant to managers involved in computer operations is presented in Figure 12. The three elements, activity ($A_1$), attitude ($A_2$), and interaction ($I$), are mutually dependent, such that a change in any one is assumed to affect the others. Forces in the external environment ($E$) may cause changes in any one of the
Figure 12
Model Of Management Interaction Related To EDP System Of A Business Organization
three elements. Hence several sets of relationships are possible:

1. \( E \rightarrow A_1 \rightarrow I \rightarrow A_2 \)
2. \( E \rightarrow A_2 \rightarrow I \rightarrow A_1 \)
3. \( E \rightarrow I \rightarrow A_1 \rightarrow A_2 \)
4. \( I \rightarrow A_2 \rightarrow A_1 \rightarrow E \)

In case 4, we have relaxed the assumption that an organization cannot change its environment. Clearly it is a question of size. Very large companies do not merely adjust to changes in the environment; they are capable of shaping it to some extent.

Managers at three distinct levels, top (TM), middle (MM), and staff (CS), are related by the three elements. Changes in the system as a result of either external or internal influences, will change the nature of their relationships. This will affect perceptions of the performance of the data processing managers. Judgments of performance are subjective and not actual outcomes, as could be measured by objective criteria, such as return on investments, orders processed per hour, etc. There has been no attempt in this study to use objective measures of performance of computer systems.
There are formidable practical and conceptual difficulties to obtaining such data, such that it was decided to rely on subjective estimates of performance in place of objective measurements.

A distinguishing feature of the interaction approach is that the researcher concentrates on the forms of interaction rather than the content. Most social scientists concerned with understanding human relationships have thought that verbal content and observed attitudes are essential to understanding of behavior. Measures of interaction, including initiation, frequency, and duration, are considered to be simple objective measures which tell us a great deal about relationships, regardless of what actually occurs between the parties. This does not mean that verbal content is not important or would not be valued by the researcher if known. It is a recognition by the investigator that (1) alternative indicators are possible, (2) problems of subjectivity are minimized, and (3) first-hand direct observations may not be feasible. Studies of the interaction process avoid a one-sided emphasis on the measurement of attitude. The limitations of
the Questionnaire as a method of measuring perceptions have been alluded to in Chapter II. There may be considerable disparity between what the respondent records and the true state of affairs. By introducing measures of interaction, or information on activities, other dimensions are added which reveal the picture more clearly. If we know that changes in interaction can change activities and attitudes, it could be an error to simply focus on attitudes.
<table>
<thead>
<tr>
<th>GOALS</th>
<th>IDENTIFICATION</th>
<th>STANDARDS</th>
<th>DOMAIN</th>
<th>VALUES</th>
<th>STRUCTURAL VIEWPOINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival Growth</td>
<td>1. Company</td>
<td>Financial</td>
<td>Company-wide</td>
<td>Entrepreneurial</td>
<td>Position of data processing in management hierarchy and structure of organization</td>
</tr>
<tr>
<td>Profits</td>
<td>2. Industry associations</td>
<td>Informational</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction of customers</td>
<td>3. Community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stockholders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>channel members</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>employees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>public</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional</td>
<td>1. Company</td>
<td>Functional</td>
<td>Departmental</td>
<td>Conscious of responsibility to TM</td>
<td>EDP perceived as threat to functional autonomy</td>
</tr>
<tr>
<td>Departmental</td>
<td>2. Community</td>
<td>performance</td>
<td>Functional</td>
<td>Responsible to subordinates for welfare, morale, etc.</td>
<td>Rapid growth of new department in the organization</td>
</tr>
<tr>
<td>Operational</td>
<td>3. Industry</td>
<td>Utility of EDP service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>1. Professional</td>
<td>Scientific</td>
<td>Inter-depart-</td>
<td>Emphasis on technical expertise</td>
<td>Level of appointment of data processing manager</td>
</tr>
<tr>
<td>Precision</td>
<td>Technological</td>
<td></td>
<td>mental EDP</td>
<td></td>
<td>Reporting relationships</td>
</tr>
<tr>
<td>Efficiency</td>
<td>2. Company</td>
<td></td>
<td>department</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 13—Possible Causes Of Disharmony In EDP Management
CHAPTER VI

FINDINGS AND DISCUSSION

When you can measure what you are speaking about and express it in numbers you know something about it; when you cannot measure it, when you cannot express it in numbers your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of a science.¹

Kelvin's dictum has been taken seriously by contemporary social scientists, but now that numerical testing is universal, scholars are more aware that, even with the advantage of numbers, knowledge is still sometimes of a meager and unsatisfactory kind. Measurements have been used in this study where it was thought appropriate for testing hypotheses; but judgments based on interviews, correspondence and written comments on the questionnaires have also been used to support or reject a hypothesis. Comments by top managers are

¹Lord Kelvin in an address to the British Association, 1910.

172
thought to be especially helpful. Thirty top managers added written comments to the information requested. Several quotations from this group are included in this chapter, but only where they represent a theme common to the majority of top managers.

The statistics used for the purpose of testing the hypotheses are taken from the BMD08D program, used for biomedical research. The printout takes the form of row and column contingency tables. This program provides the following:

1. Frequency tables of certain selected variables.

2. Chi-square values and degrees of freedom for each table.

3. Means, standard deviations, and correlation coefficients for each group of variables.

The data was also treated manually in order to compile tables and charts. These provided the background against which the output of the BMD08D analysis has been viewed. For fuller discussion of the tests, see APPENDIX D. The raw data have not been included here, or in an Appendix, due to the amount of space needed for that purpose.
The data may be grouped into three divisions:

(a) demographic (personal data concerning managers)

(b) company related (factual data describing industrial or commercial circumstances of firms)

(c) attitudinal (opinions of data processing managers and top managers on a number of issues pertinent to the hypotheses)

This chapter is planned as follows: (1) discussion concerning the significance and usefulness of the data; an ex post view, (2) statement of each hypothesis followed by relevant analysis, and (3) analysis of the written statements of top managers.

Ex post assessment of the significance and usefulness of data

Most travellers will accept the proposition that the view looking back is quite different from the one that was originally ahead. Also, similar terrain travelled by others may yield very different impressions. For instance, it was decided to include certain demographic variables to test similarity or difference in personal characteristics of top managers and data processing managers. Journal articles provided a profile of the characteristics of each group. The characteristics mentioned in the articles were selected on the basis of personal experience of the writers and not as the results of
empirical studies. The data gathered in this study give a considerably different profile from that which was expected as a result of prior reading. The question which we set out to answer with a few salient statistics was: "What manner of man is a data processing manager, or a top manager?" The EDP man was depicted as relatively youthful, mobile, well paid, college educated and professionally oriented. By contrast, top managers were expected to be of venerable age, dedicated to the company, and with less formal education. Of these characteristics, the groups differ as anticipated only on the question of professional interest versus company interest. There is a considerable difference in educational backgrounds but it is the reverse of what was anticipated. That is to say, the top managers instead of being less formally educated, had much stronger educational qualifications than the EDP managers. It was expected that the bachelor degree in science would be a necessary prerequisite for a senior position in data processing but this was found not to be the case. Perhaps it is appropriate before giving more detailed discussion to state the hypotheses concerning personal characteristics.
Hypothesis I

Data processing managers and top corporate managers differ significantly in such personal characteristics as:

1. Level of education
2. Career patterns
3. Age
4. Support for membership of professional associations

Level of Education

The replies from the EDP managers included in this study show that 53.4% received either some college training, or completed high school, but did not complete the requirements for a bachelor degree. Among the top managers, it is more common to hold bachelor degrees, plus experience of graduate study. The difference between the two groups can be appreciated by the following condensation of the data.

**TABLE II.--EDUCATIONAL ATTAINMENT**

<table>
<thead>
<tr>
<th></th>
<th>TM</th>
<th>EDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managers with Graduate Degree of Graduate Course Work</td>
<td>46</td>
<td>14</td>
</tr>
<tr>
<td>Bachelor Degree</td>
<td>40</td>
<td>27</td>
</tr>
<tr>
<td>High School or Some College Education</td>
<td>2</td>
<td>47</td>
</tr>
</tbody>
</table>
The following points can be advanced to explain the disparity between the groups:

1. Many data processing managers "grew up" with their computer systems and entered the firm after some college experience, but not always with a degree.

2. Most of the top managers in this sample either held accounting or financial degrees, or had studied engineering, economics, science or liberal arts prior to going into industry.

3. Many of the top managers had attended advanced management programs and seminars conducted by universities or business consultants.

Education was measured on a 1 to 5 ordinal scale, where 1=high school diploma, 2=some college, 3=bachelor degree, 4=some graduate study, 5=graduate degree. Mean response ($\bar{x}$) for the whole group of top managers was 3.76 ($N=133$); for the data processing managers $\bar{x}$=2.82 ($N=101$). This result indicates that top managers have had more formal education than EDP managers.

Similarity or difference between the two groups on the question of levels of education was further tested by chi square analysis. For the chi square calculation, 88 paired observations were utilized.
Using a 4x5 contingency table with 12 degrees of freedom the computed chi square value was 22.6, which was found to be significant at the .05 level. Thus the null hypothesis, that there is no difference between the two groups on the question of educational attainment, was rejected. The mean response ($\bar{x}$) for EDP was 2.61, with a standard deviation ($\sigma$) of 0.96. Top manager mean response ($\bar{x}$) = 3.75, $\sigma$ = .86. Standard deviation describes the magnitude of variation in the individual responses. A low standard deviation enables more confidence to be placed in the use of $\bar{x}$ since small variation shows that the mean response is typical for the group. In this instance, there is a very significant difference between the mean responses of the groups.

Career Patterns

The following data have been grouped under the umbrella termed "career patterns":

(a) occupational mobility
(b) work experience
(c) nature of education

There was no attempt to gather information concerning salaries since this is obtainable elsewhere.
Data processing journals publish annual salary figures for EDP personnel. A recent Wall Street Journal study published the salaries of top managers responsible for procurement of data processing equipment.\(^2\) Two brief points can be made concerning salaries of senior data processing staff:

(a) Figures given in the journals suggest that salaries are roughly comparable with those obtainable by persons with the same work experience in other management groups, such as accountants, or production engineers. Taking into consideration their lack of formal qualifications, however, senior data processing personnel are well rewarded.

(b) There is a very wide range of salaries, and amount of income does not seem to be positively correlated with managerial responsibilities, such as size of EDP department, or size of company.

Information on career patterns is helpful in throwing light on the characteristics which an individual brings into a situation. Previous experience and nature of education for example are variables which will influence a person's future behavior.

On the question of job mobility, the data processing managers were not found to be a very mobile group. Respondents were asked to state the number of employers for whom they had worked in the data processing field. Half of the group had only one employer and a further 27% had changed jobs once. The lack of mobility is evident for both younger and older managers. Taking age 40 as a turning point, a sample of seventy EDP managers was analyzed by relating age to number of moves.

TABLE 12.--THE ASSOCIATION BETWEEN AGE OF DATA PROCESSING MANAGERS AND NUMBER OF COMPANIES FOR WHICH THEY WORKED IN EDP

<table>
<thead>
<tr>
<th>Age Of Data Processing Managers</th>
<th>Number of Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Under 40</td>
<td>19</td>
</tr>
<tr>
<td>Over or Equal 40</td>
<td>16</td>
</tr>
</tbody>
</table>

Using chi square analysis with 4 d.f., $\chi^2 = 1.24$. In order for the computed value to be significant at the 0.10 level the figure would have to be much greater, $\chi^2 = 7.78$. It is therefore appropriate
to accept the null hypothesis that there is no
association between age and mobility of data pro-
cessing managers. Tests for relationship between
occupational mobility and level of education of EDP
managers also showed no association between these
variables.

TABLE 13—MOBILITY OF DATA PROCESSING MANAGERS
RELATED TO LEVEL OF EDUCATION

<table>
<thead>
<tr>
<th>Education Of Data Processing Managers</th>
<th>Number of Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Non-Graduate</td>
<td>22</td>
</tr>
<tr>
<td>Graduate</td>
<td>13</td>
</tr>
</tbody>
</table>

Computed chi square value $\chi^2 = 1.46$, far below the
7.78 necessary to be significant at 0.10 level.
This indicates that the variables are independent.
While the graduates have more mobility, the
difference is not statistically significant.

The data on lack of mobility and relatively
low level of education of EDP managers can partly
be explained by the way in which many entered the field. They were pioneers in a rapidly expanding new technology; there were no skilled computer specialists and the older men were the first of their kind. Personal data show a series of steps from machine-tending (punched cards, accounting, hardware operation) to systems planning and development, with intermediate steps of programmer and analyst. It is reasonable to suppose that for many of the older men a career in data processing occurred without conscious choice, since in the early or middle fifties one would be unable to plan such a career. In recent years, however, younger EDP staff have selected programming careers as a result of familiarity with computer concepts. Data on career patterns shows an association of accounting with developments in the EDP field, especially for top managers. Many of the older EDP managers operated accounting machinery or worked in a clerical occupation. Among the top managers responsible for EDP systems there is a preponderance of financial specialists. Accounting systems were some of the first applications; they are cited by top managers as currently yielding important benefits. The
narrow background of EDP specialists who advanced via the clerical-punched cards route could be expected to form an obstacle to development of management information systems. The requirement now is for a supply of accurate, timely and relevant information to assist overall operation of a company, as well as the clerical cost-savings.

**Age**

There is no great disparity in age between top managers and computer specialists. \( \overline{X}_{EDP} = 38.4 \text{ years}, \overline{X}_{TM} = 46.1 \text{ years} \) The fact that the top managers are somewhat younger than is usual for senior executives, brings the two groups into the position of being contemporaries instead of being a generation apart. The managers were grouped by company into 88 pairs (1 EDP, 1 TM) and BMD0BD tests were run. The resulting chi square calculation indicated that there is no significant difference between the two groups concerning age distribution \((\overline{X}^2 = 6.7, 16 \text{ d.f.}, \chi^2_{.05} = 26.3)\)

In a new and fast-growing industry, it is reasonable to postulate that age would be an important variable. Individuals are said to absorb
new ideas more easily when younger and can more easily adapt to new circumstances. The inclusion of age as a variable using comparison between groups, or correlating age with other characteristics of the same group, yielded no significant results. For example, testing age of top managers against extent of interaction with EDP managers (Questions a,b TM Questionnaire), using a 5x5 matrix, provided no pattern that was meaningful.

It was anticipated that the level of education of managers could be significantly related to age. However, in neither group was this found to be the case. Analysis of the table data for EDP managers showed no inverse relationship between age and education. The data for top managers showed the older managers to be as well educated as the younger men.

Both groups are youthful by traditional management standards and this partly explains the fact that age is not a significant variable either within or between groups. But what other explanations can be offered? First, older men who have achieved top management positions or grown with computer systems have displayed qualities of
flexibility and adaptability which may not be typical of their age group. Secondly, the measurement of "age" in this context may not be useful. The commonly accepted use of biological or chronological age does not measure intellectual growth and development. Age as measured by mental agility would show some fifty year olds to be quicker and more nimble than many men twenty years old, when "age" is measured chronologically.

**Interest in Professional Associations**

Members of both groups were asked to evaluate the following statement: "Senior EDP staff should be members of at least one professional association and attend conferences and meetings of such associations." Both groups strongly supported participation in professional associations. Using a five point scale, where 1= strong disagreement with the statement and 5= strong agreement, the mean response ($\bar{x}$) for EDP = 4.32, $\bar{x}$(TM)=4.40. A high score from the EDP managers was expected for reasons discussed in Chapter IV. The high mean response for top managers can be explained by the following:

(a) Companies wish to see their EDP staff well qualified and association with members of the
same profession assists this objective. Increasing complexity of systems and the high rate of obsolescence in EDP are factors which would cause companies to encourage their systems men to attend conferences and meetings.

(b) A more clearly established data processing profession would aid business in a variety of ways. Standards would be more uniform and functions performed by members of EDP staffs would be more sharply defined.

Strong agreement between the groups was evident from the chi square analysis \( \chi^2 = 3.26, \chi_{.05}^2 = 21.0 \). The mean response for EDP \( x_{EDP} = 4.32 \), standard deviation .865. Top manager's mean response \( \bar{x}_{TM} = 4.40 \), with a standard deviation \( \sigma = .853 \). These calculations indicate that high responses were typical for both groups, i.e., there was no large variation in the replies.

A strong interest in EDP professional activities was declared by data processing managers but little interest by top managers with EDP responsibilities.

In Table 8 (p. 97) the data obtained from 101 EDP managers is contrasted with a sample of 634 top
managers surveyed by the Wall Street Journal. The data concerning professional associations do not support the hypothesis that EDP managers and top managers differ significantly regarding support for membership of professional organizations. Both groups approve of EDP participation in such bodies as Data Processing Management Association and Association Computer Machinery, but top managers show little personal interest in membership.

Hypotheses Concerned with Interaction

Two hypotheses were advanced relating top management detachment from EDP problems with the amount of their interaction. The line of approach was to investigate whether certain stated reasons for non-involvement were associated with a small amount of interaction. Two specific hypotheses were formulated:

Hypothesis 2

Insufficient knowledge of data processing by top managers decreases their interaction with computer specialists.
Hypothesis 3

Reliance on middle management is a major factor causing top managers to be detached from computer problems.

To test the hypothesis, each group was asked to give frequency and duration of meetings with the opposite group (EDP Questionnaire, 12, 13 and TM Questionnaire a, b). The answers of 88 pairs, matched by company, using a 3x3 contingency table, showed agreement between the groups on the questions of how frequently they met ($\chi^2 = 6.45, 4$ d.f., $\chi^2_{.05} = 9.49$). Mean response for each group was similar; $\bar{x}_{TM} = 3.68; \bar{x}_{EDP} = 3.28$. There was also agreement with respect to duration of meetings ($\chi^2 = 2.17, 4$ d.f., $\chi^2_{.05} = 9.49$). There was a wide range of answers on the question of duration of meetings ($\sigma_{EDP} = 1.96, \bar{x} = 2.75; \sigma_{TM} = 1.86, \bar{x} = 2.45$). This is also true for the times spent at meetings. Top managers vary greatly in the amount of time devoted to consultation with the EDP manager. However, one salient point emerges; 57% of top managers spend less than 2 hours per week in consultation with the EDP manager. Assuming an executive working week of 60 hours, the majority of
executives devote approximately 3% of work-time to discussion with the senior data processing specialist in the company. Replies of data processing managers substantiated this finding. In view of the importance of EDP, this appears to be disproportionately small amount of time to allocate to an activity which accounts for ten percent of new investment spending by business.

In addition to the above questions, concerning frequency and duration of meetings between top corporate executives and EDP managers, the following question was submitted on the subject of possible reasons for top management detachment from EDP problems. A list of factors was given (Section i(e) TM Questionnaire) suggesting these as possible reasons for top management detachment from problems experienced by the computer staff. Space was provided for the respondents to list reasons other than the ones proposed if desired. This question was intended to test the relative weight which top managers would place upon causes for remoteness from data processing problems, and also to compare their responses with the EDP managers' responses to the same question. A high top management acceptance
of the suggestion that "pressure of more important duties" caused detachment from EDP problems was anticipated on the grounds that it would be natural for TM's to defend their lack of involvement in important data processing matters. This could be expected regardless of whether or not the pressure of other duties was a genuine reason for detachment. A majority (70%) of top managers included this explanation, whereas a minority (32%) of EDP managers did so. See Table 14 for responses.

<table>
<thead>
<tr>
<th>FACTORS LISTED</th>
<th>TM N = 133</th>
<th>EDP Managers N = 101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure of more important duties</td>
<td>70%</td>
<td>32%</td>
</tr>
<tr>
<td>Lack of knowledge of EDP</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Faith in Middle Management</td>
<td>36%</td>
<td>33%</td>
</tr>
<tr>
<td>Reticence when dealing with new technology</td>
<td>30%</td>
<td>13%</td>
</tr>
<tr>
<td>Low priority accorded EDP systems</td>
<td>1%</td>
<td>7%</td>
</tr>
</tbody>
</table>
From the above table it can be seen that both groups stressed two causes for top management lack of involvement:

1. Lack of data processing knowledge
2. Reliance on line managers

Replies of respondents who considered these factors to be significant reasons for detachment were compared to those who considered that they were not with respect to frequency and duration of meetings. It was hypothesized that there may be a relationship between low scores on questions concerning length and duration of meetings and choice of factors which explain detachment.

Hypothesis 2 states, "Lack of knowledge of EDP usage reduces the amount of contact between EDP managers and top managers." Being poorly informed on EDP matters would cause brief consultation with EDP specialists. To test this proposition, top management's and EDP managers' responses to the "unfamiliarity with EDP usage" factor were analyzed. The top managers who listed this as a factor were placed in one group and the remainder in a second group. EDP managers were grouped in a similar manner. Forty per cent of top management and EDP managers listed this as a factor. A priori,
it was felt that those top managers (or EDP managers) who listed this as a factor would tend to meet less frequently and for shorter periods of time than those who did not list this as a factor. Each group was analyzed with respect to the number and duration of meetings (Table 15). As the table illustrates, there is no clear cut evidence for concluding that "unfamiliarity with EDP usage" is a factor which affects the number and duration of meetings.

A similar procedure was followed for Hypothesis 3 ("Reliance on middle management is a major factor causing top management to be detached from computer problems"). The replies of the YES and NO respondents to the following question were analyzed separately:

Q. "Do you feel top management's faith in middle management is a factor which suggests top management detachment from important computer problems?"

A large number from each group answered affirmatively; 35% of top managers and 30% of EDP managers. Table 16 provides an analysis of the responses of the affirmative and negative respondents of each
TABLE 15.--FREQUENCY AND DURATION OF MEETINGS 
BETWEEN TOP MANAGEMENT AND EDP MANAGERS 
RELATED TO TOP MANAGEMENTS 
KNOWLEDGE OF EDP USAGE

Do you feel top management unfamiliarity with EDP usage is a factor which suggests detachment from important computer problems?*

<table>
<thead>
<tr>
<th>QUESTIONS ON FREQUENCY AND DURATION OF MEETINGS</th>
<th>Top Managers</th>
<th>EDP Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>How frequently do you meet with EDP management (or with top management)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than once per quarter</td>
<td>6.0</td>
<td>15.8</td>
</tr>
<tr>
<td>several times per quarter</td>
<td>14.0</td>
<td>11.0</td>
</tr>
<tr>
<td>several times per month</td>
<td>20.0</td>
<td>29.3</td>
</tr>
<tr>
<td>several times per week</td>
<td>36.0</td>
<td>40.2</td>
</tr>
<tr>
<td>daily</td>
<td>24.0</td>
<td>3.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

How much time do you normally spend with EDP management (or with top management) per week?

<table>
<thead>
<tr>
<th></th>
<th>Top Managers</th>
<th>EDP Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>less than 1 hour</td>
<td>26.0</td>
<td>29.6</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>30.0</td>
<td>27.2</td>
</tr>
<tr>
<td>2-3 hours</td>
<td>12.0</td>
<td>18.5</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>6.0</td>
<td>9.9</td>
</tr>
<tr>
<td>4-5 hours</td>
<td>26.0</td>
<td>14.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*From 133 responses from top management, 50 answered YES. From 101 responses from EDP management, 40 answered YES.
TABLE 16.--FREQUENCY AND DURATION OF MEETINGS  
BETWEEN TOP MANAGEMENT AND EDP MANAGERS  
RELATED TO TOP MANAGEMENTS FAITH IN  
MIDDLE MANAGEMENT TO SOLVE  
COMPUTER STAFF PROBLEMS

Do you feel top management's faith in middle management is a factor which suggests detachment from important computer staff problems?*

<table>
<thead>
<tr>
<th>QUESTIONS ON FREQUENCY AND DURATION OF MEETINGS</th>
<th>Top Managers</th>
<th>EDP Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>How frequently do you meet with EDP management (or with top management)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than once per quarter</td>
<td>17.3</td>
<td>11.8</td>
</tr>
<tr>
<td>several times per quarter</td>
<td>8.7</td>
<td>11.8</td>
</tr>
<tr>
<td>several times per month</td>
<td>28.3</td>
<td>23.5</td>
</tr>
<tr>
<td>several times per week</td>
<td>36.9</td>
<td>40.0</td>
</tr>
<tr>
<td>daily</td>
<td>8.7</td>
<td>12.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>99.9**</td>
<td>100.0</td>
</tr>
</tbody>
</table>

How much time do you normally spend with EDP management (or with top management) per week?

<table>
<thead>
<tr>
<th></th>
<th>Top Managers</th>
<th>EDP Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>less than one hour</td>
<td>28.3</td>
<td>29.8</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>28.3</td>
<td>27.4</td>
</tr>
<tr>
<td>2-3 hours</td>
<td>17.3</td>
<td>13.1</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>8.7</td>
<td>9.5</td>
</tr>
<tr>
<td>4-5 hours</td>
<td>17.3</td>
<td>20.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>99.9**</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*From 133 responses from top management, 46 answered YES. From 101 responses from EDP management, 30 answered YES.

**Does not add to 100.0 due to rounding.
group to the questions concerned with frequency and duration of meetings. The figures indicate that "a faith in middle management" is not a factor which has any bearing on frequency and duration of meetings. Brief meetings between the senior executives and the senior computer specialists are recorded by each group.

The Significance of Interaction

Hypothesis 4

The greater the interaction between top management and computer specialists the higher the perceived success of a computer system. Responses were analysed for the purpose of determining whether there is an association between extent of interaction of managers and profitable operation of a computer system.

The interactions tested were the duration, frequency, and initiation of meetings between top managers and data processing managers. (Questions 1, 2, 3 TM Questionnaire) The criteria for profitable operation were the estimates made by top managers on the question of benefits derived from computer use. Two questions, one concerning financial
benefits and one concerning non-financial benefits were put to the senior managers. (TM Questionnaire, 26,27). Data from the replies were used to group the companies into three divisions: those who estimated the operation of computer systems to be profitable; those who judged that there was little change; and the remainder who estimated that deficits had been incurred. The replies of these three groups on questions concerning initiation, frequency and duration of meetings were then evaluated. The question on initiation was intended to discover the level at which meetings were initiated. Which was most responsible for the consultations that take place? Whether the flow of initiative is predominantly upward or downward is an indicator of the degree of participation by the data processing managers in the management process. The results on this question were inconclusive; most respondents, from both groups, opted for the middle ground of mutual participation in initiation of meetings.
TABLE 17.--MEAN RESPONSE OF TOP MANAGERS CONCERNING FREQUENCY AND DURATION OF MEETINGS: GROUPED ACCORDING TO COMPANY BENEFIT FROM COMPUTERS

<table>
<thead>
<tr>
<th>Company's Experience With Computers (N=133)</th>
<th>Frequency of Meetings ($X_{TM}$)</th>
<th>Duration of Meetings Per Week ($X_{TM}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1=once per quarter</td>
<td>1=less than 1 hour</td>
</tr>
<tr>
<td></td>
<td>2=several times per quarter</td>
<td>2=1-2 hours</td>
</tr>
<tr>
<td></td>
<td>3=several times per month</td>
<td>3=2-3 hours</td>
</tr>
<tr>
<td></td>
<td>4=several times per week</td>
<td>4=3-4 hours</td>
</tr>
<tr>
<td></td>
<td>5=daily</td>
<td>5=4-5 hours</td>
</tr>
<tr>
<td>Profitable (80)</td>
<td>3.36</td>
<td>2.77</td>
</tr>
<tr>
<td>Little Change (33)</td>
<td>3.22</td>
<td>2.69</td>
</tr>
<tr>
<td>Deficit (20)</td>
<td>2.85</td>
<td>2.15</td>
</tr>
</tbody>
</table>

As the above table shows, for the majority of companies the operation of computers resulted in a significant pay off (TM Questionnaire,26). The group that felt there was little change in the status quo numbered thirty three, a further twenty estimated deficits. The mean scores of the profitable group to the questions on frequency and duration of meetings are significantly higher than those in the deficit group. Using a 1 to 5 ordinal scale.
scale a difference of at least .5 between scores is considered to be significant. This is valid in view of the fact that respondents tend to avoid the extremes and concentrate their answers on the 2,3,4 choices. The data appear to support the proposition that higher interaction is accompanied by greater profitability. The thorny point then occurs: is the better performance caused by the higher interaction, or could it be a spurious association? It is not possible to show conclusively that profitability is dependent on extent of interaction. However, attempts were made to relate other variables to financial results gained with computers. These were (1) personal characteristics of managers (age, education, career background, job mobility), (2) lack of knowledge of EDP usage, and (3) reliance on middle management. These tests showed no association. Using the Simon criteria (pp. 72-76) concerning correlation between variables, the relationship does appear to be sufficiently close to be useful. A number of third factor variables were tried to test whether the relationship was spurious. The relationship does not seem to be initiated by "side conditions" (i.e., limitations which so
seriously qualify a statement as to weaken its
generality). Further studies under different
conditions are necessary to generally validate
these findings. The data in this instance, how-
ever, support the statement that greater inter-
action between top management and computer
specialists is associated with perceived success
of computer operations.

Support by Top Management

Hypothesis 5

Computer specialists and top managers have
different perceptions of the level of support
given to the corporate computer system.

Hypothesis 6

From the viewpoint of the data processing
manager top management does not strongly depend
on the EDP manager for suggestions and advice
concerning important data processing problems.

These hypotheses can be conveniently grouped
together because they concern the same issue.
The former hypothesis refers to the support which
top management gives to the data processing staff.
The latter proposition aims to test the corollary
to that statement, namely, the extent to which top managers are dependent on the skills and expertise of the EDP manager.

The attitudes of each management group on the question of support for the corporate computer system was the subject of several related questions (TM Questionnaire, c, f, g). A key question invited opinion on whether top management support for EDP in the respondent's company should be increased from the existing level. Replies were analyzed using 86 paired responses, matched on the basis of belonging to the same company. A 3x3 contingency table grouped the information as follows: support should be greatly or moderately increased = 5; somewhat increased = 3; not increased = 1. The computed chi square value gives grounds for rejecting the null hypothesis that there is no significant difference between the groups on this issue ($\chi^2 = 15.75$, 4 d.f., $\chi^2_{.05} = 9.49$) The EDP group considered that a moderate increase in top management support is necessary, whereas the top managers were less positive ($\bar{x}_{EDP} = 4.03$, $\bar{x}_{TM} = 3.79$). There was, however, a wide variation in the responses of both groups ($\sigma_{EDP} = 1.52$, $\sigma_{TM} = 1.80$). From the computed chi square $\chi^2 = 15.75$ it was possible to derive the
contingency coefficient \((C = .37)\) which indicates a significant relation between the variables.

The issue of support or dependence was also substantiated by asking both groups the extent of reliance on the suggestions and advice of the data processing manager. An interesting difference of perception was revealed by the responses to this question (TM Questionnaire, f). The data tend to support the above results concerning top management support for EDP operations. Top managers gave a very high mean score \((\bar{x}_{TM} = 4.87\) on a 5 point scale) whereas the EDP managers did not feel such strong dependence. \((\bar{x}_{EDP} = 3.72)\) The EDP response indicated a "somewhat or moderate" reliance on their suggestions but no great dependency. In this instance, there could be a problem of communication between the two groups. The objective state of affairs is not all that matters. If the EDP group feels that their suggestions and advice are not very much needed, it will affect their attitudes accordingly.

The evidence gathered on the question of top management support tends to support Hypothesis 5. There is a significant difference in the perceptions of top managers and computer systems men concerning the level of support which top management provides.
The findings also support Hypothesis 6. The results here hinge on the words, "From the viewpoint of the data processing manager . . .". There is no evidence that top management does not rely strongly on data processing management. Their subjective judgment is that they rely to "a considerable degree" on the staff of EDP for suggestions and advice. What gives grounds for supporting Hypothesis 6 is the relatively low mean response by the EDP managers. Chi square analysis was not used to test Hypothesis 6 because of the large number of blank entries in the contingency tables. Six of the cells in a "collapsed" 2x3 contingency table are <2. The discussion in Appendix D quotes statistical authority for the necessity of a minimum cell entry of 5, though this is not achieved in all cases.

Involvement of Functional Managers

Installing and maintaining computer systems is a cross-functional activity requiring the cooperation of management at all levels. Attitudes and abilities of functional managers are crucial to the successful implementation and operation of computer systems. What the attitudes will be is strongly influenced by the behavior of top management. The following hypothesis concerning participation by
line management was formulated:

**Hypothesis 7**

The greater the profitability of a computer system the greater the degree of involvement of functional managers in the operation of the system.

The instrument used for testing this hypothesis was a group of statements which were put to the top management group. The statements are of a challenging nature, designed to elicit positive or negative response to the role of functional managers in data processing operations. Two main themes run through these statements; they are:

1. Is EDP such a complex and technical task that it should be left mainly to computer specialists? In effect, functional management was asked to abdicate its role as a major partner in data processing activities (Statements Nos. 23, 24, 25, 26, 27, 28, Table 18).

2. What positive initiative should line managers take to become more influential in the relationships with EDP? The issues raised test the respondents reaction to the proposition that in order for EDP systems to be effective they must be fully controlled by functional managers, i.e., regarded as "their system" (Statements Nos. 29, 30, 31).
Top managers replies were divided into three groups according to their estimates of benefits derived from computer use. The mean response for each group to each separate statement was then calculated. The results are tabulated in Table 18.

The responses show a definite pattern. The less successful companies have relatively high scores on questions related to the first theme (Statements 24-28), which test willingness to leave computer problems mainly in the hands of the specialists.

On statements 29, 30, 31, the mean response of the deficit group is consistently lower. The top managers of companies which have derived more benefits from computer use favor more participation by functional managers in implementation, development, and accountability for computer systems.

These statements are more appropriately evaluated as a group, rather than singly. Study of the group shows a consistency of pattern indicating that deficit companies are more ready to abdicate their role in EDP, and are less prepared to take full responsibility for computer systems. Using a yardstick of 0.5 point difference as being significant on a 5 point scale few of the statements meet this
<table>
<thead>
<tr>
<th>Statement No.</th>
<th>Statement</th>
<th>Mean Response of Deficit Companies ($X_{TM1}$)</th>
<th>Mean Response of No-Change Companies ($X_{TM2}$)</th>
<th>Mean Response of Benefit Companies ($X_{TM3}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>EDP personnel should have more responsibility for conversion to EDP because of their greater technical knowledge</td>
<td>3.15</td>
<td>2.94</td>
<td>3.11</td>
</tr>
<tr>
<td>24</td>
<td>It is to be expected that committees (or task forces) set up to study conversion to EDP are led by computer specialists because they have a greater understanding of such problems</td>
<td>3.10</td>
<td>2.73</td>
<td>2.92</td>
</tr>
<tr>
<td>25</td>
<td>In the business organization of the future EDP will be the central and most important division within the company</td>
<td>2.50</td>
<td>1.94</td>
<td>2.48</td>
</tr>
<tr>
<td>26</td>
<td>Identification of new areas of application for computers is predominantly the concern of the computer specialist</td>
<td>2.60</td>
<td>2.48</td>
<td>2.41</td>
</tr>
<tr>
<td>27</td>
<td>Planning and implementing new computer applications should be left largely to the EDP staff</td>
<td>2.55</td>
<td>2.24</td>
<td>2.28</td>
</tr>
<tr>
<td>28</td>
<td>Whether a conversion is operationally feasible should be mainly determined by EDP staff</td>
<td>3.15</td>
<td>2.79</td>
<td>2.86</td>
</tr>
<tr>
<td>29</td>
<td>In order for a firm to successfully implement an effective range of computer projects, managers of the relevant departments should initiate the changes</td>
<td>3.60</td>
<td>3.55</td>
<td>3.81</td>
</tr>
<tr>
<td>30</td>
<td>Computer applications tend to be more successful if they are initiated by operating managers (functional line managers) in consultation with the EDP staff</td>
<td>4.15</td>
<td>4.24</td>
<td>4.42</td>
</tr>
<tr>
<td>31</td>
<td>Operating and line managers should be responsible to top management for the financial performance of computer systems which serve their divisions or departments</td>
<td>2.90</td>
<td>3.18</td>
<td>3.68</td>
</tr>
</tbody>
</table>
criterion. There is more commonly a 0.3 difference between the less successful companies (\( \bar{x}_{TM1} \)) and the more successful companies (\( \bar{x}_{TM3} \)). However, it is submitted that a consistent cumulative difference of 0.3 on six of the nine statements included in the questionnaire is evidence of a significant difference between the groups. Statement 31 is a key variable which reveals a strong difference between the respondent groups. Successful users show far greater willingness for line managers to take financial responsibility for the operation of computer systems which serve their divisions or departments.

The data accumulated on this subject support the hypothesis that greater profitability is associated with greater involvement by functional managers in the operation of computer systems.

**Attitudes to Involvement of Functional Managers**

The statements given in Table 18 (also in Questionnaires, Section 11, Nos. 23-31) were also administered to data processing managers. The following hypothesis was tested:

**Hypothesis 8**

Top managers and computer specialists differ significantly concerning the role of functional
managers in the installation and operation of computer systems.

The statements were submitted to 260 top managers and 130 computer specialists, in 130 businesses. There were 133 top manager respondents and 101 EDP managers. From these replies, 88 pairs of managers (1 EDP, 1 TM) were matched according to the company for which they worked. The data were analyzed using chi square, arithmetic mean and standard deviation. The results are presented in Table 19. Consider first the mean responses ($\bar{x}_{EDP}$, $\bar{x}_{TM}$). The same pattern is present as was evident in Table 18; one group consistently higher on statements 23 through 28, and lower on statements 29, 30, 31. The difference, however, is of a much greater magnitude, a one point difference for statements 24-28. The large standard deviations ($\sigma_{TM}$, $\sigma_{EDP}$) weaken the reliance which can be placed on these results because they show that there is a large magnitude of variation in the replies. Thus the arithmetic means cannot be considered to be typical for the group. (See Appendix D for explanation of this point).

The striking difference in mean responses between the groups reflects the computer
<table>
<thead>
<tr>
<th>Statement</th>
<th>Section II</th>
<th>$\chi^2$</th>
<th>d.f.</th>
<th>$\chi_{05}$</th>
<th>$\bar{x}_{EDP}$</th>
<th>$\bar{x}_{TM}$</th>
<th>$S_{EDP}$</th>
<th>$S_{TM}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>EDP personnel should have more responsibility for conversion to EDP because of their greater technical knowledge</td>
<td>2.45</td>
<td>4</td>
<td>9.49</td>
<td>3.64</td>
<td>2.72</td>
<td>1.73</td>
<td>1.89</td>
</tr>
<tr>
<td>24</td>
<td>It is to be expected that committees (or task forces) set up to study conversion to EDP are led by computer specialists because they have a greater understanding of such problems</td>
<td>1.78</td>
<td>4</td>
<td>9.49</td>
<td>3.60</td>
<td>2.09</td>
<td>1.84</td>
<td>1.71</td>
</tr>
<tr>
<td>25</td>
<td>In the business organization of the future EDP will be the central and most important division within the company</td>
<td>2.45</td>
<td>4</td>
<td>9.49</td>
<td>3.63</td>
<td>2.72</td>
<td>1.73</td>
<td>1.89</td>
</tr>
<tr>
<td>26</td>
<td>Identification of new areas of application for computers is predominantly the concern of the computer specialist.</td>
<td>8.65</td>
<td>4</td>
<td>7.78</td>
<td>2.90</td>
<td>1.97</td>
<td>1.91</td>
<td>1.74</td>
</tr>
<tr>
<td>27</td>
<td>Planning and implementing new computer applications should be left largely to the EDP staff.</td>
<td>8.17</td>
<td>4</td>
<td>7.78</td>
<td>2.97</td>
<td>2.11</td>
<td>2.06</td>
<td>1.81</td>
</tr>
<tr>
<td>28</td>
<td>Whether a conversion is operationally feasible should be mainly determined by EDP staff.</td>
<td>1.54</td>
<td>4</td>
<td>9.49</td>
<td>3.80</td>
<td>2.88</td>
<td>1.78</td>
<td>2.06</td>
</tr>
<tr>
<td>29</td>
<td>In order for a firm to successfully implement an effective range of computer projects, managers of the relevant departments should initiate the changes</td>
<td>0.92</td>
<td>4</td>
<td>9.49</td>
<td>3.61</td>
<td>3.91</td>
<td>1.87</td>
<td>1.71</td>
</tr>
<tr>
<td>30</td>
<td>Computer applications tend to be more successful if they are initiated by operating managers (functional line managers) in consultation with EDP staff</td>
<td>29.96</td>
<td>4</td>
<td>9.49</td>
<td>4.75</td>
<td>4.88</td>
<td>0.90</td>
<td>0.82</td>
</tr>
<tr>
<td>31</td>
<td>Operating and line managers should be responsible to top management for the financial performance of computer systems which serve their divisions or departments</td>
<td>9.34</td>
<td>4</td>
<td>9.49</td>
<td>3.75</td>
<td>3.88</td>
<td>1.80</td>
<td>1.89</td>
</tr>
</tbody>
</table>
specialists tendency to claim a dominant role in various aspects of computer operations, and the reluctance of top management to concede that role.

There is no marked difference between the two groups on the desirability of the exercise of initiative by operating managers. Both EDP and top managers favor new systems suggestions and financial responsibility by line managers. There is almost unanimous agreement on statement 30 which states, "Computer applications tend to be more successful if they are initiated by operating managers in consultation with EDP staff." The standard deviation is low; a typical response was 5 points, the maximum possible. The chi square calculation in this instance is meaningless, due to the fact that seven of the cells in the 3x3 contingency table are < 2. Chi square calculations show significant differences between the groups on statements 26, 27, and on 31 at the .05 level.

Thus utilization of mean response as a measure of difference shows a significant difference between the groups. However, the chi square calculations indicate rejection of the null hypothesis in only
three of the nine statements, with those at a low level of significance. The conclusion must therefore be that though the separate groups in aggregate take different positions on the issues presented, within each firm (i.e., as paired observations) there is no consistent evidence of disagreement. Hypothesis 8 is supported by the responses from each sample of managers, but not by the responses from each firm.

Size of Companies as a Factor Influencing Profitable Use of Computers

Hypothesis 9

Large companies are more profitable users of computers than small companies.

Companies with large assets were the first to lease or purchase computer hardware. The big companies have had longer experience computerizing business processes than the small ones. Most studies of computer operations concern the activities of large companies. One might suppose that this greater experience would result in more effective use of computer systems and that this could be expressed in financial terms. Financial "measurements" in this study are the subjective estimates of top managers. It
is difficult to obtain hard data on this subject. Publications by leading business consultants refer to "more successful" and "less successful" computer users without clearly defining the basis on which that distinction is made. At the root of this problem lies the difficulty of allocating costs to information and control systems which are inter-functional. There is also reluctance to divulge information which is confidential. However, for the purposes of this study estimates by top managers provide a useful yardstick.

Top managers were asked whether there had been any measurable pay off as a result of using computer systems (TM Questionnaire, h). The responses were scaled from significant deficits (1) to very significant benefits (5). The responses were then tabulated in a 5x5 matrix showing size of firms and estimated financial results. The data are shown in Table 20.

It is now possible to contrast the results of the large/very large firms with those of small/medium small firms. The greatest benefits appear

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Note the McKinsey study "Unlocking the Computer's Profit Potential."
TABLE 20.--SIZE OF FIRM RELATED TO PAYOFF FROM USE OF COMPUTERS.

| Estimated Measurable Payoff As Result of Use of Computer | Size of Firm in Sales Revenue  (1968) | |
|--------------------------------------------------------|----------------------------------------|
|                                                        | Small $50M | Medium-Small $50-199M | Medium-Large $200-499M | Large $500-749M | Very Large $750M | Unknown |
| Significant Deficit                                    | 3          | 2                      | 0                     | 1             | 0              | 0        |
| Slight Deficit                                        | 0          | 2                      | 0                     | 0             | 1              | 0        |
| Little Change                                         | 6          | 12                     | 11                    | 0             | 5              | 4        |
| Significant                                           | 12         | 25                     | 17                    | 3             | 6              | 2        |
| Very Significant                                      | 3          | 9                      | 1                     | 0             | 0              | 3        |
| No Response                                           | 1          | 2                      | 0                     | 1             | 1              | 0        |
| TOTAL                                                 | 25         | 52                     | 29                    | 5             | 13             | 9        |

to accrue to the smaller firms. Thirteen percent (3/24) of the small companies and sixteen percent (8/49) of the medium-small companies state that very significant profits were achieved. This compares
with 3 per cent (1/29) of the medium-large firms, and none of the large or very large firms.

These findings are consistent with the fact that hardware and software have been developed which enable a smaller company to do most of the things that a large company can do. Computers designed for small firms provide management-oriented systems which have a diversity of applications. Benefits accruing to the small company as a result of computer use may be divided into three groups:

(a) Clerical-cost savings and quicker service.

  Accounting and administrative applications.

  Increased functional effectiveness as a result of computerizing routine paper work.

  Improved customer services as a result of quicker reaction to customer needs; speedier deliveries of products, maintaining inventory levels, supplying service parts, etc.

(b) Aids to supervision.

  Improved management planning, with more flexibility to allow for changes in response to changed circumstances or changed objectives.

  Improved performance resulting from continual evaluation of budgets against actual results.
Management accounting techniques were more generally practiced by large firms prior to the adoption of computers by small company. Low-cost high-speed digital computers removed this distinction. Better inventory control reduces costs of raw materials or semi-finished inputs.

(c) Information systems for managers.

The computer is a tool which improves the capability for management control. Simulation of internal or external conditions allows the consequences of alternative plans to be evaluated. Introduction of magnetic file systems in small computers made it possible to store millions of characters of business data. Such innovations, hitherto reserved for higher priced computers, extended the range of possible applications. Such applications as market research and management strategy analysis became technically, economically and operationally feasible for the smaller company.

At the outset it was hypothesized that large companies are more profitable users of computers than small companies. The information gathered in this study does not support this hypothesis.

"Small" companies (see Table 20 for meaning of this
term) and medium-small companies report profitable use more frequently than large ones. Recent developments in technology appear to have shifted the balance of advantage away from the big companies.

Computer Applications as a Function of Size of Company

Hypothesis 10

The larger the company the more sophisticated is the use of the computer system.

This hypothesis is implied in Hypothesis 9, namely, that the bigger company is able to use computer systems more profitably because of a greater number of applications. For the purpose of testing this statement, the data in Table 2 (p. 51) was used. The term "sophisticated" means the number of applications which fall in the category of "Management Information." The fact of moving away from strictly administrative and supervisory uses towards providing information for management is taken to be an indication of more sophisticated use. This could also be put in a time framework; administration and supervision is more short-run oriented, possibly day-to-day business requirements. M.I.S. is more future
oriented, planning and forecasting for long run situations. Distinction in size of firms follows the classification used in Table 5 (p. 91).

From the sample of 133 companies, 76 were classified as small or medium-small ($\leq 200 million sales revenue in 1968). The responses of these firms were then examined in order to determine the proportion of their applications which came in the M.I.S. category. The results are tabulated below.

TABLE 21.—COMPUTER APPLICATIONS OF SMALL FIRMS FOR MANAGEMENT INFORMATION PURPOSES

<table>
<thead>
<tr>
<th>Management Information Uses</th>
<th>Code No.</th>
<th>No. of Small and Medium-Small Firms Using This Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecasting (inc. sales)</td>
<td>816</td>
<td>8</td>
</tr>
<tr>
<td>Management Simulation</td>
<td>823</td>
<td>4</td>
</tr>
<tr>
<td>Management Statistics</td>
<td>824</td>
<td>6</td>
</tr>
<tr>
<td>Management Strategy</td>
<td>825</td>
<td>9</td>
</tr>
<tr>
<td>Market Research Studies</td>
<td>826</td>
<td>15</td>
</tr>
<tr>
<td>Operations Research Studies</td>
<td>827</td>
<td>7</td>
</tr>
<tr>
<td>Systems Analysis</td>
<td>858</td>
<td>-</td>
</tr>
<tr>
<td>Evaluation</td>
<td>864</td>
<td>5</td>
</tr>
<tr>
<td>Product Development</td>
<td>903</td>
<td>-</td>
</tr>
<tr>
<td>Factory Operation</td>
<td>074</td>
<td>6</td>
</tr>
<tr>
<td>Investment Analysis</td>
<td></td>
<td>TOTAL 60</td>
</tr>
</tbody>
</table>
The number of applications classified as Management Information for all companies was 110 (Table 2, p.51). If small firms utilize M.I.S. applications in proportion to their number then;

\[
\frac{\text{number of small firms}}{\text{total number of firms in sample}} = \frac{76}{130} \quad \frac{60}{110}
\]

\[
\frac{76}{130} \times \frac{110}{60} = 58.4 \div 54.5 \text{ (per cents)}
\]

Therefore, the use of more sophisticated computer applications by small companies is proportionate to their number in the sample. Or to express the results differently. The small firms have 60 M.I.S. applications. If they had M.I.S. applications in proportion to the fraction of the sample which they make up, the number would be 64 (\(\frac{76}{130} \times 110\)). Thus, 60 < 64; the small firms have slightly less than a proportionate share of more advanced applications.

This finding is consistent with the previous one concerning profitability. The small firm is not restricted in computer uses vis-a-vis the large firm. The statement made for Hypothesis 10 is not supported by the results obtained in this study.

It should be stated that to link "profitable use" of a computer system with "sophisticated use" is an oversimplification which could lead to error.
It is possible that increasing use of M.I.S. leads to what appears to be a less profitable position. This is due to the fact that benefits of M.I.S. are "intangible", i.e. difficult to measure in the sense that clerical cost-savings can be measured (wages vs. rental and costs of operating computers).

Top Management Comments

All of the written comments received from top managers are presented in Appendix E. Reference to these opinions and short extracts to illustrate positions are given in the conclusions of Chapter VII. The number of top managers who wrote comments was 30 (N = 133). Many of these stated, as mentioned above, that operating managers should be responsible for initiating programs. A second theme throughout the comments is that EDP is a service department and that as such it should try to provide the services which operating managers want.
CHAPTER VII

CONCLUSIONS

The purpose of this dissertation was to make a behavioral study of managers of business computer systems, with special reference to their relation with management. Chapter II commenced with a statement of objectives, and ten hypotheses were advanced relating to these objectives (pp. 36-40; pp. 77-79). Tests of the hypotheses are included in the previous chapter. The preceding chapter is important because it provides an explanation of important procedural points, and also includes the detailed analysis. An explanation of the statistical methods used for testing the hypotheses is provided in Appendix D.

The findings of this investigation suggest the following conclusions:

1. **Comparison of Personal Characteristics.**

   Certain demographic variables were selected on the assumption that they would have an important influence on the relationship between top managers
and data processing managers. These were: formal education; career patterns; age; and professional interests.

(a) **Formal education.** It was expected that the two groups would differ concerning the level of education attained and this proved to be the case. However, the difference was the reverse of what was anticipated. Prior reading of management texts and data processing journals suggested that senior data processing staff were likely to be better educated than corporate executives who are generalists. The findings revealed a reverse situation (pp. 176-178). A majority of senior corporate managers (52%) had a graduate degree, whereas this was true of only 16% of data processing managers. Chi square tests using 88 paired observations show a statistically significant difference between the groups regarding levels of education (at the .05 level of significance).

The stronger formal education of the top management groups may be explained by:

(1) the fact that they are mainly drawn from traditional business disciplines such as accounting or engineering.
(2) the availability of management seminars and graduate programs designed for middle and senior managers. Participation in such programs is usually encouraged and assisted by corporations.

(3) the quick growth of the data processing field, a new industry in which unqualified "pioneers" still play an important role.

(b) Career Patterns. Data were gathered concerning job mobility and work experience. The groups were found to be similar regarding career backgrounds. Lack of mobility was evident in each group. From the sample of 101 data processing managers 44% had stayed with the same employer, and 22% had changed jobs only once. For top managers, 38% had one employer, and a further 27% had moved once. It was expected that groups would differ on this characteristic, with the data processing group showing more mobility. Career data of many of the EDP managers showed a succession of steps in the same company, from punched card or clerical supervision, to the position of data processing manager. One can therefore conclude that high mobility will not characterize EDP managers until such times as the first entrants have retired from
the field. Even then, the popular stereotype of relatively young, job-hopping data processing specialists may be disproved by empirical investigation.

(c) **Age.** The findings stated in the previous chapter show that age is not a variable which may be correlated with job mobility in order to explain differences among the managers (note discussion pp. 180-181). This holds true both for comparisons of one group with the other and also within each group. On the question of job mobility, attempts to show significant differences in mobility for those data processing managers under 40 years of age, compared with those over 40, yielded no statistically significant differences. The conclusion is therefore that there is no association between age and the number of job changes made by data processing managers.

The similarity in age of the members of each group (see pp. 183-185) is likely to contribute towards the fact that they do not differ greatly on other characteristics, such as mobility, though further research would be needed to substantiate this conclusion.
(d) **Interest in Professional Associations.**

The response from both groups of managers indicated strong support for membership of professional organizations. A large proportion of data processing managers belong to professional organizations (65%). Almost all of the EDP respondents attend professional meetings or subscribe to journals concerned with developments in data processing (94%). Top management strongly supported this type of activity. However, top managers have little personal interest in membership of professional bodies (see discussion pp. 94-98). This does not however, preclude top management membership of other professional management organizations, outside of data processing. Testing with chi square for difference in the sample, with .05 as the significance level, revealed strong agreement among the managers regarding support for membership of professional organizations.

The strong interest in professionalism reported by the data processing managers has important implications for the future of the industry. It implies a more short term commitment to a particular organization. Professional specialists
perform according to personal standards and seek their rewards from the profession rather than the organization which employs them. They are more likely to travel and they are more likely to switch jobs than functional middle managers. The evidence on job mobility for this sample does not accord with such a probability. It should be remembered however, that the sample of EDP managers used for this study includes many early entrants to the field.

The interest in professionalism receives strong impetus from the fact that functions of the data processing specialist are not clearly defined. The fast growth of EDP systems in recent years has created uncertainty regarding the role which systems specialists should play vis-a-vis the functional managers. Role uncertainty and ambiguity appear to be reasons which strengthen interest in data processing as a profession.

2. **Extent of Top Management Involvement.**

The sample of top managers and data processing managers was studied in order to discover reasons for top management non-involvement or detachment from important EDP problems. Two important reasons, given by both groups of managers, were lack of knowledge
of EDP and faith in middle management (Table 14, p. 1). Tests were made to see whether there was an association between reasons for non-involvement and amount of interaction. It was thought probable that respondents from either group who answered YES to these questions would have a significantly lower amount of interaction than those who answered NO. For the top managers, it was felt that those who are knowledgeable are likely to interact with data processing staff to a greater extent than those who are not. The underlying assumption being that knowledge brings awareness, encourages confidence, and leads to involvement. The tests linking duration and frequency of meetings with YES and NO answers proved inconclusive.


Two hypotheses were tested concerning managers' perceptions of the level of support given to corporate computer system (Nos. 5,6, pp. 199). Chi square tests showed that the managers differed significantly on the question of the adequacy of existing top management support for EDP in their companies. Thus analysis of the data supports the hypothesis that specialists and top administrators differ on
the question of top management support for the data processing staff. Given the departmental viewpoint which computer specialists can be expected to have, this is not a surprising result. It does suggest however, that initiative from top management may be necessary to reduce the extent of this difference.

Hypothesis 6 concerns the degree of dependence by top managers on the data processing managers in their firms. The top managers recorded strong dependence on the computer specialists for advice and suggestions on important data processing matters. The response of the data processing managers did not acknowledge this dependency. The EDP group indicated a moderate reliance on their expertise, but not strong dependency. Measures of mean responses showed a significant divergency between the groups on this issue. Chi square testing was not feasible for this hypothesis (see p. 202 for explanation). Though the evidence relating to hypothesis 6 is not substantial, it nevertheless supports the hypothesis. What is being tested is not the dependency of the top manager on the EDP manager, but the EDP manager's belief in such dependency.

If further tests showed this hypothesis to have general validity, and given a genuine response
by top managers, it should be possible to bridge the "understanding gap" on this issue. Put simply, top managers profess great dependence on the advice of data processing specialists, but the specialists do not understand this to be the position. If top management does so depend on EDP management it can take steps to make the specialists more aware of this. This could be advocated as a method of improving the performance of the data processing managers, and thereby improving the productivity of the corporate computer division, i.e., encouraging better departmental performance.

4. Interaction of Decision-Makers. The data were analyzed to test the proposition that greater interaction between top management and computer specialists is associated with more successful operation of computer systems (hyp. 4, pp. 195). A division of the top managers into three categories of performance (profitable, little change, deficit) was made. The basis for thus was top managers' estimates of benefits derived from using computers. The results, tabulated in Table 17, show higher measures of interaction for the companies with more profitable systems. The magnitude of the difference however, is not such
that one could place great reliance on these results without further testing. With this reservation accepted, it is concluded that there is an association between the amount of interaction of top managers and computer specialists and the financial performance of computer systems.

4. The Role of Functional Managers.

In the literature concerning management of computer systems there is frequent reference to the need for more constructive participation by functional managers. The argument commonly put forward, is that data processing specialists must rely on functional managers for participation in devising systems if they are to operate successfully. The EDP specialist cannot be expected to have the knowledge of business operations possessed by functional executives. For various reasons however, many line managers withdraw from full participation in the development of EDP systems. This results in greater control of data processing systems by computer specialists than is desirable. To examine that issue two hypotheses were advanced (hyp. 7,8, pp. 203,206) and tested by a series of questions set out in Table 18 (p. 205). The responses of the top managers were
grouped according to the financial results obtained with their computer systems. On the basis of the results given in Chapter VI it may be concluded that top management in companies that are less financially successful with computers is more ready to leave major decisions concerning EDP to specialists. The companies reporting less financial benefits expected computer staff to play a stronger decision-maker's role. It was noted in the discussion in Chapter VI concerning Table 18, that the pattern of the responses is more significant than the magnitude of the scores. The less successful users consistently attribute a stronger role to the data processing specialists and a lower measure of responsibility for operating management. The conclusion must be that, judged by the criterion of financial results, companies with better results expect more active involvement by functional managers in the operation of computer systems.

For the purpose of testing hypothesis 8 both groups of managers were administered the same set of statements (Table 19, p. 208). The responses show greater differences than was the case for the top managers considered separately. It was anticipated that the data processing managers would express
strong convictions concerning the centrality of their role. It is clear from the results however, that the top managers as a group are not prepared to concede such a role to the data processing specialists. The presence of such a significant number of successful users of computers seems to be the explanation for the fact that this sample of managers shows no willingness to abdicate an active role in computer leadership in favor of the technical specialists.


Technology of third generation computers made it possible for the small firm not to be at a technical disadvantage vis-a-vis the large firm. Low-cost high-speed computers provided by computer manufacturers have enabled small companies to install a full range of computer applications. The small companies participating in this study gave evidence of a comparable range of applications to those of large companies. Their financial results were estimated as better (Table 20, p. 212).

This result should not be considered surprising in view of some important organizational advantages available to the smaller company:

(1) In a field where cooperation between many different functional groups, at several different
levels, is necessary, the small company has a more simplified operating situation. The senior executives have less organizational separation from the data processing staff.

(2) The larger and more complex a company is, the more costly will be the data processing systems. Multi-divisional large corporations require very complex systems in order to satisfy the variety of departmental needs.

(3) The small company has the opportunity to foster closer working relationships between functional managers and staff specialists. Given the importance of functional cooperation, better teamwork is a decided asset available to the small company.

(4) The example set by the chief executive in guiding EDP systems development is more obvious to the subordinate managers in a small firm. Line managers tend to take their cues from those given by senior management.

Hence, the small company which by such criteria as economies of large scale production is at a competitive disadvantage also has a number of significant organizational advantages.
7. **Level of Sophistication of Applications.**

This study is primarily concerned with the relationships between managers concerned with EDP. It has been shown that this is one factor which importantly influences the performance of computer systems. As a conclusion to the study it was decided to include size of companies as a factor which may influence performance of computers. This could be measured by estimated profitability of results according to size of firm as was discussed in the previous section. It can also be estimated by the level of sophistication of computer use. The simple proposition tested was that larger companies are more sophisticated users of computer systems (hyp. 10).

In order to test this hypothesis the list of advanced applications submitted by managers was divided according to the size of firms. This was done in order to determine the share of small firms in the more advanced applications, i.e., those classified under Management Information, Table 2. It was found that the use of sophisticated applications by small companies was proportionate to their number in the sample. Thus the results of this study do not support the hypothesis that the larger the company the more sophisticated is its use of computers.
Final Conclusions

The distinction between users of computer systems and the technicians who maintain them, a dichotomy popular with writers of journal articles, was not observed for the managers included in this study. It is commonly postulated that the background and environment of the computer specialist and the computer user are so different that it is difficult for the two groups to communicate. The computer specialist is a scientific, rational, logical being, well schooled in precise disciplines. The corporate manager moves in a world where scientific rigour is not essential, but sensitivity to human problems is important. Each is a product of his own environment.

As previously stated, the variables selected to discern a profile of the "typical" manager showed that the two groups were similar on several; age, job mobility, support for professional activities. Top managers were found to have considerable training in systematic thought as a result of formal education in accounting, economics, engineering and other disciplines. Computer personnel were poorly educated by comparison.
There was a significant difference between the groups on the subject of membership and participation in professional bodies. The top managers supported EDP staff participation but showed little personal interest in professional bodies. Thus, a dichotomy between a company-orientation (top managers) and a professional-orientation (EDP managers) was evident. The issue of professionalism seems to the author to be important in any study of management relationships in the computer world. Analysis of the various factors which stimulate professionalism, touched on only briefly in this paper, should be an important aspect of future studies on this subject.

The substantial number of pioneers in data processing management is an important reason for the failure of the popular stereotype of the EDP manager. Had the investigation included senior EDP staff below the manager level, such as systems analysts and systems planners, the results could have been different. This group may well exhibit the characteristics of college training, youthfulness, discontent (accompanied by job-hopping), impatience with the inertia of general management, over-use of jargon, and so forth. As the ranks of
the pioneers thin, EDP managers may become much closer to the common stereotype. However, analysis of the sample of EDP managers separating those over 40 years of age from those under 40 did not reveal significant differences between the two groups. Job mobility was equally low for both groups, educational attainment was similar, career patterns were similar.

Role Ambiguity

Role perception of computer specialists has an important influence on the effective operation of computer systems. There are good reasons why the role of EDP staff in many companies is not clearly defined:

(a) recent growth of the industry
(b) the newness of the specialization
(c) the fact that EDP is a cross-functional activity which involves the cooperation of various other departmental groups
(d) absence of a positive lead supplied by top management

A corporation is an amalgam of groups competing for more control over processes, seeking to influence the corporate policy in order to enhance its own influence. The EDP man, in dealing with the various rival groups, becomes aware of the importance of data processing for the organization
as a whole. The computer staff pioneer new systems, cross established boundaries and adopt an innovating, radical approach to business operations. Any manager in this position can be expected to suffer stresses and uncertainty. He tends to look to senior management for support and assistance in clarifying his role within the organization.

The data processing function needs time before it is woven into the fabric of the business organization.

Top Management Involvement

Analysis of the data gathered for this study supports the contention that top management involvement is important to a successful corporate computer effort. This study showed a positive relationship between amount of interaction between top management and computer specialists and profitable operation of systems. However, this should be regarded as a tentative conclusion, because the results of the study are not strongly supportive of this position. They indicate a relationship which needs to be substantiated by further studies.

A majority of the one hundred and thirty three top managers who responded to the inquiry
appeared to be profitable users of data processing systems, sixty per cent reported significant profits from computer operations. This finding contradicts the findings of some important studies.¹ It may fairly be objected that what has been gathered in this study is subjective estimates and not hard data. Each individual likes to portray his corporate actions in a good light and that it is somewhat naive to place great emphasis on what respondents state they do. In defense, however, measurement and evaluation of the performance of computer systems is extremely difficult and attempts at measurement involve the use of arbitrary criteria. The difficulty of using adequate yardsticks for performance increases as systems become more complex and the importance of administrative application decreases. The top managers in this study favored more involvement in data processing by functional management but perceived this to be more of a problem at the middle level of management. The chief executive and other senior corporate officers have the task of setting objectives for corporate computer activity

and assigning priorities in order to achieve the intended goals. Data processing staff have the task of designing and implementing systems for the approved top management plans. The support given by top management to achieve the corporate goals is vital if the operation is to be effective. Top management should attempt to clarify the responsibilities of the functional managers who are users of EDP. One difficult issue is that of financial accountability for computer systems. Both the top manager group and the data processing managers favored the line managers taking responsibility for the financial results of computer operations. Top managers (in sample aggregate) did not take positions which suggested a willingness to abdicate the central role which should be occupied by functional corporate executives. The less successful users (by their own evaluation) were more prone to leave important business decisions concerning EDP systems to computer specialists.

Management involvement is more accurately understood as involving various levels of management, rather than merely the two groups which are the main focus of this study. When the problem is perceived
in these terms, it becomes clear the evidence of interest and involvement by top management is not by itself sufficient to bring about successful operations. Cooperation of managers of the various functional groups involved in computer systems is also necessary. It may be difficult to secure such cooperation despite the lead given by top management. Data processing is a cross-functional activity and the failure to gain the support of any one of a number of interdependent groups can frustrate corporate plans.
APPENDIX A
LETTER ADDRESSED TO TOP MANAGERS
AUGUST, 1969
THE OHIO STATE UNIVERSITY
COLLEGE OF ADMINISTRATIVE SCIENCE
1775 SOUTH COLLEGE ROAD
COLUMBUS, OHIO 43210

FACULTY OF MARKETING
WILLIAM K. DAVISON, CHAIRMAN

It is widely acknowledged that computer technology is an important force in business today. A research project is being carried out at The Ohio State University investigating managerial problems experienced by users of data processing systems. Your assistance in this study would be of great value. Attached to this letter is a very brief questionnaire which has been sent to a group of leading business executives. Replies from the two hundred firms invited to participate in the inquiry will be aggregated and analysed.

The information provided will be used solely for University research purposes and will contribute toward a dissertation concerned with the behavioral problems of computers. The subject of this inquiry is the significance of the interactions, perceptions and relationships between top, middle and bottom managers for the effective operation of computer systems.

The short questionnaire accompanying this letter will take approximately fifteen minutes to complete. If you would like to receive a copy of the main conclusions derived from this study, please check the box at the bottom of the final page.

Sincerely,

Clifford J. Elliott
Research Associate

241
FOLLOW-UP LETTER TO TOP MANAGERS

THE OHIO STATE UNIVERSITY
COLLEGE OF ADMINISTRATIVE SCIENCE
1775 SOUTH COLLEGE ROAD
COLUMBUS, OHIO 43210

October, 1969

Gentlemen:

We recently wrote to you requesting your participation in an important research study being carried out at The Ohio State University concerning the managerial problems of computer use. Your response would greatly assist this project and we would be most appreciative if one member of your top management team could spend fifteen minutes answering the brief questionnaire. In case the original questionnaire has been mislaid, another question sheet is enclosed.

It is expected that this enquiry will yield results which are helpful to business and we will be pleased to send you a report of the main findings.

Sincerely,

Clifford J. Elliott
Research Associate

CJE/jj

Enclosure: 1
SECTION 1

Please check one answer from the following choices. If additional comments are necessary, they will be welcomed.

a. How frequently do you meet with the data processing manager (or senior computer specialist)?
   ____ less than once per quarter
   ____ several times per quarter
   ____ several times per month
   ____ several times per week
   ____ daily

b. How much time do you normally spend with the data processing manager per week?
   ____ less than 1 hour
   ____ 1-2 hours
   ____ 2-3 hours
   ____ 3-4 hours
   ____ 4-5 hours

   ____ 5-6 hours
   ____ 6-7 hours
   ____ 7-8 hours
   ____ 8-9 hours
   ____ 9-10 hours

   ____ 10 hours or more

   ____ Other:

   _____

   _____

   _____

   _____

   _____

   _____

   _____

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   _____

   _____

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low priority accorded EDP systems.

faith in middle management to solve such problems.

Other reasons:

Comments:

f. To what extent do you depend on the suggestions and advice of the company
data processing manager when making decisions on important problems which
may involve EDP?

very much

only slightly

moderately

very rarely

somewhat

g. To what extent should top management support for EDP in your corporation
be increased from the present level?

greatly

a little

moderately

not at all

somewhat

Comments:

h. Has there been a measurable pay off (profitability) as a result of use of
computer systems?

very significant

slight deficit

significant

significant deficit

little change
1. Have there been definite benefits, other than financial benefits, as a result of the use of computer systems in your company?
   _____yes  _____no

j. In what areas has use of computers yielded significant benefits?
   (please rank in order of importance)
   1. _______________________________________________________________
   2. _______________________________________________________________
   3. _______________________________________________________________
   4. _______________________________________________________________
   etc.

k. Rank applications which appear to have made the biggest contribution to effective performance in your organization.
   1. _______________________________________________________________
   2. _______________________________________________________________
   3. _______________________________________________________________
   4. _______________________________________________________________
   5. _______________________________________________________________

l. Further comments on the role of operating managers (line managers, department heads, general corporate executives) compared to the role of data-processing executives:
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   (please add further comments on separate sheet if necessary)
### SECTION II

Please read the following statements and evaluate them, registering whether you agree or disagree. Circle the appropriate number to indicate strength of agreement or the opposite.

5 = SA, Strongly Agree  
4 = A, Agree  
3 = U, Undecided  
2 = D, Disagree  
1 = SD, Strongly Disagree

---

**For Example:**

In working with functional departments (accounts, production, sales, etc.) the data processing manager should attempt to see problems from the viewpoint of the functional managers.

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21. The senior EDP staff should be members of at least one professional association and attend conferences and meetings of such associations.

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22. The data processing staff is important because departments which use EDP depend on it to such a great extent.

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23. EDP personnel should have more responsibility for conversion to EDP because of their greater technical knowledge.

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24. It is to be expected that committees (or task-forces) set up to study conversion to EDP are led by computer specialists because they have greater understanding of such problems.

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</table>
25. In the business organization of the future EDP will be the central and most important division within the company.  

26. Identification of new areas of application for computers is predominantly the concern of the computer specialists.  

27. Planning and implementing new computer applications should be left largely to the EDP staff.  

28. Whether a conversion is operationally feasible should be mainly determined by EDP staff.  

29. In order for a firm to successfully implement an effective range of computer projects, managers of the relevant departments should initiate the changes.  

30. Computer applications tend to be more successful if they are initiated by operating managers (functional, line managers) in consultation with the EDP staff.  

31. Operating and line managers should be responsible to top management for the financial performance of computer systems which serve their divisions or departments.  

(If further comment seems warranted, please attach a separate sheet.)  

*We can distinguish technical feasibility (is it possible for a system to work?), economic feasibility (will there be adequate pay off?) and operational feasibility (will it operate effectively given the particular situation, and working with the present personnel in the company?). Decisions on operational feasibility require knowledge of business operations in addition to technical knowledge.  

_____ I would like a copy of the main findings of this study.
PERSONAL DATA

(i) What is the title of your position? ____________________________

(ii) Is EDP a separate division or department within your organizational structure?

    yes    no; If "no" please briefly explain structure: _______________________

(iii) To which member of top management is the data processing manager responsible?


(iv) Approximately how many people are employed in your plant or place of work?


(v) Age? ________ (vi) Education: Graduate degree

            some graduate school

            Bachelor degree

            some college

            high school

(vii) Specialization prior to attaining top management position? (e.g., accountant, engineer, etc.)


(viii) What was the main focus of your studies when at college? Major fields: (e.g., social sciences)


Major subjects (e.g., economics)
Page 249 is missing
Data processing is an important activity, and many business organizations are increasing their use of computers. As yet however, little is known about the managerial problems involved in the operation of computer systems. In order to gain knowledge of this significant subject, a study is being carried out at The Ohio State University.

I request your cooperation in completing a brief questionnaire.

Your replies will be treated as confidential with access restricted to a few University researchers. A short report, setting out the main conclusions drawn from the study, will be made available to those who participate.

Your help and cooperation in this project is greatly appreciated.

Sincerely,

Clifford J. Elliott
College of Administrative Science
The Ohio State University
**SECTION I**

To be answered by data processing manager (director of EDP, senior systems analyst or other title).

1. **Into which industry or business does your firm or organization fall?**
   
   (Check primary based upon sales revenue)

   **Manufacturing**
   - Chemicals
   - Petroleum
   - Foods or beverages
   - Instruments, optical goods, etc.
   - Machinery (all types)
   - Paper or paper products
   - Primary metals
   - Fabricated metals
   - Rubber or plastic products
   - Stone, clay or glass
   - Textiles, apparel or leather
   - Transportation equipment
   - Wood products or furniture
   - Other (specify)

   **Non-Manufacturing**
   - Banking, financial or insurance
   - Stock brokerage
   - Business or consulting service
   - Communications
   - Construction
   - Educational
   - Government or military
   - Hospital or laboratory
   - Mining metals, coals, minerals
   - Printing or publishing
   - Transportation or public utility
   - Wholesaling or retailing
   - Other (specify)

2. **For which business processing does your company use the computer system?**
   
   (Check all applicable)

   - Accounts payable or receivable
   - Actuarial
   - Banking
   - Cost control
   - Debugging business programs
   - Financial analysis
   - Inventory control
   - Management information systems
   - Market or marketing research
   - Payroll
   - Personnel planning or scheduling
   - Production or process control
   - Sales analysis
   - Purchasing
   - Physical distribution -- routing of deliveries
   - Other (specify)

3. **What is the title of your position?**

4. **Age**
   - Under 25
   - 25-30
   - 30-35
   - 35-39
   - 40-44
   - 45 or over.
5. Education: Indicate level attained:
   Master's Degree
   Some graduate study
   Bachelor's Degree
   Some college study
   High School

6. Do you belong to any professional associations related to your field of work?
   Yes
   No

7. Do you attend professional meetings or subscribe to journals concerned with developments in EDP?
   Yes
   No

8. Employment in EDP: (list current employer first)
<table>
<thead>
<tr>
<th>Employer</th>
<th>Position held</th>
<th>Dates</th>
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</table>

9. How many employees work under your supervision?

10. Please provide an approximate, brief description of your responsibilities.
    ___________________________________________
    ___________________________________________
    ___________________________________________
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    ___________________________________________

11. What is the title of the person to whom you report?
    ___________________________________________
    ___________________________________________
12. To what degree does your job involve contact with top management?
   ____ Hardly ever (less than once per quarter)
   ____ To a slight degree (several times per quarter)
   ____ To a degree (several times per month)
   ____ Fairly often (several times per week)
   ____ Often (daily)

13. How much time per week would you normally spend with top management?
   ____ Less than 1 hour
   ____ 1-2 hours
   ____ 2-3 hours
   ____ 3-4 hours
   ____ 4-5 hours
   ____ More than 5 hours.

14. To what extent do you feel that top management is sensitive to your problems?
   ____ Very sensitive
   ____ Slightly remote
   ____ Slightly sensitive
   ____ Very remote
   ____ Neutral

15. If you believe that top management appears to be detached from the important problems of the computer staff, check the factors which account for this:
   1. ____ Reticence when dealing with a new technology
   2. ____ Lack of knowledge of EDP usage
   3. ____ Pressure of more important duties
   4. ____ Low priority accorded to the EDP systems
   5. ____ Faith in middlemanagement to solve such problems

Other reasons: ____________________________________________________________
________________________________________________________________________

Comments: ______________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
16. How much does your higher-level management depend on you for suggestions and advice on important problems that arise?
   _____ Not at all  _____ To a moderate extent
   _____ To a slight degree  _____ To a considerable degree
   _____ Somewhat

17. To what extent should top management support and understanding be increased from the present level?
   _____ It should be greatly increased
   _____ It should be increased moderately
   _____ It should be increased somewhat
   _____ It should be increased a little
   _____ It should not be increased at all

18. Do you consider that operating managers (accounts, production, etc.) have an adequate understanding of computer systems used in your company?
   _____ They are very well-informed
   _____ They are moderately well-informed
   _____ They are poorly informed
   _____ They have no understanding

19. Do you feel that you have sufficient authority to make decisions regarding operations of EDP systems? (i.e., authority commensurate with your assigned responsibilities)
   _____ I have more authority than I should have
   _____ I have slightly more authority than I should have
   _____ I have the appropriate amount of authority
   _____ I have less authority than I should have
   _____ I have much less authority than I should have

Comments: ____________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
20. Please rank (from 1-11) the importance to you of the job factors listed below.

1 = most important
2 = next most important, etc.

____ Job security I have
____ Opportunity for recognition
____ Amount of pay I receive
____ Contribution I make to the company
____ Opportunities for promotion
____ My status in the company
____ Satisfaction of doing good work
____ Amount of authority I have
____ Amount of support I get from others
____ Opportunity to do the kind of work I like
____ Chance to work for a good superior
SECTION II

Please read the following statements and evaluate them, registering whether you agree or disagree. Circle the appropriate number to indicate strength of agreement or the opposite.

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___ I would like a copy of the main findings of this study.
APPENDIX C
## APPENDIX C

**CODE BOOK FOR DATA PROCESSING MANAGERS**

**DATA FOR STUDY OF INTERACTIONS, PERCEPTIONS AND RELATIONSHIPS BETWEEN TOP CORPORATE EXECUTIVES AND EDP MANAGERS**

<table>
<thead>
<tr>
<th>Cols.</th>
<th>Var. No.</th>
<th>Description of Variable and Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td></td>
<td>Deck Number 001</td>
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<tr>
<td>4-9</td>
<td></td>
<td>Identification of respondent</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Frequency of meetings:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1- less than once per quarter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2- several times per quarter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3- several times per month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4- several times per week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5- daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9- no response</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>Duration of Meetings:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1- less than 1 hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2- 1-2 hours</td>
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<td>3- 2-3 hours</td>
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<td>4- 3-4 hours</td>
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<td>5- 4-5 hours</td>
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<tr>
<td></td>
<td></td>
<td>9- no response</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Sensitivity to EDP problems:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5- very important</td>
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<tr>
<td></td>
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<td>4- moderately important</td>
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<tr>
<td></td>
<td></td>
<td>3- somewhat important</td>
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<tr>
<td></td>
<td></td>
<td>2- slightly important</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1- not important</td>
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<tr>
<td></td>
<td></td>
<td>9- no response</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>Reticence when dealing with new technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1- yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2- no answer</td>
</tr>
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<td></td>
<td></td>
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<td>---------------------------------------------------------------------------------------</td>
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<td>14</td>
<td>5</td>
<td>Unfamiliarity with EDP usage:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-yes                                   2-no answer</td>
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<td>15</td>
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<td>Pressure of more important duties:</td>
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<tr>
<td></td>
<td></td>
<td>1-yes                                   2-no answer</td>
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<td>16</td>
<td>7</td>
<td>Low priority accorded to EDP Systems:</td>
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<tr>
<td></td>
<td></td>
<td>1-yes                                   2-no answer</td>
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<td>17</td>
<td>8</td>
<td>Degree of dependence on EDP manager:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-very much                             2-slight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-moderately                            1-rare</td>
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<td></td>
<td>3-somewhat                              9-no response</td>
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<td>19</td>
<td>10</td>
<td>Should support for EDP in your corporation be increased?</td>
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<tr>
<td></td>
<td></td>
<td>5-greatly                               2-a little</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-moderately                            1-not at all</td>
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<td></td>
<td></td>
<td>3-somewhat                              9-no response</td>
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<td>20</td>
<td>11</td>
<td>The senior EDP staff should be members of at least one professional organization and attend conferences and meetings of such organizations.</td>
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<tr>
<td></td>
<td></td>
<td>5-agree strongly                        2-Disagree</td>
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<tr>
<td></td>
<td></td>
<td>4-agree                                 1-strongly disagree</td>
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<td></td>
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<td>3-undecided</td>
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<td>21</td>
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<td>EDP is important because departments which use EDP depend on it so much.</td>
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<tr>
<td></td>
<td></td>
<td>5-strongly agree                         2-disagree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-agree                                 1-strongly disagree</td>
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<td></td>
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<td>3-undecided</td>
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<tr>
<td>22</td>
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<td>EDP personnel should have the responsibility for conversion to EDP because of their greater technical knowledge.</td>
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<tr>
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<td>5-strongly agree                         2-disagree</td>
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<td></td>
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<td>4-agree                                 1-strongly disagree</td>
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<td>3-undecided</td>
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</table>
It is to be expected that committees (or task forces) set up to study conversion to EDP are led by computer specialists because they have greater understanding of such problems.
5- strongly agree 2- disagree
4-agree 1- strongly disagree
3-undecided

In the business organization of the future EDP will be the central and most important division within the company.
5- strongly agree 2- disagree
4-agree 1- strongly disagree
3-undecided

Identification of new areas of application for computers is predominantly the concern of the computer specialists.
5- strongly agree 2- disagree
4-agree 1- strongly disagree
3-undecided

Planning and implementing new computer applications should be left largely to the EDP staff.
5- agree strongly 2- disagree
4-agree 1- disagree strongly
3-undecided

Whether a conversion is operationally feasible should be mainly determined by the EDP staff.
5- agree strongly 2- disagree
4-agree 1- strongly disagree
3-undecided

In order for a firm to successfully implement an effective range of computer projects, managers of the relevant departments should initiate the changes.
5- agree strongly 2- disagree
4-agree 1- strongly disagree
3-undecided
Computer applications tend to be more successful if they are initiated by operating managers (functional, line managers) in consultation with the EDP staff.
5—strongly agree  2—disagree
4—agree  1—strongly disagree
3—undecided

Operating and line managers should be responsible to top management for the financial performance of computer systems which serve their division or departments.
5—strongly agree  2—disagree
4—agree  1—strongly disagree
3—undecided

Title of your position:
EDP
01—Senior programmer
02—Systems Analyst
03—DP Manager
04—Director or VP Corporate DP
Middle Manager
05—Purchasing agent
06—Accounts Manager
07—Other Middle Manager
Top Managers
08—Treasurer
20—Secretary
10—Purchasing (Director)
11—Controller
12—VP Finance
13—VP Merchandising
14—VP Planning and Development/Manpower
15—VP Public Relations
16—VP Government
17—Executive VP
18—President or Chairman
19—Other Top Manager
21—VP Operations
22—VP Administration
09—No response
Age:
1-under 25
2-25-30
3-30-35
4-35-39
5-40-44
6-45 or over
9-no response

Education:
5- Graduate degree
4-Some graduate school
3-Bachelor degree
2-Some college
1-High School
9-no response

Into which industry or business does your firm or organization fall?
Manufacturing
01-Chemicals
02-Petroleum
03-Foods and beverages
04-Instruments, optical goods
05-Machinery (all types)
06-Paper or paper products
07-Primary metals
08-Fabricated metals
10-Rubber or plastic goods
11-Stone, clay or glass
12-Textiles, apparel
13-Transportation equipment
14-Wood products or furniture
15-Miscellaneous
Non-Manufacturing
16-Banking, financial or Insurance
17-Stock Brokerage
18-Business or Consulting service
19-Communications
20-Construction
21-Education
22-Government or Military
23-Hospital or Laboratory
24-Mining metals, coals, minerals
Non-Manufacturing (-Continued )
25- Printing or Publishing
26- Transportation or public utility
27- Wholesaling or retailing
28- Other
09- No response

<p>| | | |</p>
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<thead>
<tr>
<th></th>
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</table>
| 37 | 26 | Do you use business processing for accounts payable or receivable?  
1-yes  2-no response |
| 38 | 27 | Do you use business processing for actuarial purposes?  
1-yes  2-no |
| 39 | 28 | Do you use business processing for banking?  
1-yes  2-no |
| 40 | 29 | Do you use business processing for cost control?  
1-yes  2-no |
| 41 | 30 | Do you use business processing for debugging business programs?  
1-yes  2-no |
| 42 | 31 | Do you use business processing for financial analysis?  
1-yes  2-no |
| 43 | 32 | Do you use business processing for inventory control?  
1-yes  2-no |
| 44 | 33 | Do you use business processing for management information systems?  
1-yes  2-no |
| 45 | 34 |   |
46 34 Do you use business processing for payroll?
   1-yes   2-no

47 36 Do you use business processing for personnel planning or scheduling?
   1-yes   2-no

48 37 Do you use business processing for production or process control?
   1-yes   2-no

49 38 Do you use business processing for sales analysis?
   1-yes   2-no

50 39 Do you use business processing for purchasing?
   1-yes   2-no

51 40 Do you use business processing for physical distribution-routing of deliveries.

52 41 Do you use business processing for orders?
   1-yes   2-no

53 42 Do you use business processing for merchandising?
   1-yes   2-no

54 43 Do you use business processing for management planning?
   1-yes   2-no

55 44 Do you use business processing for product design or development?
   1-yes   2-no

56-57 45 What is the title of the person to whom you report?
   01- President
   02- Executive V-P
   03- Controller
   04- Treasurer
   05- Secretary
   06- V-P Finance
   07- V-P Corporate Planning
   08- V-P Systems Development
10- Director of Purchasing
11- Director of Production/
   Plant Manager
12- Director of Marketing
13- Director of EDP
14- General Manager

58  46  Do you belong to any professional
organizations related to your
field of work?
  1-yes  2-no
  9-no response

59  47  Do you attend professional meetings
or subscribe to journals concerned
with developments in EDP?
  1-yes  2-no

60  48  Employment in EDP: (Current employer
listed first.)
  1-one firm  4-four firms
  2-two firms  5-five firms
  3-three firms  9-no response

61  49  How many employees work under
your supervision?
  1- under 10  6- 50-59
  2- 10-19  7- 100-199
  3- 20-29  8- 200 or more
  4- 30-39  9- no response
  5- 40-49

62  30  Do you consider that operating managers
(accountants, production, etc.)
have an adequate understanding of
computer systems used in your
company?
  4- They are very well informed
  3- They are moderately well informed
  2- They are poorly informed
  1- They have no understanding
  9- No response
Do you feel that you have sufficient authority to make decisions regarding operations of the EDP systems? (i.e., Authority commensurate with your assigned responsibilities?)

5- I have more authority than I should have.
4- I have slightly more authority than I should have.
3- I have the appropriate amount of authority.
2- I have less authority than I should have.
1- I have much less authority than I should have.
9- No response
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<td>1</td>
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<tr>
<td></td>
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<td>1-less than once per quarter</td>
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<td></td>
<td></td>
<td>2-several times per quarter</td>
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<td></td>
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<td>3-several times per month</td>
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<tr>
<td></td>
<td></td>
<td>4-several times per week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9-no response</td>
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<td>11</td>
<td>2</td>
<td>Duration of Meetings:</td>
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<td></td>
<td></td>
<td>1-less than 1 hour</td>
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<tr>
<td></td>
<td></td>
<td>2-1-2 hours</td>
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<td></td>
<td>3-2-3 hours</td>
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<td></td>
<td>4-3-4 hours</td>
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<td></td>
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<td>5-4-5 hours</td>
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<td>9-no response</td>
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<td>12</td>
<td>3</td>
<td>Sensitivity to EDP Problems:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-very important</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-moderately important</td>
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<td></td>
<td></td>
<td>3-somewhat important</td>
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<tr>
<td></td>
<td></td>
<td>2-slightly important</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-not important</td>
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<td>9-no response</td>
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<td>4</td>
<td>Reticence when dealing with new</td>
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<td></td>
<td></td>
<td>technology:</td>
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<tr>
<td></td>
<td></td>
<td>1-yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-no answer</td>
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<tr>
<td>14</td>
<td>5</td>
<td>Unfamiliarity with EDP usage:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-yes</td>
</tr>
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<td>15</td>
<td>6</td>
<td>Pressure of more important duties:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-no answer</td>
</tr>
</tbody>
</table>
16  7  Low priority accorded to EDP systems:
1-yes  2-no answer

17  8  Faith in middle management to solve EDP problems:
1-yes  2-no answer

18  9  Degree of dependence on EDP manager:
5-very much  2-slight
4-moderately  1-very rare
3-somewhat  9-no response

19  10 Should support for EDP in your corporation be increased?
5-greatly  2-a little
4-moderately  1-not at all
3-somewhat  9-no response

20  11 The senior EDP staff should be members of at least one professional association and attend conferences and meetings of such associations.
5-strongly agree  2-disagree
4-agree  1-strongly
3-undecided  disagree

21  12 EDP staff is important because departments which use EDP depend on it so much.
5-strongly agree  2-disagree
4-agree  1-strongly
3-undecided  disagree

22  13 EDP personnel should have more responsibility for conversion to EDP because of their greater technical knowledge.
5-strongly agree  2-disagree
4-agree  1-strongly
3-undecided  disagree
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4—agree 1—strongly
3—undecided disagree

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3 - undecided

title of your position:
EDP
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02 - Systems Analyst
03 - DP Manager
04 - Director or VP Corporate DP
Middle Manager
05 - Purchasing Agent
06 - Accounts Manager
07 - Other Middle Manager
Top Managers
08 - Treasurer
20 - Secretary
10 - Purchasing (Director)
11 - Controller
12 - VP Finance
13 - VP Merchandising
14 - VP Planning and Development/Manpower
15 - VP Public Relations
16 - VP Government
17 - Executive VP
18 - President or Chairman
19 - Other Top Manager
21 - VP Operations
22 - VP Administration
09 - No response
Age:
1- under 25
2- 25-30
3- 30-35
4- 35-39
5- 40-44
6- 45 or over
9- no response

Education:
3- Bachelor Degree
4- Some Graduate School
5- Graduate Degree
1- Some College
9- No response

Initiation of Meetings:
1- Mostly by me
2- Some by me,
3- Mostly by DP Manager
some by EDP Manager

Profitability as a result of use of EDP:
5- Very significant
4- Significant
3- Little change
2- Slight deficit
1- Significant deficit
9- No response

Benefits, other than financial, resulting from use of computer systems:
1- Yes
2- No
9- No response

In what areas has the computer yielded benefits? (Rank in order of importance.) See attached code sheet
62-64  36  See attached code sheet

65  37  Is EDP a separate division or department within your organizational structure?
1-yes  2-no

66-67  38  To which top management is the data processing manager responsible?
1-Controller  10-Other Top Management
2-Treasurer  11-Middle Management
3-Secretary  12-V-P Administration
4-V-P Finance  5-V-P Planning
6-V-P DP Systems  7-Executive V-P
8-President  9-Other response

68  39  Approximately how many people are employed in your plant or place of work?
1- under 1000  5- 10,000-19,000
2- 1000-1999  6- 20,000-39,999
3- 2000-2999  7- 40,000 or over
4- 3000-9999  9- No response

69-70  40  Specialization prior to attaining top management position:
1-Accountant  11-Business/Marketing Research
2-Engineer  12-Media
3-Purchasing  13-Data Processing
4-Production Mgt./Industrial Mgt.
5-Sales/Marketing
6-Finance (other than Accountant)
7-Advertising
8-Lawyer  9-No response

71  41  What was the main focus of your studies when at college?
1-Social sciences  6-Education
2-Business studies  9-No response
3-Arts and humanities
4-Physical sciences  7-Engineering
5-Biological sciences
Major subjects:
1-Economics
2-Business Administration
3-Accounting
4-Law
5-Engineering
6-Arts
7-Sciences
8-Industrial Arts
9-No response
10-Psychology
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<tr>
<td>801</td>
<td>General Business Accounting (incl. receivables, payables)</td>
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<td>General ledger accounting</td>
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<td>Billing and invoicing</td>
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<td>Budgeting</td>
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<td>Correspondence: personalized letters to delinquent accounts</td>
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<td>Cost accounting and analysis</td>
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<td>Dispatching (incl. shipping)</td>
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<td>Mailing list operations: including membership lists</td>
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<td>Management games</td>
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<td>Punched tape: automatic production and reading</td>
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<td>Purchase order processing</td>
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Questionnaire analysis
Repair and maintenance: records, scheduling, control
Royalty processing
Salary advances
Sales analysis
Sales area distribution
Sales quota calculations
Savings bonds deductions
Service Bureau Data
Processing operations
Transportation optimization
Vacation scheduling
Voucher distribution
Wage and salary tax analysis
Wage and salary tax computations
Warehousing and stocking: records, analysis
Work-in-process records
Production control
Systems analysis evaluation
Pre-computer processing
(Data Processing service for number of organizations in same industry
Merchandising
Customer service
Product development

General Plant and Production
Assembly line balancing
Cartons: automatic manufacture and packaging
Factory operation simulation
Labor distribution
Lathe operations: automatic control
Machine loading schedules
Numerical control (Production)
Machine tools: control for automatic reproduction of complete parts
Machine utilization analysis
Materials and parts: requirements, allocations, scheduling, control procurement
Quality control
Route accounting (Bakeries, bottling plants, dairies)
Shop scheduling production, optimum 914
Critical path scheduling, (CPM) 915
Shipping and deliveries: scheduling, 916
control
Inspection 917
Maintenance and repairs: scheduling, 918
records, and analysis
Process control 919
Labor performance 920

Finance

Equipment trust accounting 064
Investments analysis 074

insurance

Claims 126
Commutation column calculations 127
Policy writing and issuance 137
Policy reserve calculations 138
Valuation calculations 142
Policy registers 146
Inter-office records 147
<table>
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<td>1-Small, less than $50 million</td>
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<td>2-Medium-small, $50-199 million</td>
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<tr>
<td></td>
<td></td>
<td>3-Medium-large, $200-499 million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-Large, $500-749 million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-Very large, greater than $750</td>
</tr>
<tr>
<td></td>
<td></td>
<td>million</td>
</tr>
</tbody>
</table>
APPENDIX D
APPENDIX D

Statistical Tests Used in This Study

The purpose of this appendix is to explain statistical tests used to test relationships between selected variables. The actual calculations were carried out by the EMDQED computer program. Measures used and commonly referred to are:

1. The arithmetic mean
2. Variance and standard deviation
3. Chi square
4. The contingency coefficient

The Arithmetic Mean

The arithmetic mean is a calculation of the average response for each group of managers scored on a five-point measuring scale. The scales were presented such that the high score (5) indicated strong agreement with a particular statement, and the lowest score (1) indicated strong disagreement. The mean is obtained by summing the values given in the answers to questions and dividing by the number
of respondents. Thus if four respondents checked scores of 3, 5, 2, 1 the mean response is (3+5+2+1)/4 = 2.75. Symbolically if N represents the number of respondents and X the value of each answer the formula for the mean is \( \overline{X} = \frac{\sum X}{N} \) where \( \overline{X} \) is the symbol for the mean of X.

**Validity of Using Means for Interval Data**

The five point interval questions used in the questionnaire represent an ordinal scale. Ordinal scales are ranking scales. They distinguish elements according to a single direction. For example, a top manager may be able to rank his company's computer department according to profitability. By assigning the number 5 to the highest ranking of profitability, the number 4 to the second highest ranking of profitability, etc., an ordinal scale is the result. However, it is important to point out that by ranking profitability on such a scale does not necessarily mean that each interval on the scale represents a corresponding interval of profitability.

Theoretically, in dealing with ordinal scales the only applicable statistics are summary statistics which deal with order and positional
measures such as median, quartile and percentile. In reality, other statistics, such as means, are often computed from ordinal scale data. This procedure is justifiable if it can be safely assumed that each interval on the scale represents an equal attitudinal difference.

Variance and Standard Deviation

The first moment of a distribution or mean is a property of the distribution which describes one characteristic of the distribution; namely its location or center. The mean only provides a partial summary of the information in a set of data. It does not give a clear picture of a distribution. For example, the following graphs show a group of distributions all having the same arithmetic mean yet obviously differing in appearance.

The need for a measure of variation is apparent.

The measures which are most commonly used for this
purpose are the variance the standard deviation. Their function is to serve as a unit in deciding whether an observation is an ordinary or an unusual value in a specified population.

The variance is represented by two symbols, \( \sigma^2 \) and \( s^2 \). \( \sigma^2 \), the Greek letter sigma, represents the variance for a population and \( s^2 \) represents the variance for a sample. The variance is determined by taking the sum of the squares of the deviates from the mean divided by the total number of deviates. This calculation is only appropriate for a finite population or for a sample.

The variance for a finite population is represented symbolically as:\(^1\)

\[
\sigma^2 = \frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + \ldots + (x_N - \mu)^2}{N}
\]

\[
= \frac{\sum_{i=1}^{N} (x_i - \mu)^2}{N}
\]

\(^1\)It should be mentioned that the sample variance is often calculated by dividing by \( n-1 \) instead of \( n \). Unless \( n \) is quite small, the result differs only slightly.
The variance for a sample is represented symbolically as:

\[ s^2 = \frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \ldots + (x_n - \bar{x})^2}{n} \]

As Hadley states, the variance has a defect. Often the random variable of interest has physical dimensions such as feet. Hence, any observation \( x_i \) will be in terms of feet but \( \sigma^2 \) will be in terms of feet squared. Therefore, it is often desirable to have a measure of variability which has the same physical dimensions as \( x_i \). This may be accomplished by taking the positive square root of \( \sigma^2 \). There is called the standard deviation of the distribution \( x \).

Symbolically the standard deviation for a finite population and a sample is respectively represented by the following formulas:

\[ \sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N}} \]

and

\[ s = \sqrt{s^2} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}} \]

---

The standard deviation tells us, when considering two different distributions with the same mean, that the one with the lower standard deviation is less spread out than the one with the higher standard deviation.

**Chi Square Analysis**

The chi square analysis is used to determine the significance of the relationship between various top management's and EDP management's attitudes. Top managers and EDP managers were asked to answer the same questions on a five point attitudinal scale. The answers to corresponding questions were then tabulated as a two-way-classification table (contingency table) and the null hypothesis that the two characteristics (top management and EDP management) were independent was tested. The term *independent* is used to mean that the distribution of one characteristic is the same regardless of the other characteristic. The null hypothesis ($H_0$) asserts that there is no relationship between the particular factors being investigated. Chi square is computed as a measure of the extent of agreement between the observed values and the expected values in the contingency table.
The expected values are ones that would be expected under the null hypothesis, that is to say, a random or chance distribution, which suggests no relationship between the factors under investigation. Chi square provides a method of estimating the probability that there is a relationship between two variables. The probability that results could be obtained purely due to chance or sampling variations is ascertained by reference to appropriate tables. A high computed chi square indicates a low probability that the relationship arises purely by chance. In which case the null hypothesis, that there is no true relationship between the variables, is rejected. As the probability that results may be due to sampling variations increases (\( \alpha > .05 \)) the greater the danger of rejecting the null hypothesis when it is true. The procedure for testing is as follows.

The observed chi square value is calculated and compared with the theoretical chi square value for the appropriate degrees of freedom at a pre-determined level of significance, usually 5 per cent. The significance level, as previously stated, is represented by the symbol \( \alpha \) (alpha) and indicates
the possibility of rejecting the hypothesis when it is true. How is \( \alpha \) selected? The classical theory of statistics provides no rules for choosing \( \alpha \). Alpha is generally a subjective level chosen by the researcher depending upon the circumstances of the problem being investigated. It is the risk the researcher is willing to accept of rejecting the hypothesis when it is true.

This situation for the chi square distribution may be represented geometrically as follows.

![Figure 1](image)

Figure 1 represents the graph of the density function for \( y \) when \( H_0 \) is true and \( \alpha \) is the chosen level of significance. If the value of \( y \) observed is \( y \), the area to the right of \( y \) is greater than \( \alpha \); hence, the hypothesis is accepted. However, if \( y=y_2 \), the area to the right of \( y_2 \) is less than \( \alpha \). In this case the test is significant and the null hypothesis rejected. Whether or not the test yields a significant result depends, of course, on the arbitrarily chosen value for \( \alpha \).
Traditionally, $\alpha$ has been selected either to have a value of 0.05 or 0.01, where 0.05 is referred to as a significant level and 0.01 is referred to as a highly significant level. This tradition has no formal logical foundation. The basis for this tradition goes back to the turn of the century when Fisher and Yeats were developing hypothesis testing. There were no operational computers at that time. Hence, theoretical values for various distributions had to be calculated by hand. Since it was often tedious time consuming and expensive to compute these values, only the five and ten per cent values for a limited number of degrees of freedom were calculated. Today, due to the advent of computers, much more complete tables are available. Because of this, there is a growing tendency among statisticians to get away from these traditional values in hypothesis testing.

For this investigation it is felt that the ten per cent level of significance should be considered, in addition to the conventional five and one per cent levels, though it is conceded that this increases the probability of chance variations. If the computed chi square value is greater than
the theoretical chi square value, the hypothesis that the two characteristics are independent is rejected. While if the observed chi square value is less than the theoretical chi square value, the hypothesis that the two characteristics are independent is accepted.

A symbolic representation of a contingency table is represented in TABLE 1. From this table the observed chi square value is calculated by the following formula:

\[ \chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{n} \frac{(o_{ij} - t_{ij})^2}{t_{ij}} \]

where:

- \( o_{ij} \) equals the number of observed frequencies in the \( i \)th row and \( j \) column;
- \( t_{ij} \) equals the theoretical frequencies given independence between characteristic A and B (null hypothesis);
- \( \sum_{i=1}^{k} \sum_{j=1}^{n} \) directs one to sum every cell in every row and column;
- \( k \) equals the number of rows;
- \( n \) equals the number of columns.

To determine the theoretical frequencies \( (t_{ij}) \) for each cell in TABLE 1, it is necessary to make use of the row and column totals of the
observed frequencies, which are often referred to as the marginal totals, and the grand total. In TABLE 1, the marginal totals are represented by \( O_j \) and \( O_i \), and the grand total is represented by \( O_{..} \), where

\[
O_j \quad \text{equals the sum of the observed frequencies in every cell of the } j \text{ column}
\]

\[
O_i \quad \text{equals the sum of observed frequencies in every cell of the } i \text{ th row}
\]

and \( O_{..} \) equals the sum of the observed frequencies in every cell of every row and column.

The theoretical frequency for each individual cell is calculated from the formula:

\[
T_{ij} = \frac{O_i \cdot O_j}{O_{..}}
\]

A practical application of the chi square test of independency for a contingency table is now presented.

Suppose, for illustrative purposes, we are interested in testing whether or not educational level is associated with occupational status. TABLE 2 is a contingency table of the collected data for this problem. In TABLE 2 there are two categories of occupational status and three categories of educational level. Here there are 52
top managers, 43 EDP managers, 44 people with graduate degrees, etc. The theoretical frequencies which are in parentheses are found from the marginal totals and grand total. It is noted that 52 out of 95 people are top managers. If the characteristics of occupational status and educational level are independent, we should expect to find the same proportion of top managers among those people who have graduate degrees. Since 44 people were observed to have graduate degrees, we should expect to find that $\frac{52}{95} \times 44 = 24.1$ of these people are top managers. Also we should expect $\frac{43}{95} \times 44 = 19.9$ of them to be EDP managers. Note these two theoretical frequencies add to 44. The same procedure is followed to determine the theoretical frequencies in the other rows. The chi square statistic is then calculated as follows:

$$\chi^2 = \frac{(32-24.1)^2}{24.1} + \frac{(12-19.9)^2}{19.9} + \frac{(14-19.7)^2}{19.7} + \frac{(22-16.3)^2}{16.3} + \frac{(6-8.2)^2}{8.2} + \frac{(9-6.8)^2}{6.8} = 10.67$$

This statistic is then compared with the theoretical chi squared value for the appropriate degrees at the chosen level of significance.

If $r$ denotes the number of rows and $c$ the number of columns, then there are $(r-1)(c-1)$ degrees
of freedom. Thus in this example \((3-1)(2-1) = 2\) degrees of freedom. For 2 degrees of freedom at the 5 per cent level of significance, the theoretical chi squared value equals 5.99. Since \(10.67 > 5.99\) the hypothesis of independence at the 5 per cent level of significance is rejected.

**TABLE 1.**—A SYMBOLIC REPRESENTATION OF A CONTINGENCY TABLE

<table>
<thead>
<tr>
<th>Characteristic A</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>\ldots</th>
<th>\ldots</th>
<th>n</th>
<th>\ldots</th>
<th>\ldots</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(0_{11}(T_{11}))</td>
<td>(0_{12}(T_{12}))</td>
<td>(0_{13}(T_{13}))</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0_{1n}(T_{1n}))</td>
<td>(0_{1})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(0_{21}(T_{21}))</td>
<td>(0_{22}(T_{22}))</td>
<td>(0_{23}(T_{23}))</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0_{2n}(T_{2n}))</td>
<td>(0_{2})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(0_{31}(T_{31}))</td>
<td>(0_{32}(T_{32}))</td>
<td>(0_{33}(T_{33}))</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0_{3n}(T_{3n}))</td>
<td>(0_{3})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
</tr>
<tr>
<td>Characteristic B</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
</tr>
<tr>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
</tr>
<tr>
<td>k</td>
<td>(0_{k1}(T_{k1}))</td>
<td>(0_{k2}(T_{k2}))</td>
<td>(0_{k3}(T_{k3}))</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0_{kn}(T_{kn}))</td>
<td>(0_{k})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
<td>\ldots</td>
</tr>
<tr>
<td>(0_{j})</td>
<td>(0.1)</td>
<td>(0.2)</td>
<td>(0.3)</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0.)</td>
<td>\ldots</td>
<td>\ldots</td>
<td>(0)</td>
</tr>
</tbody>
</table>

\(0\ = \) Grand Total
TABLE 2.—HYPOTHETICAL CONTINGENCY TABLE

<table>
<thead>
<tr>
<th>EDUCATION</th>
<th>OCCUPATIONAL STATUS</th>
<th>Top Manager</th>
<th>EDP Manager</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Degree</td>
<td></td>
<td>32 (24.1)</td>
<td>12 (19.9)</td>
<td>44</td>
</tr>
<tr>
<td>Under Graduate Degree</td>
<td></td>
<td>14 (19.7)</td>
<td>22 (16.3)</td>
<td>36</td>
</tr>
<tr>
<td>High School Diploma</td>
<td></td>
<td>6 (8.2)</td>
<td>9 (6.8)</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>52</td>
<td>43</td>
<td>95</td>
</tr>
</tbody>
</table>

The Contingency Coefficient: C

The contingency coefficient is a measure of the extent of relation between two sets of attributes. A contingency coefficient expresses the correlation between two variables, e.g. age and level of education of data processing managers. It is represented by the symbol: C.

The value of C is determined by using the formula:

\[ C = \sqrt{\frac{X^2}{N + X^2}} \]

where \( X^2 \) = computed chi square value
\( N \) = number in sample

The limits of the coefficient lie between zero (corresponding to independence) and a maximum value less than unity. What the upper limit of C will be depends on the number of columns and rows in a table.
For example, in a $c \times r$ table which is $3 \times 3$, the maximum value is 0.816. This is obtained as follows. Assuming $c = r$, the maximum coefficient which occurs when two variables as perfectly correlated, is $\sqrt{\frac{k-1}{k}}$, or $\sqrt{\frac{2}{3}} \approx 0.816$. As the number of cells increases so does the upper limit of $C$, approaching but never reaching 1. In a $10 \times 10$ contingency table the maximum value of $C = \sqrt{\frac{10-1}{10}} = \sqrt{\frac{9}{10}} \approx 0.949$. Thus for comparison of contingency coefficients it is necessary that the contingency tables are the same size.

It is clear from the formula, $C = \sqrt{\frac{X^2}{N+N^2}}$, that it is necessary to calculate the chi square value before it is possible to use the contingency coefficient. The chi square calculation is not appropriate if more than 20 per cent of the cell entries are less than 5 or if any cell has an expected frequency of less than 1.¹

The contingency coefficient is a useful measure because it indicates the degree of relation between two sets of scores. This is possible without:

(a) requiring continuity in the variables

(b) making assumptions about the shape of the population.

The significance of a coefficient of contingency is tested by evaluating the observed chi square from which it is calculated. The procedure for doing this has been described in the previous section of this Appendix. For an association between two attributes under investigation there must be a computed chi square value which, under the null hypothesis \( H_0 \), exceeds the value of \( \chi^2_{.05} \) for the appropriate number of degrees of freedom. In that case \( H_0 \), the null hypothesis, is rejected in favor of \( H_1 \).
APPENDIX E

TOP MANAGER COMMENTS

A medium-large mineral and mining firm. Code No. 125B2

e. [Comment on why top managers may be detached]

"Management will not take the time to fully familiarize themselves with EDP even though they demand and expect much."

1. [Comment on the role of operating managers]

"Most operating managers are unfamiliar with EDP and therefore don't know how to use it. If they would take a course which would at least teach them how to prepare a flow chart, they could then make big strides in profitable EDP operations."

A medium-small machine manufacturer. Code No. 199132

1. [Comment on the role of operating managers]

"All must be involved which means training to understand possible benefits."
A medium-small drug wholesale and retail firm.  

Code No. 166B2

e. [Comment on why top managers may be detached]

"If top management understood EDP and what it
can do for the company, they would realize they
could not afford to be insensitive to the problems
and potential."

l. [Comment on the role of operating managers]

"Knowledge of computer concepts, ideas,
suggestions of reports, controls, etc., which help
them to do a better job in their areas of
responsibility."

A small wholesale firm.  

Code No. 140B1

l. [Comment on the role of operating managers]

"Need to merge their special talents, expe-
rience and perspective—using a common language."

A medium-small department store.  

Code No. 171B1

l. [Comment on the role of operating managers]

"The concept, design and implementation of the
systems must have top management support, along
with continued follow-up on its progress. The
actual concept and design of the system must be
provided for by representative personnel from all areas of the business operation who will be affected by the system."

A medium-large electrical firm. Code No. 186B1

g. [Comment on the question of top management support]

"Mainly as to understanding contributions made, training needs that exist, and interface responsibilities of user departments."

l. [Comment on the role of operating managers]

"In terms of contrast, the D.P. executive renders a service, providing data and analyses, for and to operating managers."

A medium-large tool and die company. Code No. 180B1

e. [Comment on why top managers may be detached]

"Sometimes there is too wide a gap between the general business experience of senior management and the EDP specialist."

A medium-large electrical firm. Code No. 186B2

e. [Comment on why top managers may be detached]

"I think support is the essential. Problems are largely in communication, training and
personnel--a few in priorities. Only these later demand top mgt. involvement."

1. [Comment on the role of operating managers]

"Operating managers must interface with the D.P. organization to (1) learn capabilities and data base (2) express needs for adequate data (3) use data received, or offer suggestions for improvement."

A medium-large gas company.

Code No. 155B1

1. [Comment on the role of operating managers]

"Data processing executives function as a service organization and process information for the operating manager necessary in his decision making role."

A large appliance firm.

Code No. 202B1

e. [Comment on why top managers may be detached]

"Most top managers are not detached from problems of Computer Staff. Once a course of action has been established with proper controls, it is up to the computer staff to perform!"

1. [Comment on the role of operating managers]
"Operating mg'rs look to EDP mg'rs to help solve company problems. The ability of EDP mg'rs to respond to needs of oper. mg'rs dictates the degree of oper. mg'rs success."

A capital goods company. Code No. 234B3

1. [Comment on the role of operating managers]

"The operating manager is still so tied down by the details of his day to day primary duties that he cannot and does not take the time to investigate areas where data processing can make a real contribution to his department."

A medium-large insurance company. Code No. 241B2

1. [Comment on the role of operating managers]

"Operating managers utilize operational tools (man + machine) to achieve established corporate objectives; they encounter and resolve operating problems, and they may set corporate policy and direction. The data-processing executive is concerned with interpretation of the needs of operating mgmt; the design and development of mgmt. tools (systems and data) that are within the framework of corporate policy and will assist operating mgmt. in achieving objectives and resolving operating problems."
1. [Comment on the role of operating managers]

"Operating managers must recognize that computerized systems are their systems—not IBM's or the data processing departments. They must recognize their responsibility for correct and timely data input."

A small manufacturer.

1. [Comment on the role of operating managers]

"Hesitancy on part of D.P. personnel to consider themselves as a service dept. Difficulty in communicating with operating personnel managers."

A machine tool company.

1. [Comment on the role of operating managers]

"Payoff on EDP applications results only when operating managers understand EDP systems and learn to communicate with data processing people."

A system engineering firm.

1. [Comment on the role of operating managers]

"The success of a computer system is directly dependent upon the active participation of all
levels of management; working as a team, to develop the procedures and systems which fully exploits the capabilities of the computer to service all activities of an organization."

"This requires that all levels of management have a knowledge of the basic principles of a computer system and of the computer itself. This means that they must be actively involved in the development of programs in their respective areas of responsibility. The data-processing organization's function is to act as a consultant and to integrate these separate programs into an operational unit."

A medium small machine manufacturer. Code No. 199B1

1. [Comment on the role of operating managers]

"The responsibility of initiating programs lies with the line manager. Implementation is a joint responsibility."

A very large chemical firm. Code No. 131B1

1. [Comment on the role of operating managers]

"It is my opinion that there is no difference between the role of operating managers and the role of data processing executives. In order for us to obtain full benefit from the computers both should
have the corporate goals as their objectives in any joint project they undertake. The operating managers initiating new projects within their departments and the EDP personnel offering technical advice to them."

A medium-small drug company. Code No. 166B1

1. [Comment on why top managers may be detached]
   "I feel every department manager should work with D.P. managers to work out systems. Every manager should be familiar with the abilities of the company so he can get major use of the tool."

A medium-small electrical firm. Code No. 187B2

1. [Comment on the role of operating managers]
   "Operating managers at all levels must become computer oriented and D.P. managers must become more company oriented. This gap is closing."

A medium-small construction machine manufacturer. Code No. 119B1

1. [Comment on the role of operating managers]
   "Computer science is a great tool of Management. But Management of Human Resources is a field unchanged in scope for many centuries. Recognition of Data Processing as one of the great tools (and aids) of
this last 20 years in aiding Management has often been overshadowed by inept use of the tool, i.e., 'guns kill people; outlaw guns.'

A medium-large electronics corporation. Code No. 204B1

1. [Comment on the role of operating managers]

"Obviously I think operating managers should do the hard thinking; especially early in the game the D.P. managers must work closely with them to educate them on the possibilities of computers, and the impossibilities, to ask some leading questions, to offer alternatives and to keep open the maximum number of options for further expansion of the system; but after that, D.P. managers must develop the systems and, in a diversified decentralized company like ours, coordinate all possible ways."

A medium large insurance corporation. Code No. 241B3

e. [Comment on why top managers may be detached]

"The communication gap between top management and technically oriented EDP personnel has been fostered, to some extent, by the data processing supervisors who seek job security and independence of action."
"Communication and training are the great lacks. Line managers must understand the reasons for systems and data processing changes, or there will be continuous friction between the general managers and data-processing executives."

A medium small control instrument firm. Code No. 224B3

1. [Comment on the role of operating managers]

"Since data processing is a service group it should constantly be seeking ways to provide further services. For the D.P. executive to maximize his usefulness all other management people must be an integral part of planning and providing a sense of direction for him."

A medium-small brewery. Code No. 151B1

1. [Comment on the role of operating managers]

"Operations people decide what information is needed. Systems men develop formats for reports and defining flow of source documents.

A small plastics firm. Code No. 231B1

1. [Comment on the role of operating managers]

"Top line management has to tell EDP what else they need. EDP then has to develop and propose
systems approaches. After mutual agreement has been reached and decision finalized, the matter on hand is implemented."
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GLOSSARY OF TERMS

Listed below is a selection of terms drawn mainly from the computer sciences and behavioral sciences. This is not a comprehensive glossary; it is simply intended to give the meaning of words as used in the study, thereby avoiding misunderstanding between the writer and reader.

Activity - The application of time and resources that are necessary to progress from one event to the next. On the networks this is represented by an arrow joining two events.

Attitude - A readiness to respond in a prede
termined manner to a stimulus; a predisposition affecting the evaluation of objects or symbols.

Authority - The legitimate right to command or control, e.g., a manager has authority over workers only in work, not in the home or club.

Communication - The process by which a common meaning is established between interacting parties.

Cosmopolites - Persons who have a relatively large number of professional, business, or social contacts outside their immediate social circles.

Computer - A machine which stores information, and interprets some of this information as instructions causing it to process the remaining information.
Culture - That complex whole which includes knowledge, belief, art, law, morals, custom and any other capabilities and habits acquired by man as a member of society.

Data - That part of the information stored in a computer which is processed when the instructions are obeyed.

Diffusion process - The spread or movement of an innovation from producer to consumers. The transfer of a practice or idea from one person to another within a group or from group to group.

Dyadic interaction - Interaction between two persons.

Ergonomics - Human engineering, the study of human psychology and physiology in relation to equipment design.

Ethics - The study of good and bad, right and wrong.

Flow of influence - The overt expression management's desire to sell a product, as seen by its actions in relation to the communication mix, the distribution mix, and the goods and services mix.

Group - An assemblage of persons who are functionally dependent upon one another for the achievement of certain ends.

Group norms - Rules of behavior or standards for group members regarding matters of consequence to the group.

Interaction units - Institutionalized systems through which people interact, e. g. committees, departments, clubs, conferences.

Line authority chain - The chain of command between superior and subordinate.

Mechanistic structure - A fixed and routine form of structure to meet stable and established conditions.

Noise - Unwanted inputs to human or machine sense organs.
Norms - Attitudes and beliefs prevalent in a particular group or situation.

Off-line and on-line - off-line equipment is, typically, a keyboard device preparing a paper tape to be read into a computer later. An on-line keyboard, on the other hand, is one wired directly into the computer. Similarly, an off-line would be driven by its own tape deck, away from the computer, while an on-line printer would be plugged into the computer directly.

Operating system - A very complex computer program which organizes the work load of the computer and its input and output equipment so that the work as a whole is handled as efficiently as possible with due regard to job priorities.

Organic structure - Flexible organization that is structured to meet a situation of rapid or continual change.

Parameters - Numbers which suffice to define an entity with sufficient precision for the purpose in hand. In computer programming, the parameters of a sub-routine are those numbers which define the particular case with which the sub-routine deals. For example, the parameters of a P.A.Y.E. taxing sub-routine might be gross wage to date, tax to date, gross wage this period, and tax code number.

Perception - 1. The act or faculty of apprehending by means of the mind or of the senses; understanding; cognition. 2. (Psychol.) The process by which people select, organize, and interpret sensory stimulation into a meaningful and coherent picture of the world.

Program - That part of the information stored in the computer which is interpreted as instructions to be obeyed.

Ranking - The arrangement of a set of objects in order of some otherwise non-quantifiable characteristic.

Reference group - A group that an individual has in mind when formulating his opinions, attitudes, and beliefs—a group with which an individual wants to be closely identified.
Regression analysis - An algebraical technique for investigating the dependence of one variable on another, e.g. the heights of sons on the heights of their fathers.

Role - The expected behavior pattern of a given status or position performed in a group.

Significance, statistical - The probability of an observed statistical effect arising by chance alone.

Simulation - The technique of building a model of a real situation, usually set up within a computer, to measure various possible outcomes.

Status - Prestige, based on subjective examination.

Supportive behavior (managerial) - Leadership behavior that builds and maintains subordinates' sense of personal worth and importance.