1978


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AN EXPERIMENTAL EVALUATION OF THE EFFECTS OF
PSYCHOLOGICAL TYPES AND PROBLEM TYPES ON
PREFERENCE FOR SOME MANAGEMENT INFORMATION
SYSTEM CHARACTERISTICS AND DECISION-MAKING
PERFORMANCE.

THE LOUISIANA STATE UNIVERSITY AND
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AN EXPERIMENTAL EVALUATION OF THE EFFECTS OF PSYCHOLOGICAL TYPES AND PROBLEM TYPES ON PREFERENCE FOR SOME MANAGEMENT INFORMATION SYSTEM CHARACTERISTICS AND DECISION-MAKING PERFORMANCE

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The Department of Management

by

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December, 1978
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ABSTRACT

This study was an attempt to investigate the effect of the decision-maker's psychological type and the problem type on her or his preference for some selected MIS characteristics, type of report, number of reports, frequency of decision-making. It also was the purpose of this study to explore the impact of the decision-maker's psychological type, problem type, and preferred MIS characteristics upon cost performance.

Jungian typology was used to define psychological types. This model differentiates individuals based on two dimensions: perception function and evaluation function. Each function has two modes. Sensation and intuition, and feeling and thinking are the modes of perception and evaluation functions respectively. Two types of problems were used: one problem was more structured than the other.

Sixty-three undergraduate students of an Operations and Information Systems course participated in this study. By using the Myers-Briggs Type Indicator, the subjects were categorized into four groups: sensation-feeling, sensation-thinking, intuition-feeling, and intuition-thinking. Each group was randomly divided into two equal subgroups. Each
subgroup was presented with one of the two problem types. The problem settings were created with the use of an inventory simulation game. The simulation provided the subjects with a choice of type of report, number of reports, and frequency of decision-making.

The experimental results indicated that the perception function, among other independent variables, had the most impact upon the dependent variables. Perception function had a significant effect on the frequency of decision-making. On the average the sensation group had a shorter decision cycle and made more frequent decisions. The evaluation function and the problem type did not have a significant effect on any one of the dependent variables. There was a moderate interaction effect. The sensation type subjects facing a more structured problem used the highest number of reports, while the intuition type subjects facing a structured problem used the lowest number of reports. It is concluded that either there does not exist any significant relationship between most of the dependent and independent variables, or a more complicated decision setting and/or a larger sample size is needed to get a better view of the relationships of these variables.
CHAPTER 1

INTRODUCTION

To be viable an organization has to be responsive and adaptive to its environment (Hicks and Gullett, 1976, p. 83). A major function of an organization, in order to make appropriate decisions to adapt to the environment, is gathering and analyzing data about the relevant factors of the environment and the organization itself. Success or failure can very heavily depend on how well an organization can develop a system to perform this function adequately. This system is referred to as management information system, MIS.

In the process of the evolution of management information systems, the introduction of the computer was a major breakthrough. The computer increased the capabilities of the information system by providing the decision-makers with more accurate information with a much shorter time lag. The computer replaced many clerks who were involved in transforming the input data to the required information for decision-making. It also replaced some decision-makers in the areas where the decisions were basically simple and easily programmable. This new tool had many advantages, but it brought
some problems, too. It made the design and development of an information system much more complex as well as very expensive and time-consuming. The information system's increased capabilities caused many more changes in other sub-systems of the organization. It brought computer experts and systems analysts into the organization. These experts brought their problems, too.

The problems caused by the introduction of the computer, accompanied by the problems created by an increasing size and complexity of the organizations, led to a need for a more sophisticated design of MIS. Many organizations spent a large portion of their resources on this function, as Simon explains:

Most of the working force, and an increasing portion of the machines in any corporation are engaged, not directly in the manufacture of a physical product, but in the manufacture of words (cited by Mock, 1973, p. 40).

While spending lots of time and effort on developing MIS, many organizations still are not satisfied. A large majority of the information systems cannot satisfy the information needs of the decision-maker. Dickson explains the reason:

... managers are deluged with numbers [data], but little managerial information is provided with existing systems. Little is really known about the
relationship between the effectiveness of managerial decisions and the information used to make them.

Precisely, no one knows what the content of the information system should be, the form in which the information should be presented to the decision-maker, the media through which information should be presented, or what the time availability should be (Dickson, 1968, p. 23).

There is a lack of an established body of knowledge and scientifically tested and accepted principles of information systems design (Benbasat, 1974, p. 2). Juergens states:

While numerous computer-based information systems have been developed and are in operation there is no unified or commonly accepted theory to guide the development process (Juergens, 1977, p. 31).

Lack of a theory and tested principles for MIS design has led the designers to look into other sources for finding some guidelines. A main source is a successful MIS. This approach does not necessarily give good results. The situational factors of the two systems may be completely different. This requires two systems which may not be similar. Cher-vany, Dickson and Kozar (1972) explain that the MIS designers use heuristic methods based on their own experience and those of others. This approach is based on the following beliefs: (1) all decision-makers are basically the same; (2) information system characteristics do not need to vary
substantially according to the type of decision for which they provide information; and (3) in general, any one of a number of possible managerial reports will do.

These beliefs led to designers' insensitivity and ignorance of characteristics of the user, the problem, the organizational context, and the environment; while all these factors can affect the effectiveness of an MIS. It is suggested that an information system to be effective has to be tailored for each specific situation, considering the capabilities and personality of the decision-maker, the structure of the problem being supported, the organizational context, and some environmental factors (Chervany, et al., 1972; Mason and Mitroff, 1973).

Recently, more attention has been given to the field of MIS design, and the lack of a theory and commonly accepted principles have been noticed. Some authors have proposed frameworks for research in MIS design. These frameworks have indicated some key variables which affect the effectiveness of an MIS. It is through empirical research that the validity and relevance of these key variables can be determined and ultimately a general theory for MIS can be developed.
STATEMENT OF THE PROBLEM

This research is aimed at studying alternative designs of management information systems (MIS). More specifically, it investigates the impact of decision-maker's psychological type and nature of the problem upon the design of an MIS. In other words, this study attempts to indicate if the decision-maker's psychological type and the type of problem he is facing have any effect on his preference for three MIS characteristics: type of report, number of reports, and the frequency of decision-making. Also, it is desired to examine the impact of decision-maker's psychological type, problem type, and preferred MIS characteristics upon decision-making effectiveness.

PURPOSE OF THE STUDY

This research has three purposes:

1. To investigate the effect of the decision-maker's psychological type on his preference for three MIS characteristics.

2. To explore how the variation in the nature of the problem affects the preference for three MIS characteristics.
3. To examine the influence of the decision-maker's psychological type, the variation in the nature of the problem, and the variation of preferred MIS characteristics on the decision-maker's cost performance.

SCOPE OF THE STUDY

This study is an attempt to indicate the relevancy and validity of some variables considered in the Mason and Mitroff's (1973) framework for research on MIS design. Two of the variables of this framework are included in this study. These variables are the decision-maker's psychological type and the nature of the problem. The effects of these two variables on some selected MIS characteristics are examined.

The decision-maker's psychological type is represented by Jungian typology. No other psychological characteristic is considered. The nature of the problem refers to how structured is the problem. The level of uncertainty in the decision setting is the only factor considered in creating a relatively low or high structured problem. Although an MIS is characterized by many factors, only three of them are included in this study. These factors are type of report, summarized and detailed, the number of reports, and the
frequency of decision-making.

LIMITATIONS

In this research business undergraduate students are used as surrogates for businessmen. This can cause a bias. As Alpert (1967) and Flemming (1969) have shown, businessmen do not necessarily behave like students in an experimental environment. Although the use of students may decrease the validity of the results, almost all studies done in the field have used students as subjects. The lack of availability of managers and the practicality of using students are major reasons for using students as surrogates for businessmen. This limitation should be considered in interpretation of the results.

In this experiment the students are encouraged to use the information system and try to make better decisions. They are rewarded for their performance. Their final grade in the course is partially dependent on their performance in this experiment. While students are directly rewarded for their decision-making performance, this may not be the case for the decision-maker in some organizations. The decision-maker may not be evaluated and rewarded based on her or his decision-making performance and use of the information system.
This lack of connection between performance and rewards can lead to an inferior decision-making performance despite using an appropriate MIS. In applying the results of this study to an organization this limitation should be considered.

The subjects make a series of decisions in a simulated environment by using an inventory simulation game. Since simulation may not exactly represent the real world decision environment, it is possible that the results are biased. In spite of the possibility of a bias, the high cost, risk, and time involved in real world experiments still justifies the use of simulation.

Reviewing the literature on MIS reveals that simulation is an appropriate research method in this field. In an extensive review of empirical studies of MIS, Van Horn (1973) distinguishes four research methods: case study, field study, field test, and laboratory study. He reviews empirical studies using each of these four methods. It is implied that the laboratory study, including simulation experiment, has been the most fruitful method.

Dickson, Senn, and Chervany (1977) consider the four methods distinguished by Van Horn and evaluate each method. They recommend the use of laboratory study, particularly computer-based simulation for research on MIS. In another
work, Chervany, Dickson, and Kozar (1972) compare the case study method with the experimental gaming method. After a detailed discussion of shortcomings and advantages of each method, it is concluded that at the present stage of MIS development and research the experimental gaming method is more appropriate.

Finally, in this study only a few factors affecting MIS design and also only a few of many MIS characteristics have been considered. Therefore, at best, the result of this study shows only a partial picture of reality. Considering the current state of the art of information system analysis and design, there is a need for studies which only use a few variables at a time and discover their relationships. Although the results of these studies are limited, the studies are practical to conduct in a controlled environment and when the results of different studies are put together, they contribute to the overall understanding of the field.

JUSTIFICATION

Many companies which have installed an expensive computer based management information system are not satisfied with their performance. A main reason for this dissatisfaction
is the lack of knowledge of the key factors affecting MIS effectiveness. This is expressed by Chervany and Dickson.

In recent years, organizations have spent a great deal of effort developing computer based information systems to aid management process. Unfortunately, many individuals express dissatisfaction with the benefits resulting from these systems. One of the basic reasons for this dissatisfaction is that MIS's are being designed under a condition in which little is known about the relationship between the effectiveness of managerial decisions and the information systems used to support the decisions (Chevany and Dickson, 1974, p. 1335).

Lucas is in agreement with Chevany and Dickson in writing:

Computer based information systems are being developed by many organizations in an attempt to improve organizational effectiveness and efficiency. Unfortunately, there is little research evaluating the impact of information systems or suggesting ways to better utilize these systems (Lucas, 1975, p. 908).

In the last few years, more attention has been given to indicating the key factors and their influence on MIS effectiveness. Bariff and Lusk express:

The successful development and implementation of an information system should explicitly involve consideration of the psychological disposition of system's user (Bariff and Lusk, 1977, p. 820).

Lucas (1975), based on an experiment, indicates that different personal, situational, and decision style variables appear to affect development and use of information system.
Mock (1973) presents a model for MIS research. He considers the decision-maker's behavioral aspects as an important factor in designing an information system. He states:

... selection of an information system is clearly dependent upon the behavioral factors of the manager who will receive the messages and who specifies requisite actions (Mock, 1973, p. 42).

Chervany, Dickson, and Kozar (1972) design a framework for research on MIS. They include characteristics of the decision-maker, environment, and the information system in their framework. In another framework, Mason and Mitroff (1973) indicate the key variables of MIS design as the psychological type of the decision-maker, structure of the problem, organizational context, and some characteristics of the information system.

Empirical support is needed to verify these frameworks and indicate exactly the relationships of these factors and their extent of influence on MIS effectiveness. None of the previous experimental studies in MIS have considered the Jung psychological types as an indicator of the decision-maker's behavior. Also, the level of structuredness of the problem in interaction with psychological type has not been studied before.
The results of this study can contribute to verification of the relevance of key variables in the proposed frameworks, and development of a general theory for MIS design. Also, the results can be valuable to managers and MIS designers. The MIS professionals gathered at the Founding Conference of the Society for Management Information Systems held at the University of Minnesota were asked to rank twenty-six research projects based on their importance (Dickson, 1970). They gave the highest ranking to two projects: (1) the development of methods for determining what the content of an information system should be, and (2) investigation into the characteristics of decision-makers which affect MIS design.

HYPOTHESES

Based on the purposes of the study, the hypotheses are classified into three groups.

A. How psychological types affect the preference for type and number of reports and frequency of decision-making?

1. Individuals high in sensation prefer more detailed reports, compared to individuals high in intuition.

2. Individuals high in intuition prefer
more summarized reports, compared to individuals high in sensation.

3. Thinking versus feeling has no effect on the type of preferred report.

4. Individuals high in sensation ask for more reports.

5. Individuals high in thinking ask for more reports.

6. Psychological type does not affect the frequency of decisions made.

B. How the problem type affects the preference for type and number of reports and frequency of decision-making?

7. Individuals facing more structured problems prefer more summarized reports.

8. Individuals facing more unstructured problems prefer more detailed reports.

9. Individuals facing more unstructured problems ask for more reports.

10. Individuals facing more unstructured problems make more frequent decisions.

C. How desired MIS characteristics, psychological type, and problem type affect the cost performance?

11. Type of report used has no effect on
12. Number of reports used has no effect on cost performance.

13. Frequency of decision-making has no effect on cost performance.

14. Psychological type has no effect on cost performance.

15. Problem type has no effect on cost performance.

DEFINITION OF CONCEPTS

The definition of concepts used are as follows:

1. Jungian psychological types. Jung indicates four psychological functions: sensation, intuition, thinking, and feeling. The first two functions are used for perceiving the environment, while the last two functions are used for judging what is perceived. Depending on what function the individual prefers to use for perceiving s/he is referred to as sensation type or intuition type. In the same way, an individual is labeled as thinking type or feeling type based on her or his preference for using
one of the functions, thinking or feeling, for judging.

2. The nature of the problem. The nature of the problem refers to the level of "structuredness" of the problem. In this experiment two problem situations are created, one more structured than the other.

3. Preference for MIS characteristics. This refers to preference for variations of three MIS characteristics: preference for using summarized versus detailed reports; preference for number of reports used for decision-making; and preference for frequency of decision-making.

4. Decision-maker's cost performance. It refers to decision-maker's total inventory cost which is dependent on the inventory decisions made by the decision-maker. This cost represents decision-maker's performance and it is a measure of information system effectiveness.

PREVIEW

In the following chapter the literature relevant to
this study is reviewed. Chapter 3 provides a discussion of the research framework, the procedure and the tools used to collect data, and the methods of data analyses. The results of the analyses are presented in Chapter 4. Finally, the last chapter contains the discussion of the findings and their implications, some problems faced with in this study, the conclusions, and some suggestions for future research.
CHAPTER 2

REVIEW OF LITERATURE

In this chapter the literature related to this study is reviewed. In the first section some basic frameworks for MIS research are discussed. The discussion of these frameworks reveals what are considered to be the important factors that affect MIS design. It also gives a better understanding of how this study fits within the frameworks and the overall theory of MIS. Since decision-making approach was selected as one independent variable, some models of decision-making approach are discussed in the second section. Problem type, another variable included in this study, is reviewed in the third section. Finally, some relevant empirical studies in MIS are reviewed in the last section.

FRAMEWORKS FOR MIS RESEARCH

In recent years more attention has been given to research on MIS design which has resulted in some proposed frameworks for research in this area. The various frameworks indicate the variables considered important in improving the effectiveness of an MIS.
Gorry and Scott Morton

Gorry and Scott Morton (1971) try to provide a better perspective of the field by developing a framework that focuses on differentiating the managerial activities and how decisions are made within an organization. They use Anthony's (1965) categories of managerial activities: strategic planning, management control, and operational control, and Simon's (1960) distinction between programmed and nonprogrammed decisions to develop their framework. By putting these two categories together they construct a matrix (Figure 1) of managerial decisions. It is explained that the information requirement and appropriate decision model for each cell of the matrix are different and that these differences should be considered in design of an MIS.

Mock

Mock (1973) concentrates on behavioral aspects of the decision-maker and their effect on selection of an information system. He states:

Selection of the preferred information structure involves analysis of the characteristics of the information process and an evaluation of the decision process, expected decision-maker behavior and payoff (Mock, 1973, p. 41).
**Figure 1. Gorry and Scott Morton's Framework**

<table>
<thead>
<tr>
<th>Operational Control</th>
<th>Management Control</th>
<th>Strategic Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured</td>
<td>Accounts Receivable</td>
<td>Budget Analysis</td>
</tr>
<tr>
<td></td>
<td>Order Entry</td>
<td>Short-Term Forecasting</td>
</tr>
<tr>
<td>Semi-structured</td>
<td>Production Scheduling</td>
<td>Variance Analysis</td>
</tr>
<tr>
<td>Unstructured</td>
<td>PERT/COST System</td>
<td>Sales and Production</td>
</tr>
</tbody>
</table>

He believes a better understanding of the decision-maker's behavior will enhance the designer's ability to select a system which increases the payoff. He considers three aspects of the user's behavior: individual/psychological variables, organizational and interpersonal variables, and sociological and environmental variables. The classification of each variable is shown in Figure 2. Mock stresses the need for empirical research for checking the relevancy of these variables.

Lucas

Lucas (1973) focuses on organizational behavior aspects of development and operation of an information systems. He believes the behavioral problems that MIS can cause will hinder the effectiveness of the system. He mentions two of these problems:

The development and operation of information systems can drastically alter power relationships in the organization and can create the potential for dysfunctional conflict to develop (Lucas, 1973, p. 36).

He presents a descriptive model (Figure 3) to guide research on information systems within the context of the organization. He does not discuss the variables of his model in depth, but he gives fifteen propositions discussing the relationship among variables. The propositions are helpful
Individual/Psychological Variables

1. Attitudes—Empathy, Value Structure, etc.
2. Intelligence, Analytical Skill.
5. Perception of Organization Goals, Rewards, etc.
8. Physical Skills.
9. Experience and Education.

Organizational and Interpersonal Variables

1. Formality of the Information System.
   b. Decision Levels.
   c. Management Style (X, Y, or Z).
   d. Norms, Roles, etc.

Social and Environmental Variables

1. Culture.
2. Legal System.
4. Political Realities.
5. Environmental Complexity, Noxity, Eucity.

Figure 3. A Descriptive Model of Information Systems in the Context of the Organization

in guiding empirical research.

Chervany, Dickson, and Kozar

Chervany, Dickson, and Kozar (1972) believe that management information systems are developed by heuristic methods, based on designer's past experience. This approach is based on some false assumptions and does not consider the differences among decision-makers, information system characteristics, and decision environment. The authors see a need for research on information system design. To achieve a better result from research efforts, an organized research plan is necessary. Therefore, they set up their research framework by indicating the key variables of an MIS. Three independent variables are indicated: decision-maker, decision environment, and the characteristics of information system. These variables are considered important in affecting the decision effectiveness, the dependent variable. For each of the above variables, the sources of variations, which may affect the decision-maker's performance, is indicated. These variables are shown in Figure 4. Experimental gaming is proposed as the research method for acquiring knowledge about the relationships of these variables and their impact upon MIS analysis and design.
Figure 4. Independent and Dependent Variables Influencing Information Systems Design

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>The Decision Maker</th>
<th>The Decision Environment</th>
<th>The Characteristics of the Information System</th>
<th>Decision Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Indirectly Acquired Attributes</td>
<td>1. Function</td>
<td>1. Format</td>
<td>1. Quality</td>
<td></td>
</tr>
<tr>
<td>- Finance</td>
<td>- Content</td>
<td>- Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Production</td>
<td>- Form</td>
<td>- Profit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Marketing</td>
<td>- Presentation</td>
<td>- Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Personnel</td>
<td>Media</td>
<td>etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- R &amp; D etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Directly Acquired Attributes
- Training
- Experience

2. Level
- Strategic
- Tactical
- Operational

3. Environmental
- Stability
- Competitiveness
- Time Pressure

3. Decision Aids

Source: Chervany, Dickson, and Kozar, 1972, p. 9.
Mason and Mitroff (1973) consider five classes of variables in their framework. They define MIS as:

An information system consists of, at least, a person of a certain psychological type who faces a problem within some organizational context for which he needs evidence to arrive at a solution, where the evidence is made available through some mode of representation (Mason and Mitroff, 1973, p. 475).

In this definition, the authors indicate the key variables affecting the MIS effectiveness. They believe the MIS designers are guilty of ignoring the variations of these variables and their impact upon MIS effectiveness. More specifically, the designers assume only one underlying psychological type, one class of problems, one or two methods of generating evidence, and one mode or method of presentation.

In their effort to set up a framework for a systematic research on MIS, Mason and Mitroff explain the variations for each key variables. The key variables and their variations are shown in Figure 5. The authors stress the need for more research on the field to find out more about the impact of different states of the key variables on design of MIS.

Ives, Hamilton, and Davis (1977) make a review of
Figure 5. Variables Influencing MIS Design

1. Psychological Type
   (a) Thinking - Sensation
   (b) Thinking - Intuition
   (c) Feeling - Sensation
   (d) Feeling - Intuition

2. Class of Problems
   (a) Structured
      (1) Decisions under certainty
      (2) Decisions under risk
      (3) Decisions under uncertainty
   (b) Unstructural - "Wicked" Decision Problems

   (a) Lockean IS (Data Based)
   (b) Leibnitzian IS (Model Based)
   (c) Kantian IS (Multiple Models)
   (d) Hegelian IS (Deadly Enemy - Conflicting Models)
   (e) Singerian - Churchmanian IS (Learning Systems)

4. Organizational Context or Organizational Class of Problem
   (a) Strategic planning
   (b) Management control
   (c) Operational control

5. Modes of Presentation
   (a) Personalistic
      (1) Drama - Role plays
      (2) Art - Graphics
      (3) One-to-One contact group interaction
   (b) Impersonalistic
      (1) Company reports
      (2) Abstract models - computerized information systems

frameworks for MIS design and discuss the shortcomings and advantages of each. They believe that each framework has a limited focus of the MIS field, and they see a need for a common framework which would be broad enough to facilitate the categorization of all previous MIS frameworks and research. With this in mind, the authors present a broad framework for MIS research. They include three classes of variables: environmental variables, information system characteristics, and process variables. The classification of each variable is shown in Figure 6. After a discussion of each variable, the authors divide the MIS research into five categories, depending on combinations of variable classes included in the research. They mention some examples of empirical studies in each category.

In this section six frameworks for the MIS research have been discussed. All of the frameworks propose that the effectiveness of an MIS can be affected by different variables. Based on the background and interest of the authors each framework emphasizes a slightly different set of variables. While Gorry and Scott Morton (1971) stress the type of managerial decisions, Mock (1973) emphasizes behavioral aspects of the decision-maker, and Lucas (1973) focuses on organizational behavior aspects. Chervany, et al. (1972)
Figure 6. A Broad Model for MIS Research

The Environmental Variables

1. External Environment.
2. Organizational Environment.

The Information System Characteristics

1. Content.
2. Presentation Form.
3. Time of Presentation.

The Process Variables


and Mason and Mitroff (1973) provide two more comprehensive frameworks. Both frameworks concentrate on some characteristics of the decision-maker, decision environment, and information system. Considering all the above frameworks, Ives, et al. (1977) try to develop a framework to be broad enough to include all different variables discussed in previous frameworks.

Each of the above frameworks can be used to guide a researcher's efforts. It is important for the researcher to select a framework for constructing the experiment. Chervany stresses this point:

I would like to challenge MIS researchers to choose explicitly a framework. It does not matter which one you choose....The important thing is that you explicitly choose. The choice will help you to organize your research. In addition, the choice will help your MIS colleagues to understand the relevant context (or biases?) necessary to interpret and evaluate your results (Chervany, 1973, p. 181).

The Mason and Mitroff's framework was selected for this experiment. This study includes two of the independent variables enumerated in their framework: decision-maker's cognitive style and problem type. A review of literature related to these two variables is presented in the next two sections of this chapter.
DECISION-MAKING APPROACH

Decision-making approach is also called cognitive or management style. This concept recognizes that the same information can be perceived and processed differently by different decision-makers and this difference in perception and processing can affect the decision outcome. Recently, some authors have tried to differentiate and define decision-making approaches. Some typologies have been made, but as the field is relatively new, no typology has gained general acceptance. Some of these typologies are reviewed in this section.

Jung

Mason and Mitroff (1973) suggest the use of Jungian personality types as an indicator of decision-making approach of the manager. Jung specifies four basic functions that are present in every individual: sensation, intuition, thinking, and feeling. These functions are defined as:

Sensation perceives things as they are and not otherwise....Intuition perceives likewise, but less through conscious apparatus of the senses than through its capacity for an unconscious inner perception of potentialities in things....Thinking is the function which seeks to reach an understanding of the world and an adjustment to it by means of an act of thought, of cognition,
i.e., of conceptual relations and logical deductions. Feeling apprehends the world on the basis of an evaluation by means of the concepts 'pleasant or unpleasant, adience or avoidance' (Jacobi, 1954, pp. 14-15).

The first two functions are used to perceive, becoming aware of, the environment. Although both of these functions are present in everyone, each individual has a preference in using one of them. The sensation type relies primarily on his senses for perceiving the environment. He is concerned with facts and details. The intuitive passes the details carelessly and concentrates on possibilities and potentialities. He extrapolates the facts.

The other two functions, thinking and feeling, are used to judge, coming to a conclusion about, or evaluating what has been perceived. As with the other two functions, each individual has a preference to use one of them, thinking or feeling. The thinking type evaluates by using cognitions, looking for true or false results, and using objective values. The feeling type evaluates by using emotions, looking for good or bad, likes or dislikes results, and using personal and subjective values.

These functions are not equally developed and used by an individual, rather a person develops a preference for one function of perceiving and one function of judging.
Whichever function is preferred becomes dominant and the alternate function remains undeveloped. Due to practice of the preferred function, it becomes more trustworthy and more dominant. Most people have consistent preference and can be characterized by the preferred functions. Although the alternate function is undeveloped, the individual has the capacity of using them at least temporarily in some situations. Evidence concerning the preferences were reported in the studies mentioned by Myers-Briggs (1962) and Mogar (1969).

Jung's theory indicates that many apparently random variations in human behavior are actually consistent and are explained by the way an individual prefers the use of psychological functions.

The combinations of these four functions can lead to four psychological types: thinking-sensation, thinking-intuition, feeling-sensation, and feeling-intuition; shown in Figure 7. The functions for perception and evaluation that are preferred will affect directly the behavior of the individual, and differences in perception and evaluation will result in corresponding differences in behavior. Mason and Mitroff (1973) believe these differences are important and may have an impact upon design of an MIS.

The test used for indicating the preferences of an
Figure 7. Jungian Psychological Type

Source: Jacobi, 1954, p. 17.
individual is the Myers-Briggs Type Indicator (Myers-Briggs, 1962). This test is discussed in the next chapter.

**McKenney and Keen**

McKenney and Keen (1974) present a model of cognitive style which has some similarities with Jung's. Their model is based on two premises: consistent modes of thought develops through training and experience, and these modes can be classified along two dimensions—information-gathering and information-evaluation. This model is shown in Figure 8.

**Figure 8. McKenney and Keen's Model of Cognitive Style**

<table>
<thead>
<tr>
<th>Information Gathering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptive</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Information Evaluation</td>
</tr>
<tr>
<td>Systematic</td>
</tr>
<tr>
<td>Receptive</td>
</tr>
</tbody>
</table>

Source: McKenney and Keen, 1974, p. 81.
The information gathering refers to the perceptual process by which the individual receives the stimuli in the environment. This process is selective, it receives some stimuli while rejecting some others. This dimension is categorized into two modes--receptive and perceptive. The authors define these modes as:

**Receptive thinkers** are more sensitive to stimulus itself. They focus on detail rather than relationships and try to derive attributes of the information from direct examination of it instead of from fitting it to their percepts.

**Perceptive individuals** bring to bear concepts to filter data; they focus on relationships between items and look for deviations from or conformities with their expectations. Their percepts act as cues for both gathering and cataloging the data they find (McKenney and Keen, 1974, pp. 80-81).

The information evaluation refers to the process of problem-solving. As in information-gathering, individuals differ in their approach to evaluation of information received. Two modes of information evaluation are indicated as systematic and intuitive. They are defined as:

**Systematic individuals** tend to approach a problem by structuring it in terms of some methods which if followed through, lead to a likely solution.

**Intuitive thinkers** usually avoid committing themselves in this way. Their strategy is more one of solution testing and trial and error. They are much more willing to jump from one method to another, to discard information and to be sensitive to cues that they may not be able to identify verbally (McKenney and Keen, 1974, p. 81).
It is apparent that this model is similar to Jung's. While Jung considers the overall human behavior, McKenney and Keen are concerned only with problem-solving behavior. Considering the information-gathering modes, the receptive type parallels the sensation type, while the perceptive type parallels the intuition type. The definitions of the information-evaluation modes may not show a very close similarity to Jung's model. However, McKenney is an experiment found that some subjects who made high scores on intuitive capacity made high scores on feeling scale of the Myers-Briggs test. Also, some subjects who were classified as systematic thinkers were classified as thinking types in Jung's model (Keen and McKenney, 1973).

Doktor

Another model of cognitive style is presented by Doktor in his dissertation (Doktor, 1969). This model is very similar to McKenney's. Doktor uses two dimensions for defining cognitive style, shown in Figure 9.

One dimension represents the perceptual process, how individuals organize and represent data stimuli. The two modes of this dimension are called symbolic and iconic. The symbolic type parallels the perceptive type as defined by McKenney, while the iconic type parallels the receptive type.
Figure 9. Doktor's Cognitive Model

Source: Benbasat, 1974, p. 28.

The other dimension represents the problem-solving or information evaluation. The modes of this dimension are defined as logical-analytic and intuitive which correspond to McKenney's systematic and intuitive modes respectively.

Using this model Doktor found a strong relationship between the subject's symbolic-iconic type and their major field of study in college.

Witkin

Witkin et al. (1962) uses field-dependence-independence dimension to differentiate individuals based on differences of their perception. They define this dimension as:
The person with a more field-independent way of perceiving tends to exercise his surroundings analytically, with objects experienced as discrete from their backgrounds. The person with a more field-dependent way of perceiving tends to experience his surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field or context (Witkin et al., 1962, p. 35).

Field-dependence-independence is a measure of the influence of the field, surroundings, on the subject's perception of items within it. To measure this characteristic, the authors suggest some tests such as: Body Adjustment Test, Rod and Frame Test, and Embedded Figure Test.

The above difference in perceptual process can manifest itself as well in problem-solving activities. Problem-solving situations often require that parts be separated from the context and brought into new relationships. The authors state:

It is likely...that if a person has his basic ability to 'break up' a configuration it will be manifested not only in straightforward perceptual situations, but in problem-solving situations as well (Witkin, et al., 1962, p. 59).

Doktor and Hamilton (1973) used the Witkin's cognitive model to investigate the effect of cognitive style and report presentation styles on acceptance of management science recommendations. Researchers classified the subjects into two groups--high analytic (field-independent) and low analytic
(field-dependent). Then, they provided some members of each group with one of the two different report styles: analytic report and general report. They found that managerial acceptance behavior was influenced by the style of presentation. Also, it was demonstrated that the low analytic group accepted more often than the high analytic group.

Huysmans

Huysmans (1970) suggests a cognitive model somewhat different from Witkin's. He differentiates two ways of reasoning--analytic and heuristic. They are defined as:

Analytic reasoning. This type of reasoning reduces the problem situation to a core set of underlying causal relationship. All effort is directed toward detecting these relationships and manipulating the decision variables (behavior) in such a manner that some 'optimal' equilibrium is reached with respect to the objectives. A more or less explicit model, often stated in quantitative terms form the basis for each decision.

Heuristic reasoning. This type of reasoning emphasizes workable solutions to total problem situations. The search is for analogies with familiar solved problems....Common sense, intuition, and unquantified 'feelings' about future developments play an important role to the extent they are applied to the totality of the situation as an organic whole, rather as built up from clearly identifiable separate parts (Huysmans, 1970, p. 95).

Using the above cognitive model, Huysman investigated the impact of cognitive style differences between management scientists and managers on the managerial implementation of
recommendations. After grouping the subjects according to their cognitive style, some members of each group were treated to one of the two styles of report presentations: "explicit" operations research argument aimed at gaining the subjects' explicit understanding, and "integral" operations research argument aimed at gaining the subjects' general understanding. The experimental task required the subjects to accept, and later actually use, the operations research proposal. Huysmans found that the cognitive style was not a significant factor in affecting the acceptance behavior of the subjects. However, he found that the heuristic subjects receiving the explicit reports had a lower degree of actual use of the proposal, indicating the importance of cognitive style of the manager in use of the management science recommendations.

Mock, et al. (1972) and Barrett (1973) conducted empirical research using the above cognitive model. These two experiments are reviewed in the last section of this chapter.

Schroder, Driver, and Streufert

Schroder, et al. (1967) are concerned with human information processing. They indicate that the levels of
human information processing depends on two interdependent characteristics: the number of parts or dimensions and the complexity of integrating rules. As the number of parts or dimensions increases, the ability of the individual in differentiating the stimuli received from the environment increases.

The complexity of integrating rules can vary among individuals. The authors define the two extremes of this integrative complexity as:

Low integration index is roughly synonymous with a hierarchical form of integration, in which rules and programs are fixed. Schemata for organizing alternate sets of rules are not present. Consequently, ... the relationship between the parts are relatively static....

High integration index structures have more connections between rules; that is, they have more schemata for forming new hierarchies, which are generated as alternate perceptions or further rules for comparing outcomes. High integration structures contain more degree of freedom, and are more subject to change as complex changes occur in the environment (Schroder, et al., 1967, p. 7).

It is indicated that the integrative complexity structure is the more important factor, compared to the number of dimensions, in indicating the level of information processing. The number of dimensions taken alone has no necessary relationship to the level of information processing; however, the greater the number of dimensions, the greater the possibility of developing integratively complex connections or rules.
As the number of dimensions and the complexity of integrating rules increases, the information processing ability increases. The authors have used the words "concrete" and "abstract" to define the two extreme positions, low and high respectively, on the continuum of information processing level.

Schroder, et al., suggest some tests which can indicate the number of dimensions and the integrative complexity structure of an individual.

In this section six models of decision-making approach were reviewed. From this review it can be seen that there are some similarities among these models. Most of these models try to define and differentiate the decision-making approach according to two dimensions—perception and problem-solving activity. Figure 10 lists the six models and the modes of their dimensions. Although each model has somewhat different definitions for the dimensions and the modes of each dimension, it is likely that these models ultimately measure the same characteristics. Some tests have been suggested for classifying individuals according to each model discussed in this section. The Jungian model as operationalized with the Myers-Briggs Type Indicator is used in this research.
Figure 10. A List of Six Models of Decision-Making Approach

<table>
<thead>
<tr>
<th>Author</th>
<th>Perception Modes</th>
<th>Problem-solving Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jung</td>
<td>Sensation, Intuition</td>
<td>Feeling, Thinking</td>
</tr>
<tr>
<td>McKenney</td>
<td>Receptive, Perceptive</td>
<td>Intuitive, Systematic</td>
</tr>
<tr>
<td>Doktor</td>
<td>Iconic, Symbolic</td>
<td>Intuitive, Logical-Analytic</td>
</tr>
<tr>
<td>Witkin</td>
<td>Field-Dependent, Field-Independent</td>
<td>Field-Independent, Field-Dependent</td>
</tr>
<tr>
<td>Huysmans</td>
<td>- - - - - - - - - - - -</td>
<td>Heuristic, Analytic</td>
</tr>
<tr>
<td>Schroeder, et al.</td>
<td>Number of dimensions or parts</td>
<td>Complexity of Integrative rules (Concrete, Abstract)</td>
</tr>
</tbody>
</table>
Another variable considered important by the Mason and Mitroff's framework is the nature of the problem that the decision-maker is facing. The nature of the problem is a treatment variable in this study. In this section different patterns or classifications of the nature of problems are reviewed.

The nature of the problem is viewed as a continuum with "programmed" problems at one extreme and "nonprogrammed" problems at the other extreme (Simon, 1960). The use of a continuum is to stress that there existed many types of problems ranging from one extreme to the other. Simon defines programmed and nonprogrammed decisions as follows:

Decisions are programmed to the extent that they are repetitive and routine, to the extent that a defined procedure has been worked out for handling them so that they don't have to be treated de novo each time they occur.

Decisions are nonprogrammed to the extent that they are novel, unstructured, and consequential. There is no cut-and-dried method of handling the problem because it has not arisen before, or because its precise nature and structure are elusive and complex, or because it is so important it deserves a custom-tailored treatment (Simon, 1960, pp. 5-6).

The term "structured" and "unstructured" has been used for programmed and nonprogrammed to stress less dependence on the computer and more dependence on the problem-solving activity.
Structured problems are divided into three groups: decision-making under certainty, decision-making under risk, and decision-making under uncertainty (Gavett, 1968, p. 35). This categorization is based on the knowledge of the variables, states of nature, that influence the decision but are only partially or not at all controlled by the decision-maker. If events, alternative values, of a given state of nature are known with certainty, the problem is called decision-making under certainty. The problem is called decision-making under risk if events are known probabilistically. Finally, if the events are unpredictable, the problem is called decision-making under uncertainty.

Reitman (1964) uses a similar continuum for defining the nature of the problem, with "well-defined" problem in one extreme and "ill-defined" problem in the other. He classifies the ill-defined problems based on the three-component vector: initial state, desired state, and transformation. The initial state is the current state of the decision-maker or the resource available to him. The desired state is a goal or target he is trying to achieve. The transformation is the process which is required to move from initial state to desired state. A problem is classified depending on the
extent of the decision-maker's familiarity with the three components. Figure 11 shows four problem types.

In a well-defined problem all three components are known, while in an ill-defined problem any of three components or a combination of them is unfamiliar to the decision-maker.

Chervany, Dickson, and Kozar (1972) indicate the dynamics of decision-making environment as a source of variation of the nature of the problem. The decision-making environment can be stable or fluctuating. This classification is closely related to the previous classification, structured and unstructured problems. In a stable environment familiar problems are repeated more often, the key variables changes less rapidly, so a definite procedure can be worked out. Therefore, usually the problems in a stable environment are more structured than problems in a fluctuating environment.

Management science literature in general and MIS literature in particular have mainly been concerned with structured problems and have given little or no treatment to unstructured problems, while most of the real management problems are unstructured (Mason and Mitroff, 1973, p. 480). This study attempts to compare decision-making in a
Figure 11. Types of Problem Structure

<table>
<thead>
<tr>
<th>Problem Type</th>
<th>Initial State</th>
<th>Terminal State</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I, Resource Specification Problems</td>
<td>Unfamiliar</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td>Type II, Goal Specification Problems</td>
<td>Varies</td>
<td>Unfamiliar</td>
<td>Varies</td>
</tr>
<tr>
<td>Type III, Creative Problems</td>
<td>Varies</td>
<td>Varies</td>
<td>Unfamiliar</td>
</tr>
<tr>
<td>Type IV, Well-Structured Problems</td>
<td>Familiar</td>
<td>Familiar</td>
<td>Familiar</td>
</tr>
</tbody>
</table>

relatively unstructured situation to a more structured situation and to investigate the impact upon selected MIS characteristics and effectiveness.

**MIS EMPIRICAL STUDIES**

In this section some empirical studies that dealt with MIS design are reviewed. It is not the purpose of this section to make a thorough review of the studies in the field, rather the experiments related to previously discussed frameworks and variables were reviewed. Van Horn (1973) provided a general review of empirical studies in MIS.

**Mock, Estrin, and Vasarhelyi**

Mock, Estrin, and Vasarhelyi (1972) conducted an experiment to investigate the relationship between decision approach and payoff differences, decision time, and rate of learning. The experiment was conducted using twenty-five businessmen and forty-seven students who were asked to reach business-type decisions by interacting with a business simulation game for fifteen decision periods.

The researchers used the Huysman's model of cognitive style, classifying the subjects into two groups—analytic and heuristic. The profit, input cost, and the decision time were to measure the performance of the subjects in the game.
It was demonstrated that the analytic group outperformed the heuristic group both in terms of profit and input cost. The analytic group performed better because of the nature of the problem. The problem could be structured as an analytical model and could be mathematically optimized.

It was found that in the early periods it took the analytic group longer than the heuristic group to make the decisions. This was explained by the tendency of analytic approach for greater degree of search, model determination, model analysis, and incorporating feedback in the process. The experiment did not support the hypothesis that in the second half of the decision-making periods, once the analytic subject had completed his model, the analytic group should take less than the heuristic group to make the decisions.

Barrett

To investigate the relationship between the decision approach, format of report, and cost performance, Barrett (1973) conducted an experiment in a simulated production gaming environment with eleven students functioning as production managers. He used the Huysmans' model of cognitive style to indicate the decision approach of subjects. He found no significant difference between the cost performance of the two groups, analytic and heuristic. The discrepancy
between the results of this experiment and Mock's (1972) was
due to differences in different decision problems, environ­
ment, and decision time available. Barrett also found that
heuristics preferred aggregated summary reports to disaggre­
gated detail reports, while analytics preferred the detailed
reports.

Chervany and Dickson

Chervany and Dickson (1974) made an experiment inves­
tigating the impact of some variations of a decision-maker's
aptitude, verbal versus quantitative, and information system
report output, raw data versus summarized data, upon the
decision-making effectiveness. They used twenty-two graduate
students of business administration in a production simula­
tion game. The subjects were divided into two groups based
on their score on the Admission Test for Graduate Study in
Business. This score was assumed to indicate the subject's
aptitude. The members of two groups were randomly assigned
to one of two information treatments—raw versus statisti­
cally summarized data. The measures of decision-making per­
formance were: total cost, decision time, and decision con­
fidence. The experiment showed that subjects receiving
summarized data had lower total cost, but took longer to make
their decision. Quantitative aptitude was associated with
lower total cost, but not significantly related to decision-making time or confidence on the quality of the decision.

Kozar

In order to investigate the question of how the use of computer data display media affected decision effectiveness, Kozar (1973) ran an experiment using graduate business students as subjects. Similar to the Chervany and Dickson experiment subjects were divided into two groups based on their aptitude, verbal versus quantitative. Two types of display mediums were used, paper hard copy and cathode ray tube (CRT). Each group of subjects, by using reports available in one of the two display mediums, had to make some decision in a production simulation game. The results indicated that CRT users took a significantly longer time to make decisions than the hard copy users. The production cost was higher for CRT group, although not significantly. There was no difference in confidence between the two groups. The aptitude, quantitative or verbal, did not cause any significant difference in measures of the decision effectiveness.

Senn

Senn (1974) conducted an experiment using industrial
purchasing agents who interacted with a procurement simulator in making a series of purchasing decisions. The purpose of this experiment was to investigate the effects of some variations of information system characteristics on decision-making effectiveness. The subjects received one of three treatments: detailed output provided by a line printer, summarized output provided by a line printer, or summarized output provided by a CRT display. The measures of decision-making performance were: total cost, decision time, and decision confidence. The results of the experiment indicated that the CRT users had the shortest decision time and line printer detail data users had the longest decision time. The decision cost and decision confidence were not significantly different among the three groups.

Barkin

In another experiment Barkin (1975) investigated the effects of cognitive style and report format on data selection aspect of human information processing. Two types of reports were produced. In one report critical information was grouped together, in the other, the critical information was mixed with noncritical information. Two different groups in terms of cognitive style were exposed to these two report formats. The results revealed a strong relationship between
cognitive style and data selection, and a less strong relationship between report format and data selection.

Benbasat

Another attempt to investigate the impact of decision-maker and information system characteristics upon decision-making performance was made by Benbasat (1974). He used students in an operations management class playing an inventory-production simulation game. The information system variations were: tabular versus graphic output format; availability versus nonavailability of decision aids; exception versus full reporting; amount of information provided, necessary versus overload. The decision-maker characteristic variations were: the decision-making style, low versus high analytic; knowledge of the functional area. The results of the experiment indicated that subjects receiving graphical output used the fewest reports and had lower cost than subjects receiving tabular output; subjects using decision aids had better cost performance but took longer to make decisions; subjects receiving overload information requested more information than those receiving necessary information; decision-maker characteristics had significant effect on the amount of reports requested, but did not affect decision time or cost performance; exception reporting had no significant
effect.

Wynne and Dickson

Wynne and Dickson (1975) performed an experiment with managers who played the role of commodity buyers and made a series of decisions in a simulated commodity buying environment. They found that the psychological measures, such as defensiveness, need achievement, and facilitating anxiety—had an impact on effectiveness of the man-machine system performance. Also, they found that presence of goals improved performance.

Schroeder and Benbasat

Schroeder and Benbasat (1975) investigated the effects of uncertainty in a decision-making environment on the desired characteristics of an information system. They used an inventory simulator. The subjects, students in a production management class, were divided into three groups. Each group was treated with a different level of uncertainty: low, medium, and high. The subjects could decide on the frequency of decision-making, amount, and type of information they received from their decision-making. The results of the experiment indicated that frequency of decision-making was not affected by the level of uncertainty.
Subjects facing high uncertainty used data with shorter history and a higher level of detail than those facing low uncertainty. The number of reports used increased from low to medium uncertainty and decreased from medium to high uncertainty.

Tiessen

In an experiment conducted by Tiessen (1976), the effects of data aggregation level, decision-maker cognitive style, and functional area knowledge on decision-making performance were investigated. The subjects were graduate students in business administration, and they made a series of decisions in simulated production environment. It was found that data aggregation level strongly affected the decision time and number of report elements selected. Functional area knowledge was significantly related to performance cost and decision time. Cognitive style had no significant impact on dependent variables, but a significant interaction effect of aggregation level and cognitive style for decision time was found.

Bariff and Lusk

Bariff and Lusk (1977) suggested that measurement and evaluation of users' cognitive style and related
personality traits--resistance to change, defense mechanisms, and stress tolerance--may provide an effective means for a successful MIS design and implementation. They presented a procedure for development of a users' behavioral profile, which can be used by MIS designers for proper preparation of report formats and implementation procedures. In a field research they used fourteen psychological tests to develop a behavioral profile for seventeen individuals, seven in administrative positions and ten in field supervisory positions. They found that cognitive style affected the perceived attraction of communicated reports. The resistance to change was low for both groups, administrative and supervisors. This showed that both groups were adaptive, but administrators were less flexible. Tests for stress level showed that it was low for both groups but administrators were more anxious. The results indicated that administrators should be handled more carefully.

The review of empirical research in MIS should increase the researcher's insight into the field. It helps the researcher in better selection of the variables included in the study and the experimental design. In summary, all of the above mentioned studies included a measure of the decision-maker's characteristics, such as: cognitive style,
knowledge of the area, experience, risk preference, needs, etc. Also, all studies included at least one system characteristic, including: type, format, or content of the reports presented, medium of presentation, availability of decision aids, etc. Decision quality, time and confidence were the widely used dependent variables of the experiments. All of these researchers used some type of simulation setting. All but four researchers used students as the subject of the study.

IMPLICATIONS OF THE REVIEW

In the first section of this chapter some frameworks for research in MIS were discussed. It is important for a researcher to select a framework for conducting the research. It helps to organize the experiment and also it facilitates communication among the researchers in the field. The framework presented by Mason and Mitroff has been adopted for this study, and decision-making approach and problem type were the independent variables selected for investigation.

Some models of decision-making approach were reviewed in the second section. Each model attempted to differentiate individuals according to their decision-making approach. Some tools were suggested for classifying people according to
dimensions of each model. A major factor in selecting a model for study was availability of such a tool and its validity and reliability. The Jungian typology was selected for this study as a measure of decision-making approach. The Myers-Briggs Type Indicator was the tool used for classifying the subjects according to Jung's model.

The problem type, as defined and discussed in the third section, is another variable included in this study. Two problem situations were created. One situation was more structured than the other.

The review of the empirical research on MIS can be useful in guiding the researcher's efforts in conducting the experiment. In this study, like most other experiments, a simulator was used to create decision settings in which some business students played the role of businessmen and made some decisions. Their behavior was observed to test the hypotheses of this study.

The framework, the variables used in this study, and the experimental design are discussed in more detail in the next chapter.
CHAPTER 3

RESEARCH DESIGN

The materials on research design are divided into three sections. The first section, experimental framework, covers the framework used and the variables included in this study. The second section, research methodology, discusses the subjects, procedures and the tools used for data collection. The technique used for analyzing the collected data is reviewed in the third section.

THE EXPERIMENTAL FRAMEWORK

The Framework

The framework proposed by Mason and Mitroff (1973), as discussed in Chapter 2, was adopted for this study. Three variables of this framework, with some modification, were selected. These included the psychological type of the decision-maker, the problem type, and some MIS characteristics. Due to experimental design and resource constraints, not all the variables mentioned in the Mason and Mitroff framework could be included in this study.
A Stimulus Response Model

For the purpose of explanation, the variables included in this study can be viewed in terms of a basic stimulus response model, as shown in Figure 12. The above-mentioned variables can be divided into three groups: stimulus variables, organismic variables, and response variables (Edwards, 1972).

Stimulus variables refer to the input treatment given to subjects. The problem type "S" was the stimulus variable in this experiment. Each subject was presented with one of the two problem types--structured and unstructured. The unstructured problem represented a more uncertain decision-making setting.

Organismic variables refer to the characteristics of the subject. In this experiment the Jungian psychological types were the organismic variables considered. As discussed in Chapter 2, the Jungian psychological types can be used as a measure of decision-making approach. Jung's model classifies the subjects along two dimensions: perception function "O₁" with the two modes of sensation and intuition, and evaluation function "O₂" with the two modes of thinking and feeling.

A response variable refers to the subject's response
Figure 12. A Stimulus Response Model

Stimulus Variable: Problem Type "S"
Organismic Variables: Psychological Type
Perception "O_1"
Evaluation "O_2"
Response Variables: MIS Characteristics
Number of Detailed Reports "R_1"
Number of Summarized Reports "R_2"
Total Number of Reports "R_3"
Frequency of Decision-Making "R_4"
Cost Performance "R_5"
to a stimulus. The response variables of this experiment included some preferred MIS characteristics, and cost performance "R_5". The MIS characteristics considered were: type of report preferred, which was actually composed of two variables, the number of detailed reports used "R_1" and the number of summarized reports used "R_2"; the total number of reports used "R_3"; and the frequency of decision-making "R_4". The subject could decide on the number and type of reports used and the frequency of decision-making in his problem solving activities.

A Review of Hypotheses

The above model is used to represent the hypotheses reviewed in the first chapter (see Figure 13). The hypotheses of this study can be divided into three groups. In the first group, the organismic variables are the independent variables, while the response variables are the dependent ones. This group includes hypotheses one through six and fourteen. The second group uses the stimulus variable as an independent variable and the response variable as the dependent one. Hypotheses seven through ten and fifteen belong to this group. The third group studies the relationships among the response variables. The preferred MIS characteristics are used as independent variables, while the
Figure 13. List of Hypotheses and Their Independent and Dependent Variables

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Independent Var.</th>
<th>Dependent Var.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>R₁</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>R₂ &amp; R₂</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>R₃</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>R₄</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>R₅</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>R₁ &amp; R₂</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>R₂</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>R₃</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>R₄</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>R₅</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>R₁ &amp; R₂</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>R₂</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>R₃</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>R₄</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>R₅</td>
</tr>
</tbody>
</table>

WHERE:

S refers to problem types

O₁ refers to perception modes

O₂ refers to evaluation modes

R₁ refers to the number of detailed reports

R₂ refers to the number of summarized reports

R₃ refers to the total number of reports

R₄ refers to the frequency of decision-making

R₅ refers to the cost performance
cost performance is the dependent variable. This group consists of hypotheses eleven, twelve, and thirteen.

An Explanatory Note

It should be explained that the above stimulus response model was used only to explain the experimental framework and the relationships among the variables included. This model does not represent the actual relationship of these variables in an MIS.

In the information system analysis and design, the decision-maker psychological type and the problem type are set variables. They are uncontrollable variables which the designer has to consider as constraints. The MIS characteristics are the controllable variables which the designer can manipulate to increase the effectiveness of the system. A measure of the effectiveness of the system considered in this study is the cost performance.

RESEARCH METHODOLOGY

Data collection was done through the use of some measurement tools which measured the desired characteristics of the subjects. The tools used in this study were a psychological type indicator and an inventory simulation game.
The Myers-Briggs Type Indicator

One variable included in this study was the psychological type of the decision-maker. The Jungian typology was used to explain the types. The data on psychological type of the subjects were collected by means of The Myers-Briggs Type Indicator (Briggs and Myers, 1976).

The purpose of the Indicator is to implement the Jung's psychological types. It categorizes the subjects based on four dimensions: extraversion or introversion, sensing or intuition, thinking or feeling, and judgment or perception. In this study only two dimensions were used. The sensing or intuition dimension indicates the individual's preference for the two opposite ways of perceiving; that is, if the individual relies mainly on her or his senses or intuition for perception function. Similarly, the thinking or feeling dimension indicates the individual's preference for the two ways of judging. This dimension categorizes people as thinking types or feeling types.

The Indicator is composed of 166 questions (Appendix A). The questions refer to a situation and make two or three statements on how the individual may feel or act in that situation. The individual has to check the statement which s/he believes is the closest one to her or his feeling or
action. Based on the individual's answers to these questions, her or his preference for the use of different functions of perception or evaluation is indicated.

This questionnaire was first published in 1943 and is widely used and accepted. Myers (1962) reviewed some of the applications of this Type Indicator. This Type Indicator has shown that there is a relationship between occupation and major fields of study in college and psychological types (Myers, 1962). Myers investigated the reliability of the Indicator with the use of a logically-split-half procedure in some applications and found that the Indicator was highly reliable.

**Inventory Simulation Game**

An inventory simulation game was used to collect data on preferred MIS characteristics and cost performance. Some aspects of the game are described in this section.

**The Decision Setting.** Each subject had to play the role of an inventory manager. The simulation game was representing a situation where the manager had to buy a product in order to meet the daily demand. The objective of the manager was to minimize the total inventory cost by deciding on quantity and timing of the replenishment orders. Also,
the manager had to decide on the next decision point, where
s/he would get information concerning the inventory situa-
tion and would make decisions for the next cycle.

The game was played for a period of 200 simulated
days. The subject could break this 200 days period into as
many decision periods as s/he desired. The minimum number of
decision periods was four. In the beginning of each decision
period, the subject would decide on number, quantity, and
the timing of replenishment orders to cover the demand during
that decision period.

At the end of the decision period, the subject could
get some information concerning the inventory situation. No
information was provided to the subject automatically. The
information concerning different aspects of the inventory
system was arranged in twenty-five reports containing dif-
ferent amounts of information in various formats. The sub-
ject could ask for any report which s/he would consider to
be useful in improving her or his next set of decisions.
The subject was charged for each report, therefore, s/he
presumably would not ask for a report unless it would be con-
sidered useful in making better decisions.

Each report contained only the information of the
last decision cycle. The twenty-five reports covered thirteen
aspects of the inventory system including demand, lead time, inventory level, backordered demand, lost demand, units received, outstanding orders, holding cost, backorder cost, order placement cost, lost demand cost, total inventory cost, and information cost. The information concerning the first twelve aspects were provided in two formats, detailed reports and summarized reports. The list of reports and their content is represented in Appendix B.

The information obtained through reports could give the subject more insight into the situation s/he was facing.

By analyzing these reports the subject could modify her or his decisions for the next decision periods.

The Probabilistic Nature of the Decision Setting. The subjects were divided into two groups. One group faced a more unstructured decision-making environment than the other group. Since the daily demand, lead time, lost demand, and backorder cancellation were determined probabilistically, two different decision settings were created by using different probability distributions.

For every simulation day, a demand was obtained using randomly generated normal variates. For each subject a different random number generator seed was used to obtain a unique demand and other generated variables of the game. Thus,
no two subjects faced exactly the same problem. However, the average and variance of demand distribution for all subjects in each group were the same. Table 1 shows the parameters of the normal distributions used for each group.

Table 1. Parameters of Daily Demand Distribution

<table>
<thead>
<tr>
<th>Group</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Variation of Demand with 95% Confidence Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Structured</td>
<td>600</td>
<td>25</td>
<td>550-650</td>
</tr>
<tr>
<td>More Unstructured</td>
<td>600</td>
<td>75</td>
<td>450-750</td>
</tr>
</tbody>
</table>

For each order placed a lead time was generated. The lead time was added to ordering date to get the due date of the order. The lead time was determined using a random number generator and a symmetrical distribution. The distributions used are shown in Table 2.

In case of shortage, demand could be lost or it could be backordered. This situation was decided with the use of a random number generator and a probability distribution. For the more structured group the probability of shortage getting lost was thirty percent. For the less unstructured group
there was a ten per cent chance that the shortage was lost.

Table 2. Lead Time Distribution

<table>
<thead>
<tr>
<th>Lead Time</th>
<th>More Structured Situation</th>
<th>Less Structured Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>---</td>
<td>.15</td>
</tr>
<tr>
<td>2</td>
<td>.30</td>
<td>.20</td>
</tr>
<tr>
<td>3</td>
<td>.40</td>
<td>.30</td>
</tr>
<tr>
<td>4</td>
<td>.30</td>
<td>.20</td>
</tr>
<tr>
<td>5</td>
<td>---</td>
<td>.15</td>
</tr>
</tbody>
</table>

Once the daily demand was on the backorder list, it had to be met in a few days, otherwise it would be cancelled. For the more structured group the backordered demand would remain on the list for four days. At the end of the fourth day, if not met, the demand was cancelled and lost. For the less structured group, there was a chance that the backordered demand would be cancelled every day after its initiation. Table 3 shows this probability of cancellation.
### Table 3. Probability of Backorder Cancellation

<table>
<thead>
<tr>
<th>Days After Demand Is Backordered</th>
<th>Probability of Backordered Demand Cancellation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.30</td>
</tr>
<tr>
<td>2</td>
<td>.50</td>
</tr>
<tr>
<td>3</td>
<td>.70</td>
</tr>
<tr>
<td>4</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Cost Parameters.** The objective of each subject was to minimize total inventory cost for the 200 days period. Total inventory cost was composed of ordering cost, holding cost, backorder cost, lost demand cost, and information cost. These costs were the same for both experimental groups, as follows:

- **Ordering cost:** the cost of placing an order was $100.
- **Holding cost:** the cost of holding one unit of product for one day was $.05.
- **Backorder cost:** the cost of demand being backordered was $30 per occurrence. The number of units of the backordered demand and how long it
would take to meet the backordered demand was irrelevant in backorder cost calculation. Any time any portion of the daily demand was back-ordered, the subject was charged $30.

...Lost demand cost: the cost of lost demand was $.50 per unit of demand being lost.

...Information cost: the information cost was how much the subject was charged for getting reports. The reports were divided into two groups: detailed and summarized reports. The cost of getting a detailed report was $7, and the cost of getting a summarized report was $5.

The reason for charging the subject for reports was to avoid a situation where s/he would ask for all the reports and then would use some of them as s/he preferred. Rather, the subject had to decide what report s/he preferred to use and then to order them to avoid additional cost. In the latter situation, the preference of the subject for the type and number of reports used can be measured. On the other hand, the cost of reports compared to other costs was very low. Thus, the information cost was only a minor element of total inventory cost and could very easily be justified by the cost savings this information might generate.
**Computer Program.** A program was designed to represent the decision setting discussed in the previous sections. This program was composed of two major parts: record keeping and report generating, and the inventory simulator.

The first part of the program set up a file for each subject. Each time a subject made a decision run, the program would update the file of the subject. When a subject asked for some reports, this program could generate the reports in the proper format and update the record of total cost and some other variables for the latter analysis.

The second part of the program was a modified version of an inventory simulation designed by Meier, Newell, and Pazer (1969, pp. 337-354). When a subject made a decision run, this part used the subject's file accessible through part one, and using the new decisions, it operated the simulation for the number of days requested. The simulator maintained the state of the inventory system at the end of the decision period, and provided the first part of the program with this information. When a subject asked for a report, the simulator was not used. A flow chart of the simulator is shown in Figure 14.
Figure 14. Flow Chart of the Simulator

1. Read next decision point, timing, and quantity of orders
2. Indicate the lead time and due date for orders placed
3. Set the clock
4. Check for outstanding orders, if any order is received today
   - Yes: Update inventory level
   - No: Meet the backorder
     - Yes: Update inventory
     - No: Update backorder queue and calculate lost demand
5. If there exist any backordered demand
   - Yes: If inventory is greater than backordered demand
     - Yes: Update backorder queue and calculate lost demand
     - No: If the backordered demand is cancelled
       - Yes: Update backorder queue and calculate lost demand
       - No: Generate demand
   - No: Generate demand
Figure 14. Continued

If inventory can cover demand

Yes

Update inventory

Update the date

If date is equal to next decision point

Yes

STOP

If the unmet demand is lost

Yes

Calculate lost demand

No

Update Backorder queue

No

If date is equal to next decision point

Yes

STOP
The Validity of the Simulator. The validity of the simulator had to be checked to assure that it actually represented the decision setting for which it was designed. Some different methods were used for this validity appraisal.

The simulator was composed of several modules. Each module was run separately to test its functioning. Once the modules were put together, several test runs were made with every variable read, generated, or calculated by the simulator printed for every day. The accuracy of these variables was checked by hand.

Another method to check the validity of the simulator was to make multiple runs using different values for the input variables, especially the extreme values. The experimenter made over 300 runs testing different situations. Also, students volunteered in the prior semester to participate in a pilot run of the experiment. Finally, the trial run in the same semester of the actual experiment was another step in checking the mistakes students could make and their effect on the functioning of the simulator.

Subjects and Procedure

The subjects of this experiment were sixty-three undergraduate students enrolled in three sections of an
Operations and Information Systems course. The game was part of the course requirements. All students were expected to participate in the simulation game, however, answering the Indicator questionnaire was voluntary. Students could withdraw from the experiment by not answering the questionnaire. Two students refused to participate in the experiment. Approximately twelve per cent of the student's final grade depended on participation and performance in the game. The student's grade on the game depended on her or his total cost of the inventory game—the lower the cost, the higher the grade. There were no prespecified limits set for the total cost, rather students were compared to each other. Thus, the students were encouraged to do their best to make better decisions and come up with the lowest cost.

Early in the semester each subject was given the Type Indicator questionnaire to answer. Based on this Type Indicator the subject was classified as one of the four following types: sensation-thinking, sensation-feeling, intuition-thinking, and intuition-feeling. Each group was randomly divided in half; each half received a different treatment—one half were assigned a more structured problem than the other half.

The inventory models were covered in the course and
students were tested on this. Thus, the subjects were familiar with the area and could use the inventory models for analyzing their inventory problem. After discussing the inventory models the students were allowed to make one trial run to become familiar with the computer input-output facilities, the game, and the reports. In this trial run a different set of random number generator seeds were used, thus, the demand and other generated variables of the game were different from the actual run. After all students made their trial run, the files were cleared and the actual game started from day one. Students had about one month to complete their 200 days run.

**TECHNIQUE OF DATA ANALYSIS**

**Analysis of Variance**

To test the hypotheses of this experiment, analysis of variance (ANOVA) was used. A three-way ANOVA was used to test the effect of the problem type, perception function, and evaluation function. Each factor had two classes, therefore, a $2 \times 2 \times 2$ model resulted. This model is shown in Figure 15. The same model was repeated with five dependent variables: number of detailed reports, number of summarized reports, number of total reports, frequency of decision-making, and
Figure 15. The Three-Way ANOVA Model

Unstructured Problem

Structured Problem

Perception Function

Sensation Type

Intuition Type

Thinking Type

Feeling Type

Evaluation Functions
total cost. These models are referred to as models 1 through 5. Figure 16 shows what effect of what model should be used for testing hypotheses one through ten, fourteen, and fifteen. To test hypotheses eleven, twelve, and thirteen, another three-way ANOVA--model six--was used with report type, total number of reports, and frequency of decision-making as independent variables and total cost as the dependent variable.

**Computation Procedure**

SAS76 (Bar, et al., 1976) was used to carry out ANOVA computations. The procedure used for hypotheses testing was GLM type III, which is used for ANOVA with an unequal number of observations in different classes. Other procedures of this program were used to make some additional analyses.

**SUMMARY**

The framework suggested by Mason and Mitroff was used to design this experiment. Three variables included in this study are the psychological type of the decision-maker, the problem type, and some MIS characteristics.

Sixty-three students of an Operations and Information Systems course participated in this experiment. The Myers-Briggs Type Indicator was used to determine the subjects'
Figure 16. A List of Hypotheses with Their Relations to Models and Effects

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Model</th>
<th>Perception Effect</th>
<th>Evaluation Effect</th>
<th>Problem Type Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of detailed reports</td>
<td>1</td>
<td>$H_1$</td>
<td>$H_3$</td>
<td>$H_8$</td>
</tr>
<tr>
<td>Number of summarized reports</td>
<td>2</td>
<td>$H_2$</td>
<td>$H_3$</td>
<td>$H_7$</td>
</tr>
<tr>
<td>Number of total reports</td>
<td>3</td>
<td>$H_4$</td>
<td>$H_5$</td>
<td>$H_9$</td>
</tr>
<tr>
<td>Frequency of decision-making</td>
<td>4</td>
<td>$H_6$</td>
<td>$H_6$</td>
<td>$H_{10}$</td>
</tr>
<tr>
<td>Cost performance</td>
<td>5</td>
<td>$H_{14}$</td>
<td>$H_{14}$</td>
<td>$H_{15}$</td>
</tr>
</tbody>
</table>

$H$ stands for hypothesis
psychological type. Then, the subjects were presented randomly with one of the two simulated decision environments. One decision setting was more structured than the other. The decision settings were created by an inventory simulation game. Data on the subjects' preference for type and number of reports, frequency of decision making, and subjects' cost performance were collected, while they played the role of an inventory manager for a 200 simulated days period.

Analysis of variance was used to test the hypotheses of this experiment. The required computations were carried out with the use of SAS76.
CHAPTER 4

STATISTICAL ANALYSIS

The data collected by the Myers-Briggs Type Indicator and the simulation game, as discussed in the previous chapter, were used to test the hypotheses mentioned in Chapter 1. Analysis of variance was used to analyze the data to determine whether any one of the independent variables had a significant effect on any one of the dependent variables considered in the hypotheses. SAS76 was used to carry out the ANOVA computations.

The ANOVA procedure categorizes the observations based on the classes of the independent variables. Then, it computes the variance of the dependent variable within each class and compares it to the variance of the dependent variable between classes. The greater the between variance is compared to the within variance, the greater is the significance of the independent variable in affecting the dependent variable. An F value, the ratio of between variance to within variance is calculated for each test. With the F value and the degrees of freedom known, the level of significance can be determined. The level of significance represents the probability that the difference between the means of the
dependent variable by classes of the independent variable is not caused by the independent variable, rather it is caused by chance. Therefore, the smaller the level of significance, the stronger is the effect of independent variable on dependent variable. In this study a probability of 5 per cent or less is considered to show a strong, significant relationship between the independent and dependent variables.

PRESENTATION OF THE RESULTS

The results of the statistical analysis are presented according to six ANOVA models discussed in Chapter 3. Models one through five were three-way ANOVAs with the perception function, evaluation function, and problem type as independent variables. Since each independent variable had two classes, it resulted in $2 \times 2 \times 2$ models. The number of detailed reports, number of summarized reports, number of total reports, frequency of decision-making, and cost performance were the dependent variables used in models one through five respectively. Model six was a three-way ANOVA with cost performance as the dependent variable and the type of report preferred, the number of total reports used, and the frequency of decision-making as independent variables.

For each model two tables are provided. The first
table presents the average values of the dependent variable for each class of each independent variable and interaction of classes of these variables. Figure 17 shows the format used for this table of averages.

The second table of each model is an ANOVA table presenting the results of the analysis for the model. This table indicates whether the differences among the averages presented in the first table are significant. This table provides variables such as: mean of square for each independent variable, the between variance, and for error term, the within variance; degrees of freedom; F values; and levels of significance. In addition to the main effects, data on combinations of interactions of independent variables are provided.

In these tables the following abbreviations are used:

- P = Perception Function
- E = Evaluation Function
- M = Problem Type
- N = Sensation Type
- I = Intuition Type
- F = Feeling Type
- T = Thinking Type
- S = Structured problem
Figure 17. Format for presenting average values of dependent variable by classes of independent variables

| Perception Function | Evaluation Function | | Problem Types |
|---------------------|---------------------|----------------|
| Sensation "N"       | Feeling "F"  | Thinking "T" | Perception Function Sub Means |
| Perception Function | NFS                | NTS            | NS |
|                      | NFU                | NTU            | NU |
|                     | NF                 | NT             | N  |
|                      | IF                 | ITS            | IS |
|                     | IFU                | ITU            | IU |
|                     | IF                 | IT             | I  |
|                      | FS                 | TS             | S  |
|                     | FU                 | TU             | U  |
| Evaluation Function | F                  | T              | Overall Average |

Problem Types:
- Structured "S"
- Unstructured "U"
- Overall cell Average
Before presenting the results, the sample size and its classification by the independent variables are discussed in the next section.

CHARACTERISTICS OF THE SAMPLE

The subjects of this study were sixty-three students of an Operation and Information Systems course. The subjects were divided into four groups based on their psychological type as determined by the Myers-Briggs questionnaire. These four types were sensation-feeling, sensation-thinking, intuition-feeling, and intuition-thinking. Members of each group were randomly divided into two subgroups. Each subgroup faced one of the two problem types: structured and unstructured. Table 4 is designed similar to Figure 17 to present the classification of the subjects by three factors: perception function, evaluation function, and the problem type.

Thirty-seven of the subjects were sensation type, while twenty-six were intuition type. The subjects were almost evenly divided by classes of evaluation function, thirty-two feeling type and thirty-one thinking type. The
Table 4. Sample Size by Classes of Independent Variables

<table>
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smallest group was intuition-feeling with ten subjects, while the sensation-feeling group was the largest with twenty-two subjects. Thirty-one subjects faced the structured problem and thirty-two subjects faced the unstructured problem.

MODEL I

Model I was a three-way ANOVA with the perception function, evaluation function, and problem type as independent variables and the number of detailed reports as the dependent variable. The number of detailed reports refers to the total number of detailed reports a subject asked for during the 200 days simulation run. This information was recorded and saved by the simulator.

Tables 5 and 6 represent the means and the results of ANOVA respectively. The overall average of the number of reports is 26.9. Although Table 5 shows that there are some differences between the averages by classes of independent variables, Table 6 shows that none of the independent variables is significantly affecting the dependent variable. The lowest level of significance achieved is for interaction of perception function and problem type, with 13.46 per cent. Perception function compared to the other two independent
Table 5. Averages of Number of Detailed Reports Used by Classes of Independent Variables

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Table 6. ANOVA Table for Model 1

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</tr>
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<td>1</td>
<td>110.78</td>
<td>0.19</td>
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</tr>
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<td>M</td>
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<td>0.31</td>
<td>0.00</td>
<td>0.9818</td>
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<td>190.21</td>
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<tr>
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</table>
variables, has the lowest level of significance at 36.20 per cent.

MODEL II

Like Model I, Model II was a three-way ANOVA with the same independent variables; that is, perception function, evaluation function, and problem type, but a different dependent variable. The number of summarized reports was the dependent variable of this model. It refers to the total number of summarized reports a subject used during the 200 days simulation run.

Tables 7 and 8 give the results of the analysis of this model. The overall average number of summarized reports used is 13.1. There are some variations by classes of the perception and evaluation functions. For both factors the average of one class is almost double of the average in the other class. However, the results of ANOVA, Table 8, indicate that there is no significant relationships between independent variables and the dependent variable. The smallest level of significance is 25.99 per cent, which represents the effect of evaluation function. The perception function has a level of significance of 26.64 per cent.
Table 7. Averages of Summarized Reports Used by Classes of Independent Variables

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Table 8. ANOVA Table for Model II

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MODEL III

Similar to the two previous models, Model III was a three-way ANOVA with the same independent variables. The dependent variable was the total number of detailed and summarized reports used by the decision-maker for the 200 simulated days period.

Tables 9 and 10 represent the results of analyses of data for Model III. The overall average of the total number of reports used is 40.1. The averages by problem types are almost equal, while the averages by perception function show the largest difference, 45.2 for sensation type, compared to 32.8 for intuition type. None of the tests resulted in a probability less than 5 per cent, however, the test for the effect of perception function on total number of reports resulted in a probability of 21.01 per cent, the smallest in this model.
Table 9. Averages of the Total Reports Used by Classes of the Independent Variables

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</tr>
<tr>
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MODEL IV

Model IV, like previous models, was another three-way ANOVA with the same independent variables. The dependent variable of this model was frequency of decision-making. As discussed in the previous chapter, each subject broke the 200 days simulation period into some decision cycles. The frequency of decision-making refers to the number of these decision cycles.

Tables 11 and 12 present the Model IV results of data analysis. The overall average of frequency of decision-making is 7.7. Table 12 shows that perception function has a significant effect on frequency of decision-making at a level of significance of 2.47 per cent. On the average sensation type subjects made more frequent decisions than intuition type subjects, 8.2 compared to 7.0 respectively. The joint effect of evaluation function and problem type has the next smallest level of significance with 25.83 per cent.
Table 11. Averages of the Frequency of Decision-Making by Classes of Independent Variables

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Table 12. ANOVA Table for Model IV

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MODEL V

Model V was similar to four previous models with the same independent variables. The cost performance was the dependent variable. This cost refers to the total cost of inventory for the 200 simulated days period.

Tables 13 and 14 represent the averages and the ANOVA results of this model. The overall average cost is $22,451. The averages of the classes of the problem type show the largest difference, with a level of significance of 24.59 per cent, which is the smallest level of significance in this model.

MODEL VI

Model VI was another three-way ANOVA. As in Model V, the dependent variable was performance cost. The independent variables were: the type of report preferred, the total number of reports used, and the frequency of decision-making. A subject's preference for the type of report is determined by comparing the number of detailed reports to the number of summarized reports used by him or her. The type of report which is used more often indicates the subject's preference. Sixteen subjects used more summarized reports, while forty-four
Table 13. Averages of Cost by Classes of Independent Variables

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Table 14. ANOVA Table for Model V

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<tr>
<td>P x E x M</td>
<td>1</td>
<td>9,658,875.45</td>
<td>0.61</td>
<td>0.4371</td>
</tr>
<tr>
<td>Error</td>
<td>55</td>
<td>15,764,495.69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
subjects used more detailed reports, and three used an equal number of each type.

The total number of reports used ranged from 11 to 175. The frequency of decision-making varied from 5 to 15. In ANOVA computation all these classes were considered. However, for purpose of presentation some of these classes are combined to decrease the number of classes of these two variables. Table 15 presents the average of cost by classes of the three independent variables.

Table 16 shows the results of ANOVA. None of the independent variables affect the cost significantly. The lowest level of significance is for the frequency of decision-making at 33.89 per cent.

SUMMARY

In this chapter the results of the analyses were presented according to the six models of ANOVA discussed in Chapter 3. The findings indicated that there were some differences between the averages of dependent variable for groups classified by independent variables. However, none of the relationships tested were significant except one. The perception function affected the frequency of decision-making with a level of significance of 2.47 per cent.
Table 15. Cost Average by Classes of Independent Variables

<table>
<thead>
<tr>
<th>Report Type</th>
<th>Detailed</th>
<th>Summarized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>22278</td>
<td>23194</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Number of Reports</th>
<th>20 or less</th>
<th>21-30</th>
<th>31-40</th>
<th>41-60</th>
<th>61 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>22921</td>
<td>22428</td>
<td>22368</td>
<td>22768</td>
<td>21259</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of Decision-Making</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8 &amp; 9</th>
<th>10</th>
<th>11 &amp; more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>23506</td>
<td>22061</td>
<td>23428</td>
<td>22745</td>
<td>21114</td>
<td>20250</td>
</tr>
</tbody>
</table>
Table 16. ANOVA Table for Model VI

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Mean of Square</th>
<th>F Value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report Type Preferred</td>
<td>2</td>
<td>488,966.23</td>
<td>0.03</td>
<td>0.9668</td>
</tr>
<tr>
<td>Total Number of Reports Used</td>
<td>33</td>
<td>17,608,012.55</td>
<td>1.22</td>
<td>0.3408</td>
</tr>
<tr>
<td>Decision-Making Frequency</td>
<td>8</td>
<td>17,832,163.12</td>
<td>1.23</td>
<td>0.3389</td>
</tr>
<tr>
<td>Error</td>
<td>17</td>
<td>14,465,450.88</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Perception function compared to evaluation function and problem type, had the most significant effect on the number of detailed reports and total number of reports used. Evaluation function had the most significant effect on the number of summarized reports used. Considering the effect of three independent variables on the cost performance, the problem type had the lowest level of significance.

Comparing all independent variables, the perception function had the highest impact on the dependent variables considered in this study.
CHAPTER 5

DISCUSSION OF THE RESEARCH FINDINGS

This study was an attempt to investigate the effect of the modes of perception and evaluation functions used by the decision-maker and the problem type s/he faces on her or his preference regarding three MIS characteristics (the type of report used, the number of reports used, the frequency of decision-making) and cost performance. The impact of the preferred MIS characteristics upon cost performance was explored also.

The data collected in this experiment were analyzed and reported in Chapter 4. This presentation was arranged according to six ANOVA models. For each model the average values of dependent variables and level of significance for each independent variable and combination of their interaction were given.

The discussion of the results is presented in the first section of this chapter. Since most of the relationships tested were not significant, some probable reasons are discussed in the second section. Next, the conclusions of the study is presented. Finally, suggestions for future studies are given in the last section.
DISCUSSION OF THE RESULTS

In this section the results of this study are discussed. This discussion is arranged according to independent variables included in the study. Each independent variable is related to some hypotheses. Figure 16 in Chapter 3 shows this relationship. The hypotheses related to each independent variable are discussed together.

Perception Function

As discussed in Jung's model in Chapter 2, the perception function has two modes: sensation and intuition. An individual may mainly be sensation type or intuition type in perceiving the environment. Since the sensation type relies primarily on his senses and is concerned with facts and details, it can be suggested that s/he prefers more reports, especially detailed reports, and makes more frequent decisions; while the intuition type, who ignores the details and concentrates on potentialities, should use more summarized reports. Hypotheses one, two, four, six, and fourteen are designed to test the above suggestions and to test the effect of perception function modes on cost performance.

Hypothesis one, which was to test the effect of perception function modes on the number of detailed reports used,
was rejected. The results of Model 1 in Chapter 4 indicated that the difference of the number of detailed reports used by the two groups, sensation and intuition, was in agreement with predicted directions; that is, the sensation type on the average used 5.1 more reports than the intuition type. However, the difference was not large enough to be statistically significant.

The findings of this study did not support the second hypothesis, which stated that the individuals high in intuition prefer more summarized reports, compared to individuals high in sensation. In fact, the sensation group used almost double the amount of summarized reports as the intuition group used.

The fourth hypothesis was about the effect of perception function modes on the total number of reports used. The findings indicated that the sensation group used 38 per cent more reports than the intuition group. The level of significance for this test was 21 per cent which is too large to show a strong cause and effect relationship between the perception function modes and the total number of reports used. However, the level of significance is small enough to show a weak relationship and attract more attention to perception function modes of the users for analysis and design of an MIS.
These findings justify more research in this area to find some more conclusive results.

Hypothesis six was designed to test the effect of perception and evaluation functions on the frequency of decision-making. The results indicate that there is a strong relationship between perception modes and frequency of decision-making. The sensation group made 17 per cent more decisions in the same 200 days simulation period. The implication of this finding for MIS analysis and design is that the designer has to be responsive to this difference and set the reporting and decision-making frequency with regard to the user's perception modes.

Since it is found that the individuals can have different preferences for frequency of decision-making, further research can be justified to indicate how the match or mismatch of the user's preference with the actual frequency of decision-making of the system can affect the decision-maker's performance.

Hypothesis fourteen was about the effect of the perception and evaluation functions on the cost performance. The results indicated that in this study the perception modes did not have any significant effect on the performance.
Evaluation Function

Another function discussed in the Jung's model was evaluation. Similar to perception, evaluation has two modes: feeling and thinking; and each individual has a preference to use one of them. Since the thinking type evaluates by using cognition and objective methods, it can be suggested that s/he uses more reports to back up this way of evaluating compared to the feeling type who uses emotions and personal and subjective values for evaluation. Hypothesis five is to test this suggestion. Hypotheses three, six, and fourteen are designed to check on the effect of evaluation modes on preference for report type, preference for frequency of decision-making, and cost performance respectively.

None of the tests related to evaluation function was significant. Results indicated that the feeling group used more reports than the thinking group. The evaluation modes had no observed effect on preference for type of report, preference for decision-making frequency, and performance cost.

Problem Type

As discussed in Chapter 3, each subject had to face one of two problem types, one more structured than the other. Since in a more unstructured situation a subject feels more
uncertain, it can be suggested that s/he prefers less summarized reports, more detailed reports, more total reports, more frequent decision-making, and have higher cost performance. Hypotheses seven, eight, nine, ten, and fifteen were designed to test these suggestions respectively.

The findings of this study did not support any of the above suggestions. Actually, on the average, there was not much difference between the number of summarized, detailed, and total reports, and frequency of decision-making for the two groups. The only major difference was between the averages of the cost performance that had a level of significance of 24.59 per cent.

Considering the number of reports used, the results of this study contrast with the findings of Shroeder and Benbasat (1975), who found that the number of reports changed with the level of uncertainty. They found that the number of reports used increased with increase in the level of uncertainty from low to medium and decreased with increase in the level of uncertainty from medium to high. With regard to Schroeder and Benbasat's findings, it can be pointed out that one probable reason for not getting a significant difference in this study is the difference between the level of uncertainty of the two problem types. Either both problem
types were in medium range or none was in medium range, resulting in no difference in the number of reports used. Schroeder and Benbasat's finding is in agreement with this study regarding the effect of the problem type on the frequency of decision-making.

**System Characteristics**

The effect of preferred MIS characteristics on the cost performance was the subject of hypotheses eleven, twelve, and thirteen. These three hypotheses were to test the effects of type of report preferred, total number of reports used, and frequency of decision-making on cost performance. The findings of the study led to the acceptance of these hypotheses that these factors have no effect on the cost performance.

**Interaction Effect**

Among all the interaction effects checked there was only one which had a moderate effect on the dependent variable with level of significance of 13.46 per cent. It was the interaction of perception modes and problem types in indicating the number of detailed reports. The sensation type facing the structured problem on the average used the highest number of detailed reports, while the intuition type
facing the structured situation on the average used the lowest number of detailed reports. It can be suggested that the difference between the preference of the sensation and intuition groups increases when they face a more structured problem, rather than an unstructured problem. The same is true for preference for total number of reports used. The sensation subjects facing the structured problem on the average used the highest number of reports, while the intuition group facing the structured problem used the lowest number of reports. The implication of this finding is that the MIS designer should be more concerned with perception modes of the users if s/he is designing a system to handle relatively structured problems.

THE PROBLEM AND ITS REASONS

As it was indicated in the previous section, the findings of this study gave significant support only to one test, the effect of perception modes on frequency of decision-making. The findings did not support most of the hypotheses. This problem and some of its probable reasons are discussed in this section.
No Actual Relationship Between Independent and Dependent Variables

The first probable reason can be that there is actually no relationship between the independent and dependent variables of this study. The Jungian model was used as a measure of decision-making approach or cognitive style. It is probable that the Jungian model does not measure the characteristic which has a determining effect on the dependent variables. Unfortunately, there is no other study in the field which has used the Jungian model, so a comparison is not possible.

Another reason can be that the cognitive style, regardless of how it is measured, is not a significant factor in affecting the MIS effectiveness and decision-maker's performance. Eight of the studies reviewed in Chapter 2 used cognitive style as an independent variable. Except Mock et al. (1972) and Chervany and Dickson (1974), no other research reported a significant relationship between cognitive style and a measure of decision-making performance. However, significant results were found for the relationship of cognitive style and some other variables such as: data selection, found by Barkin (1975); amount of reports used, found by
Benbasat (1974); attraction of communication reports found by Bariff and Lusk (1977), etc. It is possible that there has been too much emphasis on the user's cognitive style as a major determinant of MIS effectiveness.

**Not Complicated Enough Decision Setting**

Another possibility is that the decision setting was too simple. The experiment was conducted with the use of an inventory simulation game which created the decision setting. It is possible that if a more complex decision setting was created, more significant results could be obtained. For example, it may be possible to differentiate the behavior of subjects with different evaluation modes better if decision setting becomes more complex.

In an organization it is not only the nature of the problem or some characteristics of MIS which determine the behavior of a given psychological type, rather there are many other factors which directly or indirectly affect the subject's behavior. Some of these factors may have to be distinguished and included in the experiment to get a better result. In other words, it is possible that the absence of some necessary factors and/or presence of some factors which should not be included, controllable or uncontrollable, have caused this problem of not getting more significant results.
Small Sample Size

It was shown in Chapter 4 that in some cases the differences between the averages of the dependent variable by classes of independent variable were high; however, the ANOVA results indicated that they were not significant. What explains this paradox is the high value of variance within the classes of the independent variables. Appendix C presents the mean, standard deviation, minimum value, and maximum value of dependent variables by classes of independent variables.

One reason for a large variance is that the independent and dependent variables are not related. However, there may be a relationship between the independent and dependent variables, but the sample used is not large enough to show this relationship. In a situation with large variances within classes of independent variables it is probable that an increase in the sample size can lead to more significant results.

CONCLUSION

The purpose of this study was to investigate the effect of a decision-maker's perception and evaluation modes and the problem type s/he faces on her or his preference
for three MIS characteristics: the type of report used, the number of reports used, and the frequency of decision-making. Also, it was the purpose of this study to explore the impact of the above variables and the preferred MIS characteristics upon the subjects' cost performance.

Among the independent variables, the perception function had the most impact upon the dependent variables. Perception function had a significant effect on the frequency of decision-making. On the average the sensation group had a shorter decision cycle and made 17 per cent more decisions in the same 200 days simulation period. Sensation group on the average used more reports, but the effect was not significant.

The evaluation function and the problem type did not have a significant effect on any one of the dependent variables. There is a moderate interaction effect. The sensation type subject facing a structured problem used the highest number of reports, while the intuition type subject facing a structured problem used the lowest number of reports.

It is concluded that either there does not exist any significant relationship between most of the dependent and independent variables, or a more complicated decision setting
and/or a larger sample size is needed to get a better view of the relationships of these variables.

**SUGGESTIONS FOR FUTURE STUDIES**

Based on the findings discussed in the previous sections some suggestions are presented which can be useful for MIS researchers.

As the area of the MIS research is young and most of the research designs have been unique, there has not been much verification for previous research findings. Thus, the replication of the previous studies, including this one, are necessary. A replication can verify and increase the validity of the previous findings or refute them and question their validity. In either case, it increases the insight into the field.

A replication does not have to be an exact duplication to be useful, it can vary in some aspects. For example, a replication with a different decision setting but the same independent and dependent variables can lead to some useful findings. The generality of the research findings is of much value to the MIS designers. A replication with different decision settings and environment can serve this purpose.

In replicating this study the probable reasons for
not finding significant relationships between independent and dependent variables, mentioned in a previous section, should be noted. One of these reasons was a need for more complicated decision setting. If the Jung's psychological type is used as an independent variable, it is probable that a more complicated decision setting can better differentiate the behavior of the two modes of the functions.

As discussed before, although the difference between the means of dependent variables by classes of independent variables was very large in some cases, the respective hypotheses were not supported. The reason was large variances within each class. It is suggested that a larger sample size be used in order to probably eliminate this problem and get more significant results.

A finding of this study was that perception function affected the preference for frequency of decision-making. The sensation type on the average made more frequent decisions than the intuition type. Given this finding, it is of interest to explore the effect of the match or mismatch of perception function and frequency of decision-making on decision-making performance. For example, the subjects with two different modes of perception can be treated to two different decision-making cycles: short and long. If this
match or mismatch can lead to a significant performance difference, this finding is of more value to the MIS designers.

The field of MIS research is new. Only recently, some attention has been given to this field and some frameworks to guide the MIS research have been developed. Some studies have been conducted and successfully verified some aspects of the proposed frameworks. However, there is a long way to go. There is a need for more empirical studies to verify and improve the frameworks and increase the insight to the MIS analysis and design.
BIBLIOGRAPHY


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APPENDIX A

MYERS-BRIGGS TYPE INDICATOR*

Form F

by Katharine C. Briggs and Isabel Briggs Myers

Directions:

There are no "right" or "wrong" answers to these questions. Your answers will help show how you like to look at things and how you like to go about deciding things. Knowing your own preferences and learning about other people's can help you understand where your special strengths are, what kinds of work you might enjoy and be successful doing, and how people with different preferences can relate to each other and be valuable to society.

Read each question carefully and mark your answer on the separate answer sheet. Make no marks on the question booklet. Do not think too long about any question. If you cannot decide on a question, skip it but be careful that the next space you mark on the answer sheet has the same number as the question you are then answering.

Read the directions on your answer sheet, fill in your name and any other facts asked for, and work through until you have answered all the questions.

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Which answer comes closest to telling how you usually feel or act?

1. Does following a schedule
   (A) appeal to you, or
   (B) cramp you?

2. Do you usually get along better with
   (A) imaginative people, or
   (B) realistic people?

3. If strangers are staring at you in a crowd, do you
   (A) often become aware of it, or
   (B) seldom notice it?

4. Are you more careful about
   (A) people's feelings, or
   (B) their rights?

5. Are you
   (A) inclined to enjoy deciding things, or
   (B) just as glad to have circumstances decide a matter for you?

6. When you are with a group of people, would you usually rather
   (A) join in the talk of the group, or
   (B) talk individually with people you know well?

7. When you have more knowledge of skill in something than the people around you, is it more satisfying
   (A) to guard your superior knowledge, or
   (B) to share it with those who want to learn?

8. When you have done all you can to remedy a troublesome situation, are you
   (A) able to stop worrying about it, or
   (B) still more or less haunted by it?

9. If you were asked on a Saturday morning what you were going to do that day, would you
   (A) be able to tell pretty well, or
   (B) list twice too many things, or
   (C) have to wait and see?
10. Do you think on the whole that
(A) children have the best of it, or
(B) life is more interesting for grown-ups?

11. In doing something that many other people do, does it appeal to you more to
(A) do it in the accepted way, or
(B) invent a way of your own?

12. When you were small, did you
(A) feel sure of your parents' love and devotion to you, or
(B) feel that they admired and approved of some other child more than they did of you?

13. Do you
(A) rather prefer to do things at the last minute, or
(B) find that hard on the nerves?

14. If a breakdown of mix-up halted a job on which you and a lot of others were working, would your impulse be to
(A) enjoy the breathing spell, or
(B) look for some part of the work where you could still make progress, or
(C) join the "trouble-shooters" who were wrestling with the difficulty?

15. Do you usually
(A) show your feelings freely, or
(B) keep your feelings to yourself?

16. When you have decided upon a course of action, do you
(A) reconsider it if unforeseen disadvantages are pointed out to you, or
(B) usually put it through to a finish, however it may inconvenience yourself and others?

17. In reading for pleasure, do you
(A) enjoy odd or original ways of saying things, or
(B) like writers to say exactly what they mean?

18. In any of the ordinary emergencies of everyday life, do you prefer to
(A) take orders and be helpful, or
(B) give orders and be responsible?
19. At parties, do you  
   (A) sometimes get bored, or  
   (B) always have fun?  

20. Is it harder for you to adapt to  
   (A) routine, or  
   (B) constant change?  

21. Would you be more willing to take on a heavy load of  
    extra work for the sake of  
    (A) extra comforts and luxuries, or  
    (B) a chance to achieve something important?  

22. Are the things you plan or undertake  
    (A) almost always things you can finish, or  
    (B) often things that prove too difficult to carry  
       through?  

23. Are you more attracted to  
    (A) a person with a quick and brilliant mind, or  
    (B) a practical person with a lot of common sense?  

24. Do you find people in general  
    (A) slow to appreciate and accept ideas not their own,  
       or  
    (B) reasonably open-minded?  

25. When you have to meet strangers, do you find it  
    (A) pleasant, or at least easy, or  
    (B) something that takes a good deal of effort?  

26. Are you inclined to  
    (A) value sentiment more than logic, or  
    (B) value logic more than sentiment?  

27. Do you prefer to  
    (A) arrange dates, parties, etc. well in advance, or  
    (B) be free to do whatever looks like fun when the time  
       comes?  

28. In making plans which concern other people, do you prefer  
    to  
    (A) take them into your confidence, or  
    (B) keep them in the dark until the last possible  
       moment?
29. Is it a higher compliment to be called
   (A) a person of real feeling, or
   (B) a consistently reasonable person?

30. When you have a decision to make, do you usually
   (A) make it right away, or
   (B) wait as long as you reasonably can before deciding?

31. When you run into an unexpected difficulty in something
   you are doing, do you feel it to be
   (A) a piece of bad luck, or
   (B) a nuisance, or
   (C) all in the day's work?

32. Do you almost always
   (A) enjoy the present moment and make the most of it,
   or
   (B) feel that something just ahead is more important?

33. Are you
   (A) easy to get to know, or
   (B) hard to get to know?

34. With most of the people you know, do you
   (A) feel that they mean what they say, or
   (B) feel you must watch for a hidden meaning?

35. When you start a big project that is due in a week, do you
   (A) take time to list the separate things to be done
       and the order of doing them, or
   (B) plunge in?

36. In solving a personal problem, do you
   (A) feel more confident about it if you have asked
       other people's advice, or
   (B) feel that nobody else is in as good a position to
       judge as you are?

37. Do you admire more the people who are
   (A) conventional enough never to make themselves con-
       spicuous or not?
   (B) too original and individual to care whether they
       are conspicuous or not?
38. Which mistake would be more natural for you:  
(A) to drift from one thing to another all your life,  
or  
(B) to stay in a rut that didn't suit you?  
39. When you run across people who are mistaken in their beliefs, do you feel that  
(A) it is your duty to set them right, or  
(B) it is their privilege to be wrong?  
40. When an attractive chance for leadership comes to you, do you  
(A) accept it if it is something you can really swing,  
or  
(B) sometimes let it slip because you are too modest about your own abilities,  
(C) or doesn't leadership ever attract you?  
41. Among your friends, are you  
(A) one of the last to hear what is going on, or  
(B) full of news about everybody?  
42. Are you at your best  
(A) when dealing with the unexpected, or  
(B) when following a carefully worked-out plan?  
43. Does the importance of doing well on a test make it generally  
(A) easier for you to concentrate and do your best, or  
(B) harder for you to concentrate and do yourself justice?  
44. In your free hours, do you  
(A) very much enjoy stopping somewhere for refreshments, or  
(B) usually want to use the time and money another way?  
45. At the time in your life when things piled up on you the worst, did you find  
(A) that you had gotten into an impossible situation,  
or  
(B) that by doing only the necessary things you could work your way out?
46. Do most of the people you know
   (A) take their fair share of praise and blame, or
   (B) grab all the credit they can but shift any blame on to someone else?

47. When you are in an embarrassing spot, do you usually
   (A) change the subject, or
   (B) turn it into a joke, or
   (C) days later, think of what you should have said?

48. Are such emotional "ups and downs" as you may feel
   (A) very marked, or
   (B) rather moderate?

49. Do you think that having a daily routine is
   (A) a comfortable way to get things done, or
   (B) painful even when necessary?

50. Are you usually
   (A) a "good mixer", or
   (B) rather quiet and reserved?

51. In your early childhood (at six or eight), did you
   (A) feel your parents were very wise people who should be obeyed, or
   (B) find their authority irksome and escape it when possible?

52. When you have a suggestion that ought to be made at a meeting, do you
   (A) stand up and make it as a matter of course, or
   (B) hesitate to do so?

53. Do you get more annoyed at
   (A) fancy theories, or
   (B) people who don't like theories?

54. When you are helping in a group undertaking, are you more often struck by
   (A) the cooperation, or
   (B) the inefficiency,
   (C) or don't you get involved in group undertakings?

55. When you go somewhere for the day, would you rather
   (A) plan what you will do and when, or
   (B) just go?
56. Are the things you worry about  
   (A) often really not worth it, or  
   (B) always more or less serious?  

57. In deciding something important, do you  
   (A) find you can trust your feeling about what is best 
       to do, or  
   (B) think you should do the logical thing, no matter 
       how you feel about it?  

58. Do you tend to have  
   (A) deep friendships with a very few people, or  
   (B) broad friendships with many different people?  

59. Do you think your friends  
   (A) feel you are open to suggestions, or  
   (B) know better than to try to talk you out of any­ 
       thing you've decided to do?  

60. Does the idea of making a list of what you should get 
    done over a week-end  
   (A) appeal to you, or  
   (B) leave you cold, or  
   (C) positively depress you?  

61. In traveling, would you rather go  
   (A) with a companion who had made the trip before and 
       "knew the ropes", or  
   (B) alone or with someone greener at it than yourself?  

62. Would you rather have  
   (A) an opportunity that may lead to bigger things, or  
   (B) an experience that you are sure to enjoy?  

63. Among your personal beliefs, are there  
   (A) some things that cannot be proved, or  
   (B) only things that can be proved?  

64. Would you rather  
   (A) support the established methods of doing good, or  
   (B) analyze what is still wrong and attack unsolved problems?
65. Has it been your experience that you
(A) often fall in love with a notion or project that
turns out to be a disappointment—so that you "go
up like a rocket and come down like the stick",
or do you
(B) use enough judgement on your enthusiasms so that
they do not let you down?

66. Do you think you get
(A) more enthusiastic about things than the average
person, or
(B) less enthusiastic about things than the average
person?

67. If you divided all the people you know into those you
like, those you dislike, and those toward whom you feel
indifferent, would there be more of
(A) those you like, or
(B) those you dislike?

[On this next question only, if two answers are true,
mark both.]

68. In your daily work, do you
(A) rather enjoy an emergency that makes you work
against time, or
(B) hate to work under pressure, or
(C) usually plan your work so you won't need to work
under pressure?

69. Are you more likely to speak up in
(A) praise, or
(B) blame?

70. Is it higher praise to say someone has
(A) vision, or
(B) common sense?

71. When playing cards, do you enjoy most
(A) the sociability
(B) the excitement of winning,
(C) the problem of getting the most out of each hand,
(D) the risk of playing for stakes,
(E) or don't you enjoy playing cards?
Which word in each pair appeals to you more?

72. (A) firm-minded  warm-hearted  (B)
73. (A) imaginative  matter-of-fact  (B)
74. (A) systematic  spontaneous  (B)
75. (A) congenial  effective  (B)
76. (A) theory  certainty  (B)
77. (A) party  theater  (B)
78. (A) build  invent  (B)
79. (A) analyze  sympathize  (B)
80. (A) popular  intimate  (B)
81. (A) benefits  blessings  (B)
82. (A) casual  correct  (B)
83. (A) active  intellectual  (B)
84. (A) uncritical  critical  (B)
85. (A) scheduled  unplanned  (B)
86. (A) convincing  touching  (B)
87. (A) reserved  talkative  (B)
88. (A) statement  concept  (B)
89. (A) soft  hard  (B)
90. (A) production  design  (B)
91. (A) forgive  tolerate  (B)
92. (A) hearty  quiet  (B)
93. (A) who  what  (B)
94. (A) impulse  decision  (B)
95. (A) speak  write (B)
96. (A) affection  tenderness (B)
97. (A) punctual  leisurely (B)
98. (A) sensible  fascinating (B)
99. (A) changing  permanent (B)
100. (A) determined  devoted (B)
101. (A) system  zest (B)
102. (A) facts  ideas (B)
103. (A) compassion  foresight (B)
104. (A) concrete  abstract (B)
105. (A) justice  mercy (B)
106. (A) clam  lively (B)
107. (A) make  create (B)
108. (A) wary  trustful (B)
109. (A) orderly  easy-going (B)
110. (A) approve  question (B)
111. (A) gentle  firm (B)
112. (A) foundation  spire (B)
113. (A) quick  careful (B)
114. (A) thinking  feeling (B)
115. (A) theory  experience (B)
116. (A) sociable  detached (B)
117. (A) sign  symbol (B)
118. (A) systematic  casual (B)
119. (A) literal    figurative (B)
120. (A) peacemaker judge (B)
121. (A) accept    change (B)
122. (A) agree     discuss (B)
123. (A) executive scholar (B)

Which answer comes closest to telling how you usually feel or act?

124. Do you find the more routine parts of your day
       (A) restful, or
       (B) boring?

125. If you think you are not getting a square deal in a club
       or team to which you belong, is it better to
       (A) shut up and take it, or
       (B) use the threat of resigning if necessary to get
           your rights?

126. Can you
       (A) talk easily to almost anyone for as long as you
           have to, or
       (A) find a lot to say only to certain people or under
           certain conditions?

127. When strangers notice you, does it
       (A) make you uncomfortable, or
       (B) not bother you at all?

128. If you were a teacher, would you rather teach
       (A) fact courses, or
       (B) courses involving theory?

129. When something starts to be the fashion, are you
       usually
       (A) one of the first to try it, or
       (B) not much interested?

130. In solving a difficult personal problem, do you
       (A) tend to do more worrying than is useful in reaching
           a decision, or
       (B) feel no more anxiety than the situation requires?
131. If people seem to slight you, do you
(A) tell yourself they didn't mean anything by it, or
(B) distrust their good will and stay on guard with them thereafter?

132. When you have a special job to do, do you like to
(A) organize it carefully before you start, or
(B) find out what is necessary as you go along?

133. Do you feel it is a worse fault
(A) to show too much warmth, or
(B) not to have warmth enough?

134. When you are at a party, do you like to
(A) help get things going, or
(B) let the others have fun in their own way?

135. When a new opportunity comes up, do you
(A) decide about it fairly quickly, or
(B) sometimes miss out through taking too long to make up your mind?

136. In managing your life, do you tend to
(A) undertake too much and get into a tight spot, or
(B) hold yourself down to what you can comfortably handle?

137. When you find yourself definitely in the wrong, would you rather
(A) admit you are wrong, or
(B) not admit it, though everyone knows it,
(C) or don't you ever find yourself in the wrong?

138. Can the new people you meet tell what you are interested in
(A) right away, or
(B) only after they really get to know you?

139. In your home life, when you come to the end of some undertaking, are you
(A) clear as to what comes next and ready to tackle it, or
(B) glad to relax until the next inspiration hits you?
140. Do you think it more important to
(A) be able to see the possibilities in a situation, or
(B) be able to adjust to the facts as they are?

141. Do you feel that the people whom you know personally owe their successes more to
(A) ability and hard work, or
(B) luck, or
(C) bluff, pull and shoving themselves ahead of others?

142. In getting a job done, do you depend upon
(A) starting early, so as to finish with time to spare, or
(B) the extra speed you develop at the last minute?

143. After associating with superstitious people, have you
(A) found yourself slightly affected by their superstitions, or
(B) remained entirely unaffected?

144. When you don't agree with what has just been said, do you usually
(A) let it go, or
(B) put up an argument?

145. Would you rather be considered
(A) a practical person, or
(B) an ingenious person?

146. Out of all the good resolutions you may have made, are there
(A) some you have kept to this day, or
(B) none that have really lasted?

147. Would you rather work under someone who is
(A) always kind, or
(B) always fair?

148. In a large group, do you more often
(A) introduce others, or
(B) get introduced?

149. Would you rather have as a friend someone who
(A) is always coming up with new ideas, or
(B) has both feet on the ground?
150. When you have to do business with strangers, do you feel
(A) confident and at ease, or
(B) a little fussed or afraid that they won't want to bother with you?

151. When it is settled well in advance that you will do a certain thing at a certain time, do you find it
(A) nice to be able to plan accordingly, or
(B) a little unpleasant to be tied down?

152. Do you feel that sarcasm
(A) should never be used where it can hurt people's feelings, or
(B) is too effective a form of speech to be discarded for such a reason?

153. When you think of some little thing you should do or buy, do you
(A) often forget it till much later, or
(B) usually get it down on paper to remind yourself, or
(C) always carry through on it without reminders?

154. Do you more often let
(A) your heart rule your head, or
(B) your head rule your heart?

155. In listening to a new idea, are you more anxious to
(A) find out all about it, or
(B) judge whether it is right or wrong?

156. Are you oppressed by
(A) many different worries, or
(B) comparatively few?

157. When you don't approve of the way a friend is acting, do you
(A) wait and see what happens, or
(B) do or say something about it?

158. Do you feel it is a worse fault to be
(A) unsympathetic, or
(B) unreasonable?
159. When a new situation comes up which conflicts with your plans, do you try first to
(A) change your plans to fit the situation, or
(B) change the situation to fit your plans?

160. Do you think the people close to you know how you feel
(A) about most things, or
(B) only when you have had some special reason to tell them?

161. When you have a serious choice to make, do you
(A) almost always come to a clear-cut decision, or
(B) sometimes find it so hard to decide that you do not wholeheartedly follow up either choice?

162. On most matters, do you
(A) have a pretty definite opinion, or
(B) like to keep an open mind?

163. As you get to know people better, do you more often find that they
(A) let you down or disappoint you in some way, or
(B) improve upon acquaintance?

164. When the truth would not be polite, are you more likely to tell
(A) a polite lie, or
(B) the impolite truth?

165. In your way of living, do you prefer to be
(A) original, or
(B) conventional?

166. Would you have liked to argue the meaning of
(A) a lot of these questions, or
(B) only a few?
APPENDIX B

LIST OF REPORTS

There are twenty-five reports, twelve detailed and thirteen summarized, from which the decision-maker can select. Each report contains data only on the last decision period, that is, since the last review point to the present.

Following is an explanation of reports:

1. Detailed history of demand. It lists demand for each day.

2. Summarized history of demand. It shows the total, average, maximum and minimum values of demand.

3. Detailed history of lead time. It lists the lead time for each order placed.

4. Summarized history of lead time. It shows average, minimum, and maximum values of lead time.

5. Detailed history of inventory. It lists the inventory of each day.

6. Summarized history of inventory. It shows average, minimum, maximum, and present values of inventory.

7. Detailed history of backorder. It lists the backordered units in each day.

8. Summarized history of backorder. It shows the average, minimum, maximum, and present values of backordered units.

9. Detailed history of lost demand. It lists the units of demand lost in each day.
10. Summarized history of lost demand. It shows average and total of units lost.

11. Detailed history of units received. It lists the units received in each day.

12. Summarized history of units received. It shows the number of orders and the total amount of units received.

13. Detailed listing of outstanding orders. It presents the list of outstanding orders and quantity of each order.

14. Summarized record of outstanding orders. It shows the number of outstanding orders and total amount of units on order.

15. Detailed history of holding cost. It lists the holding cost for each day.

16. Summarized history of holding cost. It shows total holding cost for the period.

17. Detailed history of backorder cost. It lists the backorder cost for each day.

18. Summarized history of backorder cost. It shows the total backorder cost for the period.

19. Detailed history of order placement cost. It lists the order placement cost for each day.

20. Summarized history of order placement cost. It shows the total order placement cost for the period.

21. Detailed history of lost demand cost. It lists the lost demand cost for each day.

22. Summarized history of lost demand cost. It shows the total cost of lost demand.

23. Detailed history of total cost. It lists the total cost of each day.
24. **Summarized history of total cost.** It shows the total cost for the period.

25. **Summarized record of information cost.** It shows the total cost of report acquisition.
APPENDIX C

SOME STATISTICS OF THE STUDY

This Appendix contains eight tables, Tables 17 through 24. Each table presents the mean, standard deviation, minimum value, and maximum value of the five dependent variables: detailed reports, summarized reports, total reports, frequency of decision-making, and cost. Table 17 shows the statistics of dependent variables. Tables 18, 19, and 20 present the statistics of the dependent variables by classes of three independent variables: perception function, evaluation function, and problem types, respectively. Tables 21, 22, and 23 are presentation of statistics of dependent variables by combinations of interactions of classes of two independent variables at a time. Finally, Table 24 shows the statistics of dependent variables by combination of classes of the three independent variables.

In the tables of this Appendix the following abbreviations are used:

DREP = Detailed Report
SREP = Summarized Report
TREP = Total Report
FREQ = Frequency of Decision-Making
COST = Cost Performance
PERC = Perception Function
EVAL = Evaluation Function
PTYP = Problem Type

O = Number of Observations
N = Sensation Mode
I = Intuition Mode
F = Feeling Mode
T = Thinking Mode
S = Structured Problem
U = Unstructured Problem
Table 17. Statistics of Dependent Variables

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Table 18. Statistics of Dependent Variables by Classes of Perception Function

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Table 19. Statistics of Dependent Variables by Classes of Evaluation Function

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Table 20. Statistics of Dependent Variables by Types of Problem

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Table 21. Statistics of Dependent Variables by Interaction of Classes of Perception and Evaluation Functions

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| TREP     | 16 | 33.87| 18.91             | 11.00         | 84.00         |
| FREQ     | 16 | 7.00 | 2.55              | 5.00          | 15.00         |
| COST     | 16 | 22358.00| 2817.67       | 17044.00      | 30278.00      |</p>
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Table 22. Statistics of Dependent Variables by Interaction of Classes of Perception Function and Problem Types

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Table 22. (Continued)
Table 23. Statistics of Dependent Variables by Interaction of Classes of Evaluation Function and Problem Types

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| SREP | 16 | 17.37 | 23.63 | 0.00 | 81.00 |
| TREP | 16 | 40.81 | 38.00 | 11.00 | 149.00 |
| FREQ | 16 | 8.12 | 1.99 | 6.00 | 13.00 |
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Table 24. Statistics of Dependent Variables by Interaction of Classes of Perception Functions, Evaluation Functions, and Problem Types

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Ghasem Haj Manoochehri was born on March 30, 1948 in Tehran, Iran. He was graduated from Adib High School in 1966. He received his Bachelor in business in 1970 from Tehran Business College in Tehran, Iran. Then, he was drafted to the army for a two years term. In 1974 he got his Master of Business Administration degree from Louisiana State University in Baton Rouge, Louisiana. He was accepted in the doctoral program in the same university in the fall of 1974. He has been a Graduate Teaching Assistant from 1976 until the fall of 1977 when he became an Instructor for the Department of Management, Louisiana State University. He had this position for the 1977-1978 academic year.
Candidate: Ghasem Haj Manoochehri

Major Field: Management

Title of Thesis: An Experimental Evaluation of the Effects of Psychological Types and Problem Types on Preference for Some Management Information System Characteristics and Decision-Making Performance

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signature]

[Signature]

[Signature]

Date of Examination:

July 21, 1978