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AN ANALYSIS OF DECISION MAKING IN A MILITARY POPULATION

THESIS

Michael J. Bonometti
Captain, USA

Colt A. Mefford
Captain, USAF

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ABSTRACT

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A population of AFIT students was selected and defined by psychological instruments. The instruments chosen to classify the population were the Myers-Briggs Type Indicator, the Herrmann Brain Dominance Inventory and Rowe's Decision Style and Values Inventories. Factor analysis techniques were used to further classify the participants into four basic categories: Logical versus Emotional and Detailed versus Creative.

A four by two by two experimental design was constructed by varying information quantity in four categories, time in two categories and flexibility in two categories. Each participant was measured in each of the sixteen cells of the resulting design. The measurement instrument for testing in this design was a scenario for each cell. Each scenario presented each participant with a situation testing his decision making process in terms of these parameters. Keywords include: 19

The results of the experiment were analyzed by the techniques of ANOVA, ANCOVA, and Discriminant Analysis. Statistical difference was found in the performance of certain elements of the population when subject to varying parameter situations. Between category differences were not found to be statistically significant across decision environments. However, within categories, significant differences were found. Specifically, the Emotional and Creative types performed significantly worse with increasing quantities of information in a high flexibility environment The Logical and Detailed types were insensitive to change in the decision environment.

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THESIS

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Master of Science in Operations Research

Michael J. Bonometti, B.S.

Captain, USA

Colt A. Mefford, B.S.

Captain, USAF

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CHAPTER 1

INTRODUCTION

Success on the battlefield has been for centuries a matter of ingenuity, maximum effective use of resources, and strict discipline. A new dimension has been added to this subject. The US Armed Forces throughout past wars has prided itself on the ability of individual soldiers to "take charge" of a situation and lead fellow soldiers to victory. Each soldier is a potential leader and each potential leader is a decision maker.

The Army Chief of Staff has declared 1985 as the "Year of the Leader." There is increasing awareness of the need to investigate the attributes that compose a good leader. This need should logically extend to research in the area of decision making. Good decision making must be recognized as an integral part of good leadership. The relevance of research in decision making must be acknowledged as being an integral part of the research in analyzing and documenting the attributes which make people better leaders.

To be a leader is to be a decision maker. A good leader, among other things, consistently makes good decisions. The ability to consistently make good decisions requires both a sense of intuition - a difficult if not impossible parameter to measure - and the ability to acquire and effectively use information about the decision at hand. The latter ability has been given much attention in past decision making research and is the focus of this thesis.

If the effective leader is to make good decisions, he must understand the importance of timing, the collection and processing of information, and the intuition or "gut feeling" of the situation. History has proven the necessity of timing in decision making. To paraphrase General George C. Patton: better a good plan executed now, than a perfect plan executed next week.

There is little one can say on the subject of "gut feeling" or intuition short of taking a stand as to whether good leaders (or good decision makers) are born or made. No attempt will be made here to address this issue. This leaves the Decision Maker's collection and processing of information as a primary area of study that can be subjected to objective experimentation. It is important to know how a decision maker's collection and processing of information affects his decisions. The results of this experimentation may benefit future military decision makers, managers, and leaders.

A brief look at certain types of decision makers may reveal an important relationship. A person who by nature is slow to decide may wish a great deal of information prior to choosing an alternative. This type of person usually relies more on information and less on intuition. In contrast, a person who is quick to decide and act may wish only basic information prior to choosing an alternative. This person may supplement the collected information with past knowledge or intuition when choosing a course of action. There are times when each of these approaches can be preferred.

Great military leaders have either fit the personality that was needed at a particular time in history or knew how to tailor their methods to the environment. The effective decision maker knows his strengths, weaknesses, surroundings, and his influence on his surroundings. Additionally, he must know which behavior is most appropriate in a particular situation, and finally he must know how to adapt himself accordingly.

In the next war, there will be no time to learn from mistakes. Military decision makers must know their limitations before the first shot is fired. Strengths and weaknesses must be addressed, analyzed and appropriate actions taken prior to commencement of hostilities. These necessary actions are the assessment of limitations and include the limitations of present technology and weapon systems, logistics, production capabilities, field units, and individual leaders and decision makers. It is only recently that the need for research in the area of assessing the quality of our leaders and decision makers has been recognized. This research is finally being accomplished.

Perhaps the strategy of molding the individual into a preconceived image of what makes a good leader should be modified. A leader may be influenced by a multitude of factors. These factors change from situation to situation and from individual to individual. Instead of trying to create decision makers in the same image, a better approach would be to make each individual a better decision maker while retaining his own unique decision making style. In accomplishing this goal, we must first research what type of behavior or style is most effective in different situations. Once educated about these findings, decision makers will acquire the knowledge of the type of behavior which will maximize their performance in a given situation. This research may result in recognition that the study of differences among individuals can lead to better decision makers and better leaders.

It is proposed that a decision maker needs to know the decision situation to properly evaluate the alternatives. It is further proposed that different types of personalities are better decision makers in different situations; and individuals of the same type tend to be similar in how they approach problem solving and decision making. There are a number of ways to examine these proposals. Rather than look for the differences between people, an alternative approach would look for similarities among types of decision makers. Once the common traits have been identified, further investigation can then determine what type of decision maker does best in a particular situation or environment.

This thesis will examine several factors that have been the subject of past research. Researchers have traditionally chosen a particular decision making factor and analyzed its effect on the decision making process. Little work has been done on clarifying which, among the many factors may provide the most significant impact on a decision maker, and which are most sensitive to change. A significant factor which is robust or insensitive to change will have little practical use in improving the decision making process. A less robust factor which is highly sensitive to change may prove to be extremely important in attempting to optimize an individual's decision making process.

The decision making factors investigated in this study are the effects of time, decision flexibility - the impact of changing the number of alternatives in a decision, and psychological profile of the decision maker as measured by several psychometric instruments. Finally, we will look at the possibility of increased familiarity which comes from repeatedly facing the same type of decision. This last possibility will be referred to as the "learning curve" effect.

This research will be presented by initially reviewing the past studies on the interactions and effects of several key decision making factors. A discussion on the theories which are the basis for the experiment will follow the literature review. The next chapters will explain the experimental design, how the experiment was conducted, and the experimental results. The final chapters will present the conclusions, implications of the experimental results, and recommendations for future research.

CHAPTER 2

LITERATURE SEARCH

The purpose of this chapter is to provide a historical overview of the research that has been done in specific areas of decision making. The focus of this thesis is on the problem of determining the optimal amount of information to use in decision making. This chapter reviews decision making experiments and theories that provide insight into this problem.

In this thesis a decision making parameter is an element of the decision making process which, when varied, affects the amount of information that would maximize a decision maker's probability of choosing an optimal solution to a particular problem. A decision making process is defined as the act of examining a set of alternatives and applying some form of logic or reasoning in selecting one alternative from the set of all possible courses of action. The authors define an element of the decision making process as a physical or psychological factor that influences the manner in which the decision maker evaluates the alternatives and arrives at a solution.

One reasonable method of classifying decision making parameters is to categorize them into two groups: environmental factors and decision maker factors. Environmental factors are those parameters that describe the setting in which the decision must be made. They include, but are not limited to, time, stress, and flexibility (the number of choices available to the decision maker). In many decision making experiments, the environmental factors compromise the independent variables because these environmental factors can be controlled by the experimenter.

The second group, that of decision maker factors, includes parameters generally fixed for a given decision maker, but that vary across dimensions. Thus they are outside the control of the experimenter and normally comprise the dependent variables in an experiment. Examples of decision maker parameters are conceptual level and decision style, both of which will be discussed here.

Considerable research has been done on various aspects of the information usage problem. Each researcher attempts to create a model that can be used to predict or analyze the amount of information that may optimize the decision maker's ability to choose the best course of action. One virtually unanimous conclusion drawn from these reports is that a model capable of achieving this goal must be tailored to each individual problem. The analysts seem to agree that there is no one universal model that will work for all people and all decisions under all circumstances. The model must be tailored, but this is where agreement subsides.

Some would conclude that the model must be tailored to the task under investigation and the environment in which the decision is made [21] [22] [29]. Others conclude that the tailoring would be more appropriate if it matched the decision style of the given decision maker [2] [4] [11] [20] [36] [38]. Another study uses the cognitive aspect of tolerance of ambiguity as the determining regulator of information flow [10]. These different tailoring schemes support the belief that the quantity of information which optimizes a decision is not a universal figure. Rather, this optimal quantity of information is subject to change based upon one or more parameters, such as stress, time constraints, decision style, or cognitive style. Review of the literature on this subject clearly indicates that this problem can be investigated.

To provide a broad perspective on past research on this subject, the following decision making parameters will be discussed: stress and time, decision flexibility, decision style, conceptual level, and cognitive style. Stress, time and decision flexibility are environmental factors related to the decision making environment. Decision style, conceptual level and cognitive style are decision maker factors related to the individual characteristics of a decision maker.

ENVIRONMENTAL FACTORS

Stress and Time

The first set of research to be examined is the efforts investigating stress and time. Experiments conducted to test the effect of stress on the ability of a decision maker to process information have concluded that increased stress degrades the ability to absorb information. Furthermore, under stressful conditions, less information increases a decision maker's capability of choosing the optimal course of action [33]. Some researchers subscribe to the theory that a decision making model which would determine optimal information flow must be tailored to the decision environment. One researcher, Streufert, has done significant of research on stressors and task performance [32]. One of his projects examined time as a stressor in hand-eye coordination tasks. While the project was designed to specifically examine "risk taking" behavior, the authors determined that under time urgency, decision makers make more errors [33]. In another experiment built around a game-type of simulation, they concluded that complex and long term future planning decision making were negatively affected by time urgency [36].

O'Connell used the setting developed by Streufert to examine the experimental effects of information load and specificity and group structure interactions on stress among his subjects. He discovered complex interactions between these various factors. In general the environmental effects were very dependent on the type of stress being measured [27].

In an experiment using electronic mazes, Ward also attempted to measure time-stress interactions in individual performance. The subjects' objective was to take a moving dot through a maze similar to "Pac-Man" generated on a CRT by a computer. The subjects had control over the direction of the dot but not the speed. The time-stress factor was induced by increasing the dot's speed, thus putting the subject under pressure. Ward discovered that errors in solving the mazes increased with increased dot speed. In addition, it was determined that these errors were not simple failures of motor skills, but were due to the subjects time constrained decision making [38].

Decision Flexibility

Decision flexibility is an environmental factor defined as the number of choices available to a decision maker. Merkhofer examined the problem from a slightly different approach than that used in this thesis. Rather than attempting to find an optimal quantity of information to present to a decision maker, he sought to measure the "value of information" to the decision maker. He defined the value of information as the most a decision maker would be willing to pay to resolve some uncertainty. The result of this experiment was that varying the quantity of information alone was not sufficient to determine the value of information. Knowledge of the correlation between the pieces of information was essential in determining their value [22].

Correlation in this context is a measure of how closely related two pieces of information are to each other. For example, in a study to determine which of two new cars is more economical over a five year period, the size of the engine and the miles per gallon would be two highly correlated pieces of information. The region of the country where the vehicle is purchased and whether the car is equipped with air conditioning are uncorrelated pieces of information. Merkhofer concluded, "...if two information items are highly correlated, learning one would be nearly as valuable as learning both" [21:724]. It would not be advantageous to purchase two items of information when one item would result in nearly the same insight on which alternative was best. It was also found that increased decision flexibility generally requires more information in order to choose the optimal course of action from among various options.

The results of Merkhofer's study can be directly applied to the optimal quantity of information problem. This research concludes that in more flexible or complex decision environments(increased the number of options) the decision maker's probability of choosing the optimal decision increases with additional uncorrelated information.

DECISION MAKER FACTORS

Decision Style

The first of the decision maker factors to be reviewed is decision style. Driver and Mock investigated this parameter's influence on the optimal information problem [11]. Their efforts added to the validity of partitioning individuals into groups by decision style. They define several schools of thought regarding personality types. On one extreme the theory states that all men are basically the same. The other extreme states that each individual is completely unique. Driver and Mock subscribe to the mid-ground theory that people can be divided into basic categories. Most of the studies on decision and cognitive styles subscribe to this grouping concept.

Driver and Mock found that the ideal amount of information a decision maker could use effectively varied with decision style. Four basic decision styles were presented: flexible, hierarchic, integrative and complex. These styles and their defining characteristics are explained in Figure 2-1.

Degree of Focus in Use of Data		Minimal (Satisficer)	Maximum
	Multiple Solutions	Flexible	Integrative
	One Solution	Decisive	Hierarchic

Amount of Information Used

	Decisive	Flexible	Hierarchic	Integrative
Values	Efficiency Speed Consistency	Adaptability Speed Variety	Quality Rigorous Method System	Information Creativity
Planning	Low data base Short-range Tight control for results	Low data base Intuitive	High data base Long-range Tight control of method and results	High data base Long-range Adaptive
Goals	Few; organization focus	Many; self-focus	Few; self-focus	Many; self- and organization-focus
Organization	Short span of control Rules Classic organization	Control by confusion Loose	Wide span of control Elaborate procedures Automation	Team process Matrix organization
Communication	Short summary format Results focus one solution	Short, summary format Variety several solutions	Long, elaborate reports Problem, methods, data, give "Best Conclusion"	Long, elaborate Problem analysis from many views; Multiple solution

Figure 2-1
Comparison Of Preferences Between Decision Styles

These researchers used a business game model to analyze the effect of decision style on decision making. The game allowed the participants, grouped by decision style, to purchase additional problem solving information. This additional information provided detailed data on specific elements of the task under investigation. The data was analyzed by calculating the percent of information purchased by each group during several decision making periods. The results indicated a positive relationship between decision style and the amount of information used in decision making.

Specifically, Driver and Mock found that the complex decision maker required more complete information. The flexible and hierarchic decision makers needed a moderate amount of information. The integrative decision maker required the least amount of information to choose an optimal plan. It is interesting to note that the researchers discovered that individuals often perceived a need for more information than was actually useful to them. Driver and Mock found that decision makers could sometimes make better decisions based on differing amounts of information than the given decision maker thought he really needed.

Driver and Mock were not alone in their idea of grouping according to style. Watkins, in a study on information usage found that groups developed along personal style parameters. This research among others suggested that information should be tailored to the types of users [39].

Conceptual Level

Miller and Gordon echo this concept of decision maker factors as an influence in decision making [23]. Theirs is a slight modification, however. They feel that information used in decision making is influenced by the individual's conceptual level. Additionally, they propose that the decision environment and the task which faces the manager affect the information used in the decision making process.

Miller and Gordon begin by defining conceptual level as the ability to analyze a problem in multi-dimensional rather than simplistic fashion. This includes the processes used in combining these dimensions in arriving at a solution. Multidimensional analysis is done by approaching a problem from many different perspectives and defining several alternative solutions. Simplistic analysis usually requires only one approach to solving the problem and offers only one solution. Their research concluded that high conceptual individuals used information differently than low conceptual individuals. High conceptuals took an active role in analyzing the given information and combined this information with their past experience, enabling them to efficiently use a greater amount of information and solve more complex problems. Low conceptuals, on the other hand, used a more simplistic approach to decision making. Their approach to problem solving resembled a stimuli-response mechanism rather than true analysis. They did, however, make better decisions than the high conceptuals when confronted with a smaller amount of information.

The authors concluded that neither group scored consistently higher than the other when confronted with a multitude of decisions. The higher conceptuals were better at solving more complex tasks, but were slower and less proficient at solving basic problems. One possible explanation for this phenomenon was that high conceptuals tried to analyze simple information and make this information more complex than it was. By reading more into the given information, they ultimately arrived at less favorable decisions. The low conceptuals were better decision makers when confronted with simple problems. They took the given information at face value and not only produced more desirable decisions, but did so in far less time. The authors concluded that the ability of people to absorb varying quantities of information is a function of the conceptual level of the decision maker.

Cognitive Style

One of the many aspects of decision making is that of cognitive style - the decision maker's personal attitudes: his feelings, his thoughts, his style. In many ways cogn'tive style is very similar to decision style. Much research has been devoted to the study of cognitive style. In general, cognitive style is defined as the "relatively fixed patterns for experiencing the world as learned by decision makers " [3:44]. There are numerous viewpoints as to how this affects the use of information. By examining some of the literature we show that indeed cognitive style ought to be an issue in the decision process.

Cognitive styles can differ by groups much as decision styles differ. There is ample research to show that this difference exists. In particular, past research has attempted to find whether if there are differences in the way individuals of certain cognitive styles perceive or use information. A study by Vasarhelyi in 1976 shows that individuals of different styles react differently to information [37]. He used certain psychological instruments to determine that some individuals could be divided into two basic types. These were "analytics" - those interested in quantitative solutions, explicit data and hard models; and "heuristics" - those who worked with feelings, the organic whole concept and analogies. In general, he found that the designers of information systems were the analytic type and the users of those systems were the heuristic type. His conclusions were that the analytics preferred more hard, quantitative data and more time to analyze it. In addition, they liked more interaction with computer systems. Heuristics, on the other hand, preferred qualitative data, liked to be more flexible with their problem solving approach, and required less time to make decisions.

McKenny and Keen noted in a study made in the early 70's that this same dichotomy existed in many management situations. They determined four types of cognitive styles. They stated that there was a great deal of conflict in information use due to the lack of communication among these various types. Keen and Scott Morton add: "The true believer in rationality... tries to get managers to clarify their goals explicitly, to search for many alternatives, and to define utility functions. Any unwillingness to do so is obviously 'pathological'" [17:63]. Kaiser and Srinivasan studied the difference between users and designers of information systems. They inferred that there should be more involvement of individual user characteristics in the information system which supports the decision making process [16].

Bariff and Lusk propose in a 1974 article that the "measurement and evaluation of user's cognitive styles and related personality traits may provide an effective means for attaining successful ... systems" [2:820]. Using several measurements for cognitive styles they found that within a population of nurses and their supervisors, the low analytic types preferred less complex reports and more raw data [2:826].

More emphasis has been placed on the role of the individual decision maker in the information use process [4:74]. This emphasis is due to the development of new methods of measuring cognitive style, and more reliable, validated measurement instruments. Blaylock and Rees, like many other researchers, used the Myers-Briggs Type Indicator as an instrument to measure these cognitive styles. They discovered that cognitive style did make a difference in information preference and usage. They stressed the importance of incorporating cognitive style into information system theory.

Blaylock and Rees also examined the effects of different cognitive styles on the optimal information problem. The instrument used in their study, the Myers Briggs Type Indicator, categorizes cognitive style in four distinct groups according to Jung's theory of psychological types [15]. The division of cognitive style begins by examining two aspects of human information processing: perception and judgment. These are further divided into two subcategories: perception occurring through intuition or sensing, and judgment accomplished through either thinking or feeling. Hence, the four distinct cognitive styles are:

ST	sensing plus thinking
SF	sensing plus feeling
NT	intuition plus thinking
NF	intuition plus feeling

To test the effects of cognitive style on information used in decision making, Blaylock and Rees conducted a modified Delphi experiment on graduate students using a merger/acquisition scenario. The Myers Briggs Type Indicator was administered to 50 MBA candidates. Four individuals from each psychological type who showed the strongest preferences in each category were chosen to participate in the experiment. The investigation was to determine whether information preference varied by cognitive style. They tested the hypotheses:

H1: In each round of the decision process the information selected to make a merger decision is affected by the decision maker's cognitive style.

H2: Feeling cognitive styles prefer social information more than thinking cognitive styles.

H3: Perceived important information varies by cognitive style.

H4: Perceived useableness of information varies by cognitive style.

They concluded that information usage varied according to the perceived dimension, as measured by the Myers Briggs Type Indicator. The judgment dimension experienced no general pattern with respect to cognitive style and decision making.

These findings can also be applied to the problem of optimizing the quantity of information. This research supports the conclusion that the optimal quantity of information to provide to a decision maker depends not only on his cognitive style - sensing or intuition - but also on the type of information furnished. If the information is predominantly social in nature, the feeling types require more social information and the thinking types require less social information to reach the optimal decision.

Dermer made an analogous study on how individuals perceived information importance. He found that "conceptually concrete individuals prefer more information than do more abstract ones" [10:517]. The theory that different cognitive types influence decision making behavior indicates that "the utility of a particular type of information cannot be effectively evaluated apart from the users of that information" [10:517].

Not all the literature agrees with the inclusion of cognitive styles in the problem of information use. George Huber wrote a scathing review of past efforts on this subject and determined that the current literature was an inadequate basis for further development of information systems. He also concluded that any further research in cognitive styles would not provide parameters on which to base future ideas. He attributed these conclusions to the inadequate theory, inadequate psychometric instruments, weak experimental design and methodological weakness [14].

Huber's arguments have some degree of validity, but his case is overstated and extreme. In a critique of the Huber article, Daniel Robey notes that by and large, cognitive style research is responsible for the current concern with how to properly use information [28]. Possibly Huber's attitude is an example of the differences between the psychological types as noted by other authors. Huber states that by adapting a system to an individual's personal style "we would provide the decision maker a powerful tool for reinforcing his or her idiosyncratic predispositions"

[14:571]. Huber apparently views cognitive style parameters as 'pathological' - that there is a right way of doing things and these researchers are definitely wrong in their pursuit of better information systems through cognitive style research. This attitude abounds, and one can see it daily in business, the classroom, and the military. The obvious implication is that there is a difference among people. It is only logical to deal with these differences.

CONCLUSION

This sampling of research supports the conclusion that the information absorption process can be analyzed. Researchers have used time and stress as parameters in information use and found that high stress (and thus time constraints) degrades information absorption. Increased flexibility in the form of more options affects a decision maker's ability to choose the optimal solution. Some studies have found that a decision maker's decision style can be determined as one of several types, and that given types respond differently to information. Further breakdowns of decision maker factors result in aspects of personality such as conceptual level and cognitive style. These elements appear to influence an individual's decisions as much as the environmental factors of time, stress and flexibility.

The past research, with the exception of Huber, supports the recommendation for further research. To accomplish this, these past efforts should be integrated and data gathered on how the different parameters cause different responses to information. These past efforts show it is possible to find relationships among these various parameters and the decision making process. Yet these works do not pursue the line of inquiry that the authors of this thesis feel necessary. Previous research does not focus on the extent of influence of the decision making factors. This thesis question revolves around the degree to which these parameters influence the decision making process. This thesis investigates several unanswered questions:

1) Which decision making factors are most influential in determining the optimal quantit, of information to present to a decision maker?

2) In what situations do various psychological types perform differently?

3) If indeed a relationship does exist between the quantity of information and the decision making factors, can the extent of this relationship be measured?

4) Can it be determined what quantity of information a given psychological type uses most effectively in various decision situations?

This paper proposes additional research in a number of areas which have not been adequately investigated in the past. There needs to be tests of the military population and their performance. Most of the previous research projects have been accomplished using graduate students and business-persons. The performance of these people and the performance of military people may not be identical. The decision making experiment conducted in this thesis will extend the study of decision making factors to a military population. The objective of many past studies is to investigate how individuals use information. This thesis will concentrate on the question of how much information is most beneficial to a decision maker.

The first step in investigating the optimal quantity of information problem, is to identify and measure the psychological types of the individuals who will use the given information. One of the most widely used instruments for determining this psychological type and style is the Myers-Briggs Type Indicator. This instrument has been used effectively by numerous investigators, notably Benbesat and Taylor, Blaylock and Rees, as well as McKenny and Keen [3] [4] [20].

The use of a single instrument, however, may not produce the validity needed in this determination. Bariff and Lusk point out that at least two test instruments for these behavior aspects should be included to cross validate the results [2:822]. In terms of these guidelines then, several instruments will be used to measure these styles. Other instruments which have been used with favorable results are Rowe's Decision Style and Values Inventory (a two part instrument), and the Herrmann's Participant Survey Form. With these additional instruments a study can have the required cross-validation and redundancy. These instruments are used extensively throughout the Department of Defense [8] [29]. The Rowe's Decision Style Inventory measures respondents as analytic, conceptual, directive or behavioral. Rowe's Values Inventory classifies people as purist, idealist, humanist or pragmatist. The Herrmann's Instrument is somewhat more complex, yet measures essentially the same characteristics. There is ample past research to recommend and justify the means chosen to examine the important topic of information use and possible overload. Tools and methods are available to pursue further efforts. The next chapter explains this in more detail.

CHAPTER 3

THEORY

The information absorption process by a Decision Maker contains a multitude of obscurely defined parameters. These parameters include, but are not limited to those listed in Figure 3-1.

INFORMATION PARAMETERS

Mode	Content	Presentation	Quantity
verbal	brevity	general format	low
written	ambiguity	complexity	medium
graphical	clarity	consistency	high
pictorial			
computer assisted			

Figure 3-1
Parameters of the Information Absorption Process by a Decision Maker

Each of these parameters can be the subject of intense research to determine how each can be tailored to best support the decision maker. The thrust of this thesis will be to investigate, through the use of a decision making experiment, how and under what conditions the Quantity of Information parameter can be determined. The specific problem can be stated as follows. Does there exist an "optimum" amount of information which will inform rather than confuse a Decision Maker?

In order to scale this problem down to a manageable size, it will be assumed throughout the thesis that all of the parameters mentioned above, other than the one in question, are fixed. That is, it is assumed that the brevity, ambiguity, clarity, and general format of the elements of information remain constant across individuals while testing for variations in the specific parameter under investigation - the Quantity of Information.

The problem of information overload is receiving increasing attention. Initially, the use of bigger and more efficient computers was seen as a means of improving information processing for government and business. While automation is creating some improvement, the shear wealth of available information is proving that bigger is not always better. Without proper constraints, the ability to access more information may lead to chaos rather than efficiency.

> A universal problem in information systems exists today in government - too much paper, but a lack of information...
>
> Unnecessary data often hinders the decision making process...
>
> Information supports the decision making process, but not just any information...
>
> The final step is to provide information required by the decision makers in the proper format (and quantity) to assist them in achieving the mission of the organization in the most productive and efficient way possible [7:36].

This chapter discusses several theories regarding a number of decision making parameters which may affect the ability of a decision maker to process and absorb information. The remainder of this section will present various theories on the concept of tailoring information to meet the needs of a decision maker. Those concepts, which deal specifically with varying the quantity of information given to a decsion maker will be further developed in the remaining sections of this chapter.

Decision makers at all levels of business, government, and the military have become increasingly concerned about the arrangement of information in Management Information Systems (MIS) and Decision Support Systems (DSS).

> Systems failure often occurs because the decision maker perceives report format, timing, and content as irrelevant to the problem, and therefore does not process the information. While some would attribute this failure to the manager, who should have used the information, often the information system is to blame because of the way the information is presented [28:68].

The greatest challenge to the developers of information systems is to create systems that truly support the user. This can only be accomplished if the system has the capability of tailoring the presentation and quantity of information to both intuitive people who more easily relate to possibilities and relationships and to analytic people who value facts and ideas [28:68]. This concept of categorizing people by the way they think and by their preferences will be developed in the subsequent sections of this chapter.

The majority of initial MIS and DSS systems were designed by highly analytical individuals. These people prefer to use data in a very structured format, consisting of an array of facts easily retrieved within a well ordered package. In terms of the preferences of highly analytical people, only data which is directly and obviously connected with the problem should be available to assist in problem solving. This type of person will be referred to as a high analytic. These systems were created by these high analytics for high analytics. That is, the preferences for the quantity and format of information is tailored for this type of individual.

Many theories propose that these preferences are not universal [10] [11] [13]. These theories suggest that information support should fit both the objective demands of the task or decision and the preferences of the user [28:68]. Some people may not prefer the same arrangement and amount of information as the high analytics. As discussed in the Literature Search chapter, these preferences are often referred to as the cognitive style or decision style of the decision maker. Two key performance objectives for decision support systems follow from this theory.

> ...the concept of 'structure' in decision making is heavily dependent on the cognitive style and approach to problem solving of the decision maker.
>
> ... a very important characteristic of a DSS is that it provide the decision maker with a set of capabilities to apply in a sequence and form that fits his/her cognitive style [28:68].

The suggestion that the preferences of nonanalytics differ from analytics does not suggest that nonanalytic decision makers do not use information to make decisions. The theory only predicts differences. In fact, nonanalytics may use more information than high analytics. Additionally, in contrast to the support required by a high analytic decision maker, to support an intuitive decision maker, it may be vital to supply information that would seem irrelevant to a high analytic. This information may spark an idea in the intuitive decision maker's mind.

It is more difficult to specify precisely how information is processed by an intuitive decision maker. Hence, it may be more difficult to know exactly the type and quantity of information that would be most beneficial. Decision Support Systems tailored to intuitive decision makers may provide information the decision maker already knows, but which may provide some insight into the problem from a new perspective. In contrast, Decision Support Systems tailored for high analytics traditionally provide only information the decision maker does not already know.

In summary, these theories suggest that knowing how humans process information should be a major consideration in the development of systems to support human decision making. MIS designers have traditionally never taken this consideration too seriously in the past. The aim of this thesis is to determine specifically what quantity of information best supports the individual decision maker. The remainder of this chapter is devoted to a closer examination of the theories that apply to tailoring the quantity of information to best support the individual decision maker. Additionally, an in depth look at each of the decision making parameters will be provided.

General Theory

The review of the literature presented in Chapter II, although not all directly addressing the quantity of information versus the quality of decision question does support a more general theory which is outlined in the following statements.

1. People are not all alike in how they perceive the world around them or in how they interact with the world around them.

2. All Decision Makers do not approach problem solving from the same perspective.

3. Although there are differences between individuals, there are also similarities in world perception and in problem solving techniques which allow groupings of many individuals who share some commonality.

4. By identifying similarities among Decision Makers, one can tailor the quantity and structure of the information to best suit a particular type of Decision Maker.

This general theory is the foundation of this thesis. Four specific hypotheses are established in this chapter and tested in the decision making experiment. These hypotheses are developed from this general theory and the background research presented in the Literature Search chapter. The first of the four hypotheses proposes that the general theory of differences among types of decision makers can be extended to the question of optimizing the Quantity of Information used in decision making.

HYPOTHESIS I

Decision Makers are not all alike in how they collect and process information. However, groups of Decision Makers tend to accomplish these tasks in a similar manner.

Each of the three remaining hypotheses proposes a relationship between one or more decision making parameters, including the Quantity of Information parameter, and the effect of these parameters on the decision making process. They will be presented in the next section which provides a detailed look at each of the decision making parameters that will be used in the experiment.

Experimental Decision Making Parameters

This section provides the rationale for the choice of parameters used in the decision making experiment. Additionally, each parameter will be described in detail. As previously stated, the parameters can be classified as either environmental factors or decision maker factors. Throughout the remainder of this thesis, specific environmental or decision maker factors, collectively referred to as decision making parameters, will be capitalized to clarify that reference is being made to the parameter and not to another meaning of the word.

Two environmental factors, Time and Decision Flexibility, will be discussed first. The instruments used to measure the decision maker factors will then be examined. The three remaining hypotheses will be presented during the discussion. Hypothesis II relates Time and Quantity of Information with decision quality. Hypothesis III relates Decision Flexibility and Quantity of Information with decision quality. Hypothesis IV proposes a relationship between the decision maker factors, Quantity of Information, and decision quality.

Environmental Factors

Time

Many experiments have been conducted to evaluate the effect of increased stress on the ability to perform a physical or mental task [27] [32] [33] [38]. These experiments support the theory that as stress increases, performance decreases. Although all subjects do not necessarily experience the same fluctuation in performance from changes in stress, it is generally accepted that given sufficient stress, performance will decline. In evaluating the factors which increase or degrade a decision maker's ability to choose the best solution from a list of alternatives, it seems that changes in stress should affect a decision maker's performance.

Stress in decision making may be caused by many factors. These factors may not produce the same level of stress in all people. One such factor is the consequence of failing to choose the best solution which may have professional, financial, or personal esteem repercussions. A second factor may be the physical surroundings in which the decision must be made, which often includes life threatening conditions for military decision makers. The amount of time allocated to make a decision may also be a stress producing factor. This relationship of time and stress will be further developed in the remainder of this section.

Time is a parameter closely related to stress, and in many decision making environments, time may be the underlying cause of stress. It is proposed that the conclusions of time constraint experiments may then be applied to increased stress environments. Time was chosen as a parameter in this experiment primarily to evaluate how stress affects decision making. Time was chosen over other forms of stress because of its ease of control and its ability to be varied. Although the "effect" of time constraints may vary from person to person and be difficult if not impossible to measure, time still remains far easier to control than stress caused by fear of failure or adverse physical conditions, especially in a classroom experiment environment.

Using Time as a means of varying stress, the investigation begins by how this environmental factor will affect a decision maker's use of information. Decision making can be described as the task of evaluating information, arriving at alternative solutions or examining a list of predefined alternative solutions and selecting one course of action based upon some decision rule. If, as theorized, increased stress degrades the ability to perform this task, then it is proposed that the quantity of information which can be evaluated effectively will be decreased. This theory applied to the time parameter yields Hypothesis II.

HYPOTHESIS II

In a decision making situation, as time decreases, stress increases and the quantity of information which a decision maker can evaluate effectively decreases.

The goal of this research is to discover how various factors affect the quantity of information used in decision making and hence, the quality of a decision. With this goal in mind, it is hypothesized that the Quantity of Information that should be given to a decision maker to increase decision quality should be decreased as the time allowed to make the decision decreases.

Decision Flexibility

Decision Flexibility, the number of options available to a Decision Maker, is an environmental factor which has been the subject of past research [22]. It is predicted that varying this parameter (increasing or decreasing the number of potential options) will result in changes in the quality of the decision. It is further anticipated that some decision makers will improve the quality of their decisions, while others will find it more difficult to choose from among a larger or smaller set of alternatives. Whether a decision maker finds increased flexibility a benefit or a liability may be due to individual preferences as defined by psychological inventories. As summarized in the Literature Search chapter, much research has been devoted to the study of these preferences [2] [4] [6] [10]. The next section discusses four psychological instruments: the Myers Briggs Type Indicator, the Decision Styles Inventory, the Values Inventory, and the Herrmann Participant Survey Form. These instruments are validated measures of individual preferences and have been used both in past research and in this thesis.

Assuming Decision Flexibility can alter decision quality, the next step in this investigation is to determine whether or not changes in flexibility affect the quantity of information which optimizes a decision maker's ability to choose the best solution. Stated another way, if the Quantity of Information is kept fixed but the flexibility of the decision is changed, the quality of the decision may change. This theory is stated by the third hypothesis.

HYPOTHESIS III

As the decision flexibility is altered, the quantity of information which a decision maker can effectively evaluate is also altered.

Decision Maker Factors

As stated previously, various measures of preferences of individuals have been designed. Instruments designed to measure these preferences traditionally consist of a series of questions designed to classify an individual as being predominately one type out of several alternative categories of the preference being investigated. Four of these psychological instruments are used in this experiment and each is described in further detail in the sections which follow. A glossary of terms and their meanings is provided in Appendix A and may be a useful reference while reading these sections. The instruments are: the Myers Briggs Type Indicator (MBTI), Rowe's Decision Styles Inventory (DSI) and Values Inventory (VI), and the Herrmann Participant Survey Form (HPSF).

These instruments will be used in the experiment to categorize the test population in terms of dominant psychological traits. The set of dominant psychological traits as measured by these instruments will be collectively considered as the psychological profile of each participant. The psychological variables measured by these instruments comprise the decision maker factors of the experiment as defined earlier. Each of the instruments has been used extensively in past research and each has been validated to varying degrees of accuracy. However, no one instrument absolutely classifies individuals in the dimension being studied. For this reason, more than one instrument was chosen for this experiment. The last section of this chapter discusses a theory that these instruments may be to some degree redundant and complementary. That is, they measure the same underlying personality differences from various perspectives.

Myers Briggs Type Indicator

The Myers Briggs Type Indicator, designed and developed by Isabel Myers Briggs, is a 126 question psychological inventory that tests the degree to which an individual can be categorized according to Jung's sixteen dominant psychological types [15]. The MBTI has been used extensively in past research in many psychological experiments as well as many decision making experiments [4] [25]. It is one of the most widely accepted psychological instruments currently in use and has undergone many revisions since its conception, which has added greatly to its validity as a psychometric instrument.

The MBTI tests for four pairs of contrasting preferences which Jung and others believe are found in all people:

EXTRAVERSION (E) ---- INTROVERSION (I)

SENSING (S) --------- INTUITION (N)

THINKING (T) -------- FEELING (F)

JUDGING (J) --------- PERCEPTIVE (P)

The Extravert-Introvert pair describes how people relate to the world. Extraverts turn outward to the world of people and things for stimulation. Introverts tend to turn to an inner world of ideas and concepts.

The Sensing-Intuition pair describes the way a person perceives the world. Sensing is acquiring knowledge of what is happening through the use of the physical senses: seeing, hearing, tasting, smelling and touching. Intuition is what we infer from these observations. Intuitive types tend to be more creative with the information provided and look for possibilities and relationships. Sensers are more practical and matter-of-fact. They would rather work with known facts and take data at face value.

The third of Jung's pairs is the Thinking-Feeling pair. This pair describes the way individuals use judgment. Thinking occurs when a person considers only the objective facts pertaining to a problem and bases his decisions on impersonal analysis and logic. Feeling occurs when a person considers only the feelings, attitudes and values of people, and bases his decisions on personal values.

Finally, the Judging-Perception pair shows how an individual organizes his view of his environment. A Judging person decides issues far in advance and quickly determines his position on controversial issues. This type of person prefers a planned, decided, orderly way of life. A Perceptive individual does not like to plan and is much slower in determining his position on difficult issues. This individual prefers a flexible, spontaneous way of life.

Four dominant traits are identified for each individual in terms of these four pairs. This gives rise to sixteen possible combinations of personality traits. Figure 3-2 is a list of the 16 psychological types categorized by the MBTI along with a brief narrative of the characteristics associated with each type.

The MBTI was chosen primarily for its high degree of validity and acceptance in the psychological and decision making fields of study. Additionally, it has the advantage of being easy to administer and score and is readily obtained through most university educational testing centers.

The MBTI provides eight decision making parameters (Extraversion, Introversion, Sensing Intuition, Thinking, Feeling, Judging, Perception) which will be used in the hypothesis that various psychological types prefer different quantities of information in arriving at a decision. Furthermore, it is anticipated that changes in decision quality will be found due to the psychological type of the decision maker when the Quantity of Information is varied. Hypothesis IV relates all the decision maker factors and Quantity of Information to the decision quality.

CHARACTERISTICS FREQUENTLY ASSOCIATED WITH EACH TYPE

	SENSING TYPES		INTUITIVE TYPES		
INTROVERTS	**ISTJ** Serious, quiet earn success by concentration and thoroughness Practical, orderly, matter-of fact, logical, realistic and dependable See to it that everything is well organized Take responsibility Make up their own minds as to what should be accomplished and work toward it steadily, regardless of protests or distractions	**ISFJ** Quiet friendly, responsible and conscientious Work devotedly to meet their obligations Lend stability to any project or group Thorough, painstaking, accurate May need time to master technical subjects as their interests are usually not technical Patient with detail and routine Loyal, considerate, concerned with how other people feel	**INFJ** Succeed by perseverance, originality and desire to do whatever is needed or wanted Put their best efforts into their work Quietly forceful, conscientious, concerned for others Respected for their firm principles Likely to be honored and followed for their clear convictions as to how best to serve the common good	**INTJ** Usually have original minds and great drive for their own ideas and purposes In fields that appeal to them, they have a fine power to organize a job and carry it through with or without help Skeptical, critical independent determined, often stubborn Must learn to yield less important points in order to win the most important	INTROVERTS
INTROVERTS	**ISTP** Cool onlookers – quiet, reserved, observing and analyzing life with detached curiosity and unexpected flashes of original humor Usually interested in impersonal principles, cause and effect, how and why mechanical things work. Exert themselves no more than they think necessary, because any waste of energy would be inefficient.	**ISFP** Retiring, quietly friendly, sensitive, kind, modest about their abilities Shun disagreements, do not force their opinions or values on others Usually do not care to lead but are often loyal followers Often relaxed about getting things done, because they enjoy the present moment and do not want to spoil it by undue haste or exertion	**INFP** Full of enthusiasms and loyalties, but seldom talk of these until they know you well Care about learning, ideas, language and independent projects of their own Tend to undertake too much, then somehow get it done Friendly, but often too absorbed in what they are doing to be sociable. Little concerned with possessions or physical surroundings	**INTP** Quiet, reserved impersonal Enjoy especially theoretical or scientific subjects Logical to the point of hair splitting Usually interested mainly in ideas, with little liking for parties or small talk Tend to have sharply defined interests Need careers where some strong interest can be used and useful	INTROVERTS
EXTRAVERTS	**ESTP** Matter-of-fact, do not worry or hurry, enjoy whatever comes along Tend to like mechanical things and sports, with friends on the side. May be a bit blunt or insensitive Adaptable, tolerant, generally conservative in values. Dislike long explanations. Are best with real things that can be worked, handled, taken apart or put together.	**ESFP** Outgoing, easygoing, accepting, friendly, enjoy everything and make things more fun for others by their enjoyment Like sports and making things. Know what's going on and join in eagerly Find remembering facts easier than mastering theories. Are best in situations that need sound common sense and practical ability with people as well as with things	**ENFP** Warmly enthusiastic, high-spirited, ingenious, imaginative Able to do almost anything that interests them Quick with a solution for any difficulty and ready to help anyone with a problem Often rely on their ability to improvise instead of preparing in advance Can usually find compelling reasons for whatever they want	**ENTP** Quick, ingenious good at many things. Stimulating company, alert and outspoken May argue for fun on either side of a question Resourceful in solving new and challenging problems, but may neglect routine assignments. Apt to turn to one new interest after another Skillful in finding logical reasons for what they want.	EXTRAVERTS
EXTRAVERTS	**ESTJ** Practical, realistic, matter-of-fact, with a natural head for business or mechanics Not interested in subjects they see no use for, but can apply themselves when necessary Like to organize and run activities May make good administrators, especially if they remember to consider others' feelings and points of view	**ESFJ** Warm-hearted, talkative, popular, conscientious, born cooperators, active committee members Need harmony and may be good at creating it. Always doing something nice for someone Work best with encouragement and praise Little interest in abstract thinking or technical subjects Main interest is in things that directly and visibly affect people's lives	**ENFJ** Responsive and responsible Generally feel real concern for what others think or want, and try to handle things with due regard for other person's feelings Can present a proposal or lead a group discussion with ease and tact Sociable, popular, sympathetic Responsive to praise and criticism.	**ENTJ** Hearty, frank, decisive, leaders in activities Usually good in anything that requires reasoning and intelligent talk such as public speaking. Are usually well informed and enjoy adding to their fund of knowledge May sometimes be more positive and confident than their experience in an area warrants	EXTRAVERTS

Figure 3-2

Decision Styles Inventory

The Decision Style Inventory is one section of a three part instrument designed by Dr. Rowe. It is used extensively throughout the Department of Defense, including the Uniformed Services, as part of the Organizational Effectiveness programs [8] [29]. It consists of twenty forced response questions, each of which has four possible answers that are assigned values of 8, 4, 2, or 1. If a participant most agrees with a statement he codes "8" and if he least agrees with a statement he codes "1". This instrument categorizes the test population by decision style: Directive, Analytic, Conceptual, or Behavioral. Decision style may be thought of as the manner in which a person prefers to approach problem solving or decision making. A total of 300 points is distributed among the four decision styles. The scoring range for any one style is a low of 20 points up to a maximum of 160 points. The higher the score, the more a person is inclined to exhibit that type of decision style.

The Directive decision maker prefers to approach problem solving in a very organized and systematic fashion. His solutions tend to be simplistic and uncomplicated, much like the problem solving approach itself. The Analytic prefers to approach decision making by separating the problem into its constituent elements and carefully examining each variable that effects the decision. The

Conceptual decision type solves problems and forms concepts by mentally combining all the characteristics or particulars of the situation. This problem solving approach could be described as a synthesis of all available information pertaining to a decision. The Behavioral decision maker approaches decisions from an interpersonal perspective and is most concerned with how a particular solution will affect the people affected by the decision.

The Decision Styles Instrument was selected primarily for its wide acceptance and use by the military services, its ease of administration and scoring, and its availability to the experimentors. It will provide four decision maker factors which are the scores obtained in each decision style. It is hypothesized that information usage will vary with decision style. Furthermore, depending upon the decision maker's decision style, the quality of the decision will be affected by the Quantity of Information.

Values Inventory

The values inventory is the second part of the aforementioned instrument designed by Dr. Rowe. This psychometric instrument was chosen for similar reasons as the first part. The Values Inventory also consists of twenty forced response questions scaled 8, 4, 2, and 1 with scores ranging from 20 to 160 points in each of the four values categories. This instrument categorized individuals according to their values preferences: Pragmatist, Purist, Idealist, or Humanist.

The Pragmatist is a person who is oriented towards the success or failure of a particular line of action, thought, or decision alternative. This individual can be characterized as a practical person with practical values. A Purist is a person who is abstract or theoretical. This type's value preferences tend to be abstract not applied. The Idealist cherishes or pursues high or noble principles, purposes, goals, and values. The Idealist type tends to be visionary, an impractical person, and tries to represent things as they might or should be rather than as they are. The Humanist is a person having a strong interest in or concern for human welfare, values, and dignity.

In both the Values Inventory and the Decision Style Inventory it is possible for an individual to exhibit dominant behavior in more than one category. That is, it is possible, although very unlikely, that a person could score

75 points in each of the four categories that distinguish decision styles or values preferences. This type of scoring would signify that the person equally exhibits the various characteristics which distinguish between the categories. This type of person is more likely to be situationally dependent on which decision style or values preference will be dominant at any given time.

The hypothesis here is identical to the Decision Style Instrument except now the fluctuations in decision quality as the quantity of information is varied should be attributed to the differences in values preference. Once again, it is theorized that people with different values will make different decisions with a specific quantity of information. Furthermore, as the Quantity of Information changes, it is proposed that the quality of the decision will change depending upon the decision maker's values preferences.

This instrument that categorizes the Decision Style and Values Inventories also has a third section. This section deals with an individual's perception of his organizational culture. Since this is not applicable to this research on decision making parameters, it was not used.

Herrmann Participant Survey Form

The Herrmann Participant Survey Form (HPSF), designed by Mr. Ned Herrmann, consists of eleven sections which include biographical information, hobbies, self rated introversion/extraversion scale, and a twenty question survey on likes and dislikes. Although the instrument has been less widely used that the other measurements, the concept of brain dominance has received much attention in recent years and further investigations into this subject are ongoing [8] [29].

This instrument characterizes people in two ways. A person may predominantly utilize the right or left hemisphere of the brain in decision making roles. The human brain is, in reality, two semi-autonomous systems that process information differently and that can used in specialized manners. The human brain is not split, but whole with specialized parts. For example, the left hemisphere is more involved in sequential information processing than the right hemisphere; the right hemisphere deals more with information all at once [29]. The left hemisphere performs rational, sequential, and analytic functions while the right hemisphere controls intuitive, simultaneous, and holistic functions [28]. Definitions of these terms may be found in Appendix A. Figure 3-3A summarizes the clinical and experimental evidence about hemispheric specialization [28:62].

LEFT HEMISPHERE		RIGHT HEMISPHERE	
Words	Active	Images	Receptive
Analytic	Realistic	Intuitive	Imaginative
Sequential	Planned	Simultaneous	Impulsive

Figure 3-3A
Summary of Clinical and Experimental Evidence
About Hemispheric Specialization

Figure 3-3B shows the contrasting style, decision task preference, and information support which typifies the left and right hemispheres [28:69].

LEFT HEMISPHERE		RIGHT HEMISPHERE	
STYLE		STYLE	
Analytic		Intuitive	
TASK	FORMAT	TASK	FORMAT
Structured	Fixed Linear Tabular	Unstructured	Flexible Nonlinear Graphic

Figure 3-3B
User Style, Decision Task, and Information Support Among Users

Both hemispheres are further divided into cerebral and limbic halves. The upper half of each hemisphere is known as the cerebral area; the lower half is know as the limbic area. The cerebral area processes human thought, while the limbic area processes the emotions. Each area specializes in certain activities, as shown in Figure 3-4 [29].

LEFT CEREBRAL	RIGHT CEREBRAL
Logic	Conceptual
Analysis	Synthesizer
Mathematics	Artistic
Technical Concepts	Holistic
Problem Solving	Visual
LEFT LIMBIC	**RIGHT LIMBIC**
Control	Interpersonal
Conservative Attitudes	Emotional
Planning	Musical
Organization	Spiritual
Administration	Talkative

Figure 3-4
Specialization Of The Four Areas Of The Brain

The HPSF categorizes people as predominately Lower Left, Upper Left, Upper Righ or Lower Right. A brief explanation of the traits exhibited by each group will serve to clarify the four categories. The dominant Lower Left person is conservative, controlled, and administrative. This type is a planner and an organizer. The dominant Upper Left person is logical, analytical, mathematical, technical and a problem solver. The dominant Upper Right person is creative, a synthesizer, artistic, holistic, and a conceptualizer. The dominant Lower Right person is interpersonal, emotional, musical, spiritual and a talker. Explanations of these terms are provided in Appendix A.

Unlike the previous psychological instruments which can be easily scored, the HPSF is difficult to score and requires some expertise. The results of this instrument were scored by Mr. Daniel Robinson, a retired USAF Officer and an expert with many years of practice in administering and scoring this particular test.

The HPSF was included in this research primarily to provide an additional psychometric instrument which appeared to be measuring the same factors as several of the parameters in the three previously discussed instruments. This concept of redundant measure of the same underlying factors will be discussed further in the next section.

In addition to the four decision maker factors already discussed, the HPSF also provides a score for two additional factors: Total Right and Total Left hemispheres of the brain. Hence, this instrument provides six additional decision maker factors. Once again, it is hypothesized that information absorption by a decision maker will vary with the brain dominance measures of the HPSF and will affect the decision quality as the amount of information presented to the decision maker is varied.

The statement of the fourth hypothesis will conclude the last four sections on psychological profile.

HYPOTHESIS IV

The psychological profile of an individual as measured by the above instruments will affect the way a decision maker uses information. By varying the quantity of information, the quality of decision will also vary depending upon the psychological profile of the decision maker.

Redundancy Theory Of The Psychological Parameters

This section investigates relationships between the decision maker parameters discussed in the previous sections. A classification procedure is developed which eliminates much of the redundancy between these parameters. This provides a greater similarity of psychological profile within categories and a greater diversion of these profiles between categories. The classification procedure also reduces the number of variables used to classify an individual's psychological profile. Reducing the number of variables simplifies the analysis that can be performed using the classification procedure. Many of the psychological descriptors of the four instruments appear to be measuring the same underlying factor. Descriptors such as Thinking from the MBTI and Analytic from the DSI could be measuring the same personality trait, logic perhaps. Another example of this apparent similarity in the descriptors are Feeling (MBTI), Behavioral (DSI), and Humanist (VI) which all appear to be measuring an interpersonal trait.

To test whether or not this apparent similarity in the psychological parameters is more that just "skin deep", a theory of redundancy in the instruments was postulated and tested using the Statistical Package for the Social Sciences (SPSS) [26]. This theory initially proposes that the DSI, VI, and HPSF may all measure many of the same underlying factors since each instrument tests for dominance in one of four categories.

Based upon the narrative descriptors of each parameter, four groups were made in which the parameters believed to measure similar traits were placed. it was postulated that Directive (DSI), Pragmatist (VI) and Lower Left (HPSF) all measure the same underlying trait and belong to Group 1. Similarly, the Analytic (DSI), Purist (VI), and Upper Left (HPSF) all measure the same trait and belong to Group 2. The Conceptual (DSI), Idealist (VI), and Upper Right (HPSF) all measure a similar trait and belong to Group 3. Finally, the Behavioral (DSI), Humanist (VI) and Lower Right (HPSF) measure the same underlying trait and were assigned to Group 4. The Total Right and Total Left parameters of the HPSF did not logically fit into any one of these groups since each of these parameters is a combination of two of the other HPSF variables.

The MBTI was next examined to see if the eight parameters it measured could also be placed into one of the four groups. Upon a further examination of the definition of each of these parameters, it was proposed that the Sensing parameter should belong to Group 1, the Thinking parameter best resembled the characteristics of Group 2, the Intuition parameter was most suited to Group 3, and finally the Feeling parameter appeared to measure the Group 4 trait. The remaining four MBTI parameters: Extraversion, Introversion, Judging, and Perspective were more difficult to place into the groups and seem to perhaps be measuring factors which did not coincide with any group trait.

Further investigation revealed other possible underlying relationships between the parameters. Since the eight MBTI parameters form four opposite trait pairs: E-I, S-N, T-F, J-F, it was hypothesized that this opposite pair relationship may be found in the four groups. This proposal led to the theory that the Group 1 and Group 3 parameters measure opposite spectrums of the same underlying factor since these groups include the opposite traits of Sensing versus Intuition. Likewise, the Group 2 and Group 4 parameters which contained the opposite traits of Thinking versus Feeling were opposite measures of the same underlying factor.

If this theory were found to be correct, a population could then be classified according to psychological preferences using one or more of these instruments and divided into the four groups or quadrants. Opposite quadrants would measure opposite traits of the same underlying factor. Each of the parameters in the same quadrant would measure a similar underlying trait. Using this theory of redundancy in the instruments, individuals could be classified as belonging to a specific Quadrant regardless of the instrument or instruments used in the classification procedure.

This "Quadrant Theory" outlined in Figure 3-5, shows the variables from each instrument as elements of one of the four quadrants. Note the similarity between the names of the parameters within quadrants. Also note the opposite relationship between the names of the parameters across Quadrants 1 and 3, which contain opposite sides of one primary factor, and across Quadrants 2 and 4, which contain opposite sides of the second primary factor.

This theory states that the four tests are redundant in that they actually test for the same underlying traits and would predict the correlations between the quadrants for each of the pairs of instruments as shown in Figure 3-6.

QUADRANT II			QUADRANT III		
MBTI	thinking	(M2)	MBTI	intuition	(M3)
DSI	analytic	(D2)	DSI	conceptual	(D3)
VI	purist	(V2)	VI	idealist	(V3)
HPSF	upper left	(H2)	HPSF	upper right	(H3)
QUADRANT I			**QUADRANT IV**		
MBTI	sensing	(M1)	MBTI	feeling	(M4)
DSI	directive	(D1)	DSI	behavioral	(D4)
VI	pragmatist	(V1)	VI	humanist	(V4)
HPSF	lower left	(H1)	HPSF	lower right	(H4)

Figure 3-5
Quadrant Theory Variables

THE QUADRANT THEORY MODEL

	D1	D2	D3	D4
M1	Hi		Lo	
M2		Hi		Lo
M3	Lo		Hi	
M4		Lo		Hi

	V1	V2	V3	V4
M1	Hi		Lo	
M2		Hi		Lo
M3	Lo		Hi	
M4		Lo		Hi

	H1	H2	H3	H4
M1	Hi		Lo	
M2		Hi		Lo
M3	Lo		Hi	
M4		Lo		Hi

	V1	V2	V3	V4
D1	Hi		Lo	
D2		Hi		Lo
D3	Lo		Hi	
D4		Lo		Hi

	H1	H2	H3	H4
D1	Hi		Lo	
D2		Hi		Lo
D3	Lo		Hi	
D4		Lo		Hi

	H1	H2	H3	H4
V1	Hi		Lo	
V2		Hi		Lo
V3	Lo		Hi	
V4		Lo		Hi

Figure 3-6
Predicted Relationships Between Pairs of Instruments

Since opposite quadrants are evaluating opposite traits, the theory would suggest large negative correlations (Lo's) across quadrants and large positive correlations (Hi's) within quadrants. The theory does not address correlations between adjacent quadrants.

Pearson Correlation

The Quadrant Theory was tested using Pearson Correlation and Factor Analysis from the SPSS [26]. The 43 Operations Research students, who were to be the participants in the decision making experiment, were administered the four psychological instruments. The test population will be discussed in detail in Chapter Four. Each participant received scores for the 22 decision maker parameters, eight from MBTI, four from DSI, four from VI, and six from HPSF. The scores from the participants were arranged in the 22 x 43 data matrix. Each column represents the score for one parameter for all participants. Each row consists of all 22 scores for one participant.

The data matrix was transformed into a 22 x 22 correlation matrix using Pearson Correlation. This matrix is shown in Figure 3-7. The Pearson Correlation represents an index of the degree of linear relationship between the parameters. That is, the tendency of the data to fall along a straight line. Positive correlation results when the data groups along a line with a positive slope. Similarly, negative correlation results when the data falls along a line with a negative slope. The greater the correlation between each pair of parameters, the larger the Pearson Correlation.

The Pearson Correlation for each pair of traits is represented by the first number in each entry of Figure 3-7. Parameters which are negatively correlated have an appropriate sign change. All 43 cases were used to determine the correlation between each pair of parameters. The second number listed represents the significance of the correlation. The significance level,P, provided in the SPSS output represents the lowest significance level, alpha, at which the null hypothesis that the correlation is zero can be rejected.

Since it is of interest to test for both large positive and large negative correlation, a two tailed test was performed. The two tailed test is associated with the alternate hypothesis that the correlation is different from zero and eliminates any ambiguity in interpreting the results. Figure 3-8 provides a summary of the Pearson Correlation in which only the strongest correlations are shown. These correlations have a significance value of alpha less than or equal to 0.001.

	M1	M2	M3	M5	M4	M6	M7	M8	D1	D2	D3	D4
M1	1.0000 P=******	-.9489 P= .001	-.4293 P= .004	-.2609 P= .091	.3613 P= .017	.2595 P= .093	-.4665 P= .002	.4529 P= .002	.0767 P= .625	-.1789 P= .251	.0411 P= .794	.0966 P= .538
M2	-.9489 P= .001	1.0000 P=******	.3865 P= .010	.2704 P= .080	-.3068 P= .045	-.2551 P= .099	.3903 P= .010	-.3667 P= .016	-.1315 P= .401	.1670 P= .284	-.0321 P= .838	-.0530 P= .736
M3	-.4293 P= .004	.3865 P= .010	1.0000 P=******	.4289 P= .004	-.9121 P= .001	-.4491 P= .003	.7276 P= .001	-.7081 P= .001	.4095 P= .006	.1736 P= .266	-.5430 P= .001	-.0536 P= .733
M5	-.2609 P= .091	.2704 P= .080	.4289 P= .004	1.0000 P=******	-.4195 P= .005	-.9075 P= .001	.3496 P= .022	-.3231 P= .035	.3954 P= .009	.3058 P= .046	-.3202 P= .036	-.3456 P= .023
M4	.3613 P= .017	-.3068 P= .045	-.9121 P= .001	-.4195 P= .005	1.0000 P=******	.5095 P= .001	-.6977 P= .001	.7000 P= .001	-.4935 P= .001	-.1563 P= .317	.5797 P= .001	.0672 P= .669
M6	.2595 P= .093	-.2551 P= .099	-.4491 P= .003	-.9075 P= .001	.5095 P= .001	1.0000 P=******	-.4510 P= .002	.4452 P= .003	-.4082 P= .007	-.2944 P= .055	.3288 P= .031	.3366 P= .027
M7	-.4665 P= .002	.3903 P= .010	.7276 P= .001	.3496 P= .022	-.6977 P= .001	-.4510 P= .002	1.0000 P=******	-.9727 P= .001	.2702 P= .080	.2572 P= .096	-.3879 P= .010	-.1575 P= .313
M8	.4529 P= .002	-.3667 P= .016	-.7081 P= .001	-.3231 P= .035	.7000 P= .001	.4452 P= .003	-.9727 P= .001	1.0000 P=******	-.2167 P= .163	-.2958 P= .054	.3976 P= .008	.1518 P= .331
D1	.0767 P= .625	-.1315 P= .401	.4095 P= .006	.3954 P= .009	-.4935 P= .001	-.4082 P= .007	.2702 P= .080	-.2167 P= .153	1.0000 P=******	.0603 P= .701	-.5578 P= .001	-.3416 P= .025
D2	-.1789 P= .251	.1670 P= .284	.1736 P= .266	.3058 P= .046	-.1563 P= .317	-.2944 P= .055	.2572 P= .096	-.2958 P= .054	.0603 P= .701	1.0000 P=******	-.3819 P= .012	-.7679 P= .001
D3	.0411 P= .794	-.0321 P= .838	-.5430 P= .001	-.3202 P= .036	.5797 P= .001	.3288 P= .031	-.3879 P= .010	.3976 P= .008	-.5578 P= .001	-.3819 P= .012	1.0000 P=******	.0238 P= .879
D4	.0966 P= .538	-.0530 P= .736	-.0536 P= .733	-.3456 P= .023	.0672 P= .569	.3366 P= .027	-.1575 P= .313	.1518 P= .331	-.3416 P= .025	-.7679 P= .001	.0238 P= .879	1.0000 P=******
V1	.2612 P= .091	-.2855 P= .063	.0604 P= .701	.2300 P= .138	-.1308 P= .403	-.1686 P= .280	-.0876 P= .576	.0327 P= .835	.3828 P= .011	.1522 P= .330	-.3988 P= .008	-.1219 P= .436
V2	-.2766 P= .073	.2554 P= .098	.3839 P= .011	.3195 P= .037	-.3328 P= .029	-.3649 P= .016	.5251 P= .001	-.4858 P= .001	.2081 P= .181	.4849 P= .001	-.2868 P= .062	-.4211 P= .005
V3	-.1651 P= .290	.1614 P= .301	-.1281 P= .413	.0809 P= .606	.2121 P= .172	-.0407 P= .796	-.1360 P= .384	.2029 P= .192	-.0607 P= .699	-.1790 P= .251	.3944 P= .009	-.0735 P= .640
V4	.1218 P= .436	-.0738 P= .638	-.2803 P= .069	-.6032 P= .001	.2306 P= .137	.5395 P= .001	-.2392 P= .122	.1997 P= .199	-.5336 P= .001	-.4187 P= .005	.3026 P= .049	.5704 P= .001
H2	-.2426 P= .117	.1883 P= .227	.5976 P= .001	.1917 P= .218	-.5919 P= .001	-.2629 P= .089	.6463 P= .001	-.6470 P= .001	.2790 P= .070	.0971 P= .536	-.4803 P= .001	.0683 P= .663
H1	-.3882 P= .010	.3205 P= .036	.3660 P= .016	.3627 P= .017	-.4093 P= .006	-.4873 P= .001	.4358 P= .003	-.4444 P= .003	.3014 P= .049	.4968 P= .001	-.2715 P= .078	-.5102 P= .001
H4	.3775 P= .013	-.3306 P= .030	-.7362 P= .001	-.2280 P= .141	.7410 P= .001	.3646 P= .016	-.7976 P= .001	.8127 P= .001	-.3652 P= .016	-.2906 P= .059	.5499 P= .001	.1358 P= .385
H3	.5492 P= .001	-.4772 P= .001	-.3947 P= .009	-.3624 P= .017	.3791 P= .012	.4175 P= .005	-.4433 P= .003	.4420 P= .003	-.1608 P= .303	-.2893 P= .060	.1309 P= .403	.3073 P= .045
H5	-.4422 P= .003	.3589 P= .018	.6350 P= .001	.3938 P= .009	-.6635 P= .001	-.5323 P= .001	.7167 P= .001	-.7238 P= .001	.3954 P= .009	.4394 P= .003	-.4923 P= .001	-.3513 P= .021
H6	.5128 P= .001	-.4468 P= .003	-.6766 P= .001	-.3662 P= .016	.6670 P= .001	.4702 P= .001	-.7315 P= .001	.7381 P= .001	-.3150 P= .040	-.3431 P= .024	.4186 P= .005	.2529 P= .102

Figure 3-7

	V1	V2	V3	V4	H2	H1	H4	H3	H5	H6
M1	.2612	-.2766	-.1651	.1218	-.2426	-.3882	.3775	.5492	-.4422	.5128
	P= .091	P= .073	P= .290	P= .436	P= .117	P= .010	P= .013	P= .001	P= .003	P= .001
M2	-.2855	.2554	.1614	-.0738	.1883	.3205	-.3306	-.4772	.3589	-.4468
	P= .063	P= .098	P= .301	P= .638	P= .227	P= .036	P= .030	P= .001	P= .018	P= .003
M3	.0604	.3839	-.1281	-.2803	.5976	.3660	-.7362	-.3947	.6350	-.6766
	P= .701	P= .011	P= .413	P= .069	P= .001	P= .016	P= .001	P= .009	P= .001	P= .001
M5	.2300	.3195	.0809	-.6032	.1917	.3627	-.2280	-.3624	.3938	-.3662
	P= .138	P= .037	P= .606	P= .001	P= .218	P= .017	P= .141	P= .017	P= .009	P= .016
M4	-.1308	-.3328	.2121	.2306	-.5919	-.4093	.7410	.3791	-.6635	.6670
	P= .403	P= .029	P= .172	P= .137	P= .001	P= .006	P= .001	P= .012	P= .001	P= .001
M6	-.1686	-.3649	-.0407	.5395	-.2628	-.4873	.3646	.4175	-.5323	.4702
	P= .280	P= .016	P= .796	P= .001	P= .089	P= .001	P= .016	P= .005	P= .001	P= .001
M7	-.0876	.5251	-.1360	-.2392	.6463	.4358	-.7976	-.4433	.7167	-.7315
	P= .576	P= .001	P= .384	P= .122	P= .001	P= .003	P= .001	P= .003	P= .001	P= .001
M8	.0327	-.4858	.2029	.1997	-.6470	-.4444	.8127	.4420	-.7238	.7381
	P= .835	P= .001	P= .192	P= .199	P= .001	P= .003	P= .001	P= .003	P= .001	P= .001
D1	.3828	.2081	-.0607	-.5336	.2790	.3014	-.3652	-.1608	.3954	-.3150
	P= .011	P= .181	P= .699	P= .001	P= .070	P= .049	P= .016	P= .303	P= .009	P= .040
D2	.1522	.4849	-.1790	-.4187	.0971	.4968	-.2906	-.2893	.4394	-.3431
	P= .330	P= .001	P= .251	P= .005	P= .536	P= .001	P= .059	P= .060	P= .003	P= .024
D3	-.3988	-.2868	.3944	.3026	-.4803	-.2715	.5499	.1309	-.4923	.4186
	P= .008	P= .062	P= .009	P= .049	P= .001	P= .078	P= .001	P= .403	P= .001	P= .005
D4	-.1219	-.4211	-.0735	.5704	.0683	-.5102	.1358	.3073	-.3513	.2529
	P= .436	P= .005	P= .640	P= .001	P= .663	P= .001	P= .385	P= .045	P= .021	P= .102
V1	1.0000	-.1638	-.5896	-.3616	.0512	.1176	-.0739	-.0318	.1187	-.0846
	P=******	P= .294	P= .001	P= .017	P= .744	P= .453	P= .638	P= .840	P= .449	P= .590
V2	-.1638	1.0000	-.1867	-.5278	.2395	.5144	-.4986	-.3829	.5388	-.5223
	P= .294	P=******	P= .231	P= .001	P= .122	P= .001	P= .001	P= .011	P= .001	P= .001
V3	-.5896	-.1867	1.0000	-.1578	-.1272	-.1115	.2163	-.0191	-.1611	.1379
	P= .001	P= .231	P=******	P= .312	P= .416	P= .476	P= .164	P= .903	P= .302	P= .378
V4	-.3616	-.5278	-.1578	1.0000	-.1444	-.4720	.3119	.3890	-.4474	.4187
	P= .017	P= .001	P= .312	P=******	P= .356	P= .001	P= .042	P= .010	P= .003	P= .005
H2	.0512	.2395	-.1272	-.1444	1.0000	.0646	-.6751	-.2843	.6395	-.5835
	P= .744	P= .122	P= .416	P= .356	P=******	P= .681	P= .001	P= .065	P= .001	P= .001
H1	.1176	.5144	-.1115	-.4720	.0646	1.0000	-.5510	-.7930	.8084	-.7719
	P= .453	P= .001	P= .476	P= .001	P= .681	P=******	P= .001	P= .001	P= .001	P= .001
H4	-.0739	-.4986	.2163	.3119	-.6751	-.5510	1.0000	.4579	-.8222	.8565
	P= .638	P= .001	P= .164	P= .042	P= .001	P= .001	P=******	P= .002	P= .001	P= .001
H3	-.0318	-.3829	-.0191	.3890	-.2843	-.7930	.4579	1.0000	-.7794	.8438
	P= .840	P= .011	P= .903	P= .010	P= .065	P= .001	P= .002	P=******	P= .001	P= .001
H5	.1187	.5388	-.1611	-.4474	.6395	.8084	-.8222	.7794	1.0000	-.9391
	P= .449	P= .001	P= .302	P= .003	P= .001	P= .001	P= .001	P= .001	P=******	P= .001
H6	-.0846	-.5223	.1379	.4187	-.5835	-.7719	.8565	.8438	-.9391	1.0000
	P= .590	P= .001	P= .378	P= .005	P= .001	P= .001	P= .001	P= .001	P= .001	P=******

Figure 3-7 (cont.)

	E	I	S	N	T	F	J	P	DIR	ANA	CON	BEH	PRA	PUR	IDE	HUM	LL	UL	UR	LR	TL	TR
MBTI																						
Extraversion (E)	1.0	-.95																		.55		.51
Introversion (I)		1.0																		-.48		
*Sensing (S)			1.0	-.91			.73	-.71			-.54						.60		-.74		.64	-.68
*Intuition (N)				1.0		.51	-.70	.70	-.49		.58						-.59		.74		-.66	.67
*Thinking (T)					1.0	-.91										-.60						
*Feeling (F)						1.0										.54		-.49			-.53	.47
Judging (J)							1.0	-.97						.53			.65		-.80		.72	-.73
Perception (P)								1.0						-.49			-.65		.81		-.72	.73
DSI									DIR	ANA	CON	BEH	PRA	PUR	IDE	HUM	LL	UL	UR	LR	TL	TR
*Directive (DIR)									1.0		-.56					-.53						
*Analytic (ANA)										1.0		-.77		.48				.50				
*Conceptual (CON)											1.0						-.48		.55		-.49	
*Behavioral (BEH)												1.0				.57		-.51				
VI													PRA	PUR	IDE	HUM	LL	UL	UR	LR	TL	TR
*Pragmatist (PRA)													1.0		-.59							
*Purist (PUR)														1.0		-.53		.51	-.50		.54	-.52
*Idealist (IDE)															1.0							
*Humanist (HUM)																1.0		-.47				
HPSF																	LL	UL	UR	LR	TL	TR
*Lower Left (LL)																	1.0		-.68		.64	-.58
*Upper Left (UL)																		1.0	-.55	-.79	.81	-.77
*Upper Right (UR)																			1.0		-.82	.86
*Lower Right (LR)																				1.0	-.78	.84
Total Left (TL)																					1.0	-.94
Total Right (TL)																						1.0

* - Indicates initial quadrant theory variables
Blanks indicate correlations with significance alpha > .001

Figure 3-8

Figure 3-9 shows a comparison of the predicted groups which comprised the Quadrant Theory to the actual groups formed by the significant correlations of the parameter pairs as summarized in Figure 3-8. Several relationships are immediately apparent from Figure 3-9.

Thinking did not have a significant positive correlation (alpha = .001) with any other parameter. However it was placed in Quadrant II since Thinking and Upper Left (a Quadrant II parameter) both had significant negative correlation with Humanist (a Quadrant IV parameter). The desired relationship of significant negative correlation of opposite quadrant variables allowed Thinking to be placed in Quadrant II. Similar significant negative correlation between Directive and Lower Left in Quadrant I and between Lower Right and Feeling in Quadrant IV allowed these parameters to be placed in those Quadrants, respectively.

The Pragmatist and Idealist parameters from the Values Inventory showed no strong positive or negative correlation with any other parameter. They did not appear to fit the Quadrant Theory. These two parameters appear to be opposite extremes of a factor different from those of the Quadrant Theory. This factor could be named "the practicality" of the decision maker. As predicted, the Extraversion-Introversion pair from the MBTI also appeared to measure a unique factor which may be named "information collection process" of the decision maker.

PARAMETER GROUPS PREDICTED BY THE QUADRANT THEORY

Quadrant II	Quadrant III
thinking	intuition
analytic	conceptual
purist	idealist
upper left	upper right

Quadrant I	Quadrant IV
sensing	feeling
directive	behavioral
pragmatist	humanist
lower left	lower right

ACTUAL GROUPS FORMED BY SIGNIFICANT CORRELATION OF PARAMETER PAIRS

Quadrant II	Quadrant III
thinking *	intuition
analytic	conceptual
purist	upper right
upper left	perspective **
	feeling

Quadrant I	Quadrant IV
sensing	feeling
directive *	behavioral
lower left	humanist
judging **	lower right *

* group membership established by similar significant negative correlation with other parameters in the group

** parameters not included in the original Quadrant Theory

PARAMETERS NOT FITTING THE MODEL
(ie. not significantly correlated with any other parameter)

idealist ***	pragmatist ***
extraversion	introversion

*** predicted Quadrant Theory parameters

Figure 3-9
Comparison of the Predicted Groups to the Actual Groups

Hence, Figure 3-9 clearly supports the Quadrant Theory with the exception of those parameters discussed above. This summary also shows a high positive correlation between Judging and the Quadrant I parameters and between Perceptive and the Quadrant III parameters, hence they will be placed in these quadrants respectively. Although Feeling (a predicted Quadrant IV parameter) is significantly correlated with Intuition (a Quadrant III parameter) as well as with Humanist (a Quadrant IV parameter) the correlation is strongest with the Quadrant IV parameters and therefore it will be considered as a Quadrant IV parameter.

The Total Left and Total Right parameters for the HPSF will also be eliminated from the experiment since they are each correlated with the two quadrants which contain the Right (Upper and Lower) and Left (Upper and Lower) parameters of the HPSF.

Figures 3-11 through 3-16 list portions of the SPSS output of the Pearson Correlation that have been extracted to show the actual versus theoretically predicted correlation of the parameters from each pair of instruments. Only the four parameters from each instrument shown in the Quadrant Theory model, Figure 3-4, will be included in these correlation matrices. In each of these comparisons, a significant level of alpha = 0.05 will be used. Significance levels of greater than alpha = 0.05 will be interpreted as being uncorrelated; that is, not statistically significantly correlated at the alpha = 0.05

level. The decision maker parameter codes used in these figures are shown in Figure 3-10.

M1	Extraversion	V1	Pragmatist
M2	Introversion	V2	Purist
M3	Sensing	V3	Idealist
M4	Intuition	V4	Humanist
M5	Thinking		
M6	Feeling	H1	Upper Left
M7	Judging	H2	Lower Left
M8	Perceptive	H3	Lower Right
		H4	Upper Right
D1	Directive	H5	Total Left
D2	Analytic	H6	Total Right
D3	Conceptual		
D4	Behavioral		

Figure 3-10
Decision Maker Parameter Codes

MYERS BRIGGS TYPE INDICATOR - DECISION STYLES INVENTORY

	D1	D2	D3	D4
M3	.4095	.1736	-.5430	-.0536
	(43)	(43)	(43)	(43)
	P= .005	P= .266	P= .001	P= .733
M5	.3954	.3058	-.3202	-.3456
	(43)	(43)	(43)	(43)
	P= .009	P= .046	P= .036	P= .023
M4	-.4935	-.1563	.5797	.0672
	(43)	(43)	(43)	(43)
	P= .001	P= .317	P= .001	P= .669
M6	-.4082	-.2944	.3288	.3366
	(43)	(43)	(43)	(43)
	P= .007	P= .055	P= .031	P= .027

Figure 3-11
Pearson Correlation of the MBTI and the DSI
Quadrant Variables Only

MYERS BRIGGS TYPE INDICATOR - VALUES INVENTORY

	V1	V2	V3	V4
M3	.0604	.3839	-.1281	-.2803
	(43)	(43)	(43)	(43)
	P= .701	P= .011	P= .413	P= .069
M5	.2300	.3195	.0809	-.6032
	(43)	(43)	(43)	(43)
	P= .138	P= .037	P= .606	P= .001
M4	-.1308	-.3328	.2121	.2306
	(43)	(43)	(43)	(43)
	P= .403	P= .029	P= .172	P= .137
M6	-.1686	-.3649	-.0407	.5395
	(43)	(43)	(43)	(43)
	P= .280	P= .016	P= .796	P= .001

Figure 3-12
Pearson Correlation of the MBTI and the VI
Quadrant Variables Only

MYERS BRIGGS TYPE INDICATOR - HERRMANN PARTICIPANT SURVEY FORM

	H2	H1	H4	H3
M3	.5976 (43) P= .001	.3660 (43) P= .016	-.7362 (43) P= .001	-.3947 (43) P= .009
M5	.1917 (43) P= .218	.3627 (43) P= .017	-.2280 (43) P= .141	-.3624 (43) P= .017
M4	-.5919 (43) P= .001	-.4093 (43) P= .006	.7410 (43) P= .001	.3791 (43) P= .012
M6	-.2628 (43) P= .089	-.4873 (43) P= .001	.3646 (43) P= .016	.4175 (43) P= .005

Figure 3-13
Pearson Correlation of the MBTI and the HPSF
Quadrant Variables Only

DECISION STYLES INVENTORY - VALUES INVENTORY

	V1	V2	V3	V4
D1	.3828 (43) P= .011	.2081 (43) P= .181	-.0607 (43) P= .699	-.5336 (43) P= .001
D2	.1522 (43) P= .330	.4849 (43) P= .001	-.1790 (43) P= .251	-.4187 (43) P= .005
D3	-.3988 (43) P= .008	-.2868 (43) P= .062	.3944 (43) P= .009	.3026 (43) P= .049
D4	-.1219 (43) P= .436	-.4211 (43) P= .005	-.0735 (43) P= .640	.5704 (43) P= .001

Figure 3-14
Pearson Correlation of the DSI and the VI
Quadrant Variables Only

DECISION STYLES INVENTORY - HERRMANN PARTICIPANT SURVEY FORM

	H2	H1	H4	H3
D1	.2790	.3014	-.3652	-.1608
	(43)	(43)	(43)	(43)
	P= .070	P= .049	P= .016	P= .303
D2	.0971	.4968	-.2906	-.2893
	(43)	(43)	(43)	(43)
	P= .536	P= .001	P= .059	P= .060
D3	-.4803	-.2715	.5499	.1309
	(43)	(43)	(43)	(43)
	P= .001	P= .078	P= .001	P= .403
D4	.0683	-.5102	.1358	.3073
	(43)	(43)	(43)	(43)
	P= .663	P= .001	P= .385	P= .045

Figure 3-15
Pearson Correlation of the DSI and the HPSF
Quadrant Variables Only

VALUES INVENTORY - HERRMANN PARTICIPANT SURVEY FORM

	H2	H1	H4	H3
V1	.0512	.1176	-.0739	-.0318
	(43)	(43)	(43)	(43)
	P= .744	P= .453	P= .638	P= .840
V2	.2395	.5144	-.4986	-.3829
	(43)	(43)	(43)	(43)
	P= .122	P= .001	P= .001	P= .011
V3	-.1272	-.1115	.2163	-.0191
	(43)	(43)	(43)	(43)
	P= .416	P= .476	P= .164	P= .903
V4	-.1444	-.4720	.3119	.3890
	(43)	(43)	(43)	(43)
	P= .356	P= .001	P= .042	P= .010

Figure 3-16
Pearson Correlation of the VI and the HPSF
Quadrant Variables Only

Figure 3-13 shows that the MBTI and the HPSF fit the Quadrant Theory exactly. That is, all expected large positive correlations and large negative correlations were found to be present in the experimental population (see Figure 3-6).

Comparisons of the MBTI - DSI (Figure 3-11), DSI - VI (Figure 3-14) and DSI - HPSF (Figure 3-15) also fit the Quadrant Theory with most of the predicted positive and negative correlations being significant at alpha = 0.05. Those pairs of parameters which were not significantly correlated were none the less in the expected direction (positive or negative).

In the comparison of the MBTI - VI (Figure 3-12) and the VI - HPSF (Figure 3-16) only four of the eight expected significant correlations held in each matrix. In both matrices, the Pragmatist and Idealist parameters once again failed to show a significant correlation with any other parameter. This justifies the removal of these parameters from the Quadrant Theory model.

The results of the comparison of the pairs of instruments for the theoretical and actual correlation are summarized in Figure 3-17.

INSTRUMENT PAIRS	NUMBER OF THEORETICAL RELATIONSHIPS WHICH HOLD		
	Total	Positive	Negative
MBTI vs DSI	7 of 8	4 of 4	3 of 4
MBTI vs VI	4 of 8	2 of 4	2 of 4
MBTI vs HPSF	8 of 8	4 of 4	4 of 4
DSI vs VI	7 of 8	4 of 4	3 of 4
DSI vs HPSF	7 of 8	3 of 4	4 of 4
VI vs HPSF	4 of 8	2 of 4	2 of 4

Figure 3-17
Summary of Relationships for Each Pair of Instruments

The results of the Pearson Correlation show that the Quadrant Theory is valid for this population with the exception of the parameter pairs which were not significant in Figures 3-11 through 3-16. Those parameters which were not significant appear to be measuring traits which do not coincide with the characteristics of the factors in the Quadrant Theory and were removed from the model. These parameters include Extraversion, Introversion from the MBTI; Pragmatist, Idealist from the VI; and Total Left, Total Right from the HPSF.

Factor Analysis

These conclusions are supported by the results of a Factor Analysis of the 16 parameters which compose the Quadrant Theory. They include Sensing, Thinking, Intuition, Feeling, Judging, Perspective from the MBTI; Directive, Analytic, Conceptual, Behavioral from the DSI; Purist, Humanist from the VI; and Lower Left, Upper Left, Upper Right, Lower Right from the HPSF.

Factor Analysis is used as a means of extracting from the data obtained from a large number of measurable or "manifestation" variables the relatively few underlying or "latent" factors. The objectives for performing a factor analysis are, first, to identify the true dimensionality of the set of variables on which the data has been gathered. That is, to determine how many underlying factors might have generated the data. Second, to estimate what the value of each factor would have been if they were measured directly. These estimated values are called factor scores. The third objective is to identify a set of factors smaller in number than the manifestation variables and give some simple interpretation to each of them. The use of Factor Analysis is to test the Quadrant Theory of two underlying factors each having positive and negative traits which represent the four quadrants.

A Factor Analysis may be done in one of two ways. The first way is to allow the algorithm to find the smallest number of factors which accounts for the largest amount of variation in the manifestation variables. The second way to perform a Factor Analysis is to specify the number of factors desired. In the latter procedure, the algorithm will determine the specified number of factors such that the maximum amount of variation in the manifestation variables is captured.

The first procedure allows the Factor Analysis to determine the number of significant factors. When this was done for the Quadrant Theory parameters, four factors were defined. The results of this Factor Analysis are summarized in Figure 3-18. The % column identifies the percent of the manifestation variable captured by the latent factor. The QUAD column refers to the quadrant which the manifestation variable is associated.

LOADINGS OF QUADRANT THEORY PARAMETERS

F1(+)	QUAD	%
Sensing	I	82
Judging	I	89
Lower Left	I	78

F1(-)	QUAD	%
Intuition	III	80
Perceptive	III	90
Upper Rt	III	88

F2(+)	QUAD	%
Behavioral	IV	86
Humanist	IV	55

F2(-)	QUAD	%
Analytic	II	88
Purist	II	64
Upper Left	II	64

F3(+)	QUAD	%
Feeling	IV	86
Humanist	IV	57

F3(-)	QUAD	%
Thinking	II	88

F4(+)	QUAD	%
Directive	I	68

F4(-)	QUAD	%
Conceptual	III	69

PARAMETERS NOT LOADING SIGNIFICANTLY (loading < 50%) ON ANY FACTOR

Parameter	QUAD
Lower Right	I

Figure 3-18
Summary of Factor Analysis

Figure 3-18 clearly shows the strong relationships or loadings of the Quadrant Theory parameters on the latent factors. The Quadrant I parameters had strong positive loadings on Factors 1 and 4. The Quadrant III parameters loaded negatively on these same factors. This shows the predicted strong opposite relationship between these two opposite quadrants. Similarly, the Quadrant IV parameters loaded positively on Factors 2 and 3 and the Quadrant II parameters loaded negatively on these same factors. This also shows the predicted strong opposite relationship between the remaining two quadrants. A total of 77.8 percent of the variation in the manifestation variables was captured by these four factors.

If the Quadrant Theory is valid, one would expect the following relationships to hold when the Factor Analysis is performed forcing only two factors. The Quadrant I and III parameters should load positively and negatively on the same factor, respectively. Similarly, the Quadrant II and IV parameters should load oppositely on the same factor. This is precisely what occured when the specification of two factors was imposed on the Factor Analysis. The results are shown in Figure 3-19.

LOADINGS OF QUADRANT THEORY PARAMETERS ON TWO FACTORS

F1(+)	QUAD	%
Intuition	III	87
Perceptive	III	85
Conceptual	III	60
Upper Rt	III	86

F1(-)	QUAD	%
Sensing	I	87
Judging	I	85
Lower Left	I	81

F2(+)	QUAD	%
Feeling	IV	65
Behavioral	IV	84
Humanist	IV	80
Lower Rt	IV	55

F2(-)	QUAD	%
Thinking	II	66
Analytic	II	72
Purist	II	60
Upper Left	II	73

PARAMETERS NOT LOADING SIGNIFICANTLY
(loading < 50%) ON ANY FACTOR

Parameter	QUAD
Directive	I

Figure 3-19
Summary of Factor Analysis Forcing Two Factors

A total of 61.4 percent of the variation in the 16 parameters of the Quadrant Theory is explained by the two factors. This result supports the Quadrant Theory. Several observations are immediately apparent from Figure 3-19. With the exception of Directive, all of the manifestation variables significantly loaded on only one factor. This is consistent with the theory. The opposite trait pairs of the MBTI, DSI, VI and HPSF are clearly seen in the negative and positive loadings on each factor by opposite quadrant variables.

These underlying latent factors support the Quadrant Theory quite well and agree with the findings of the Pearson Correlation. It was hypothesized that the opposite quadrant pairs of traits would load on opposite ends of the same factor. This is precisely what occured with the exception of Directive, Pragmatist, and Idealist.

The list of commonalities for each parameter shown in Figure 3-20 shows the percent of each manifestation variable which was captured by the two factors. The larger the commonality, the more the parameter was captured by the factors. The strong commonalities support the Quadrant Theory model.

PARAMETER		COMMONALITY
M3	Sensing	.79
M4	Intuition	.80
M5	Thinking	.51
M6	Feeling	.56
M7	Judging	.79
M8	Perceptive	.78
D1	Directive	.30
D2	Analytic	.52
D3	Conceptual	.42
D4	Behavioral	.73
V2	Purist	.48
V4	Humanist	.65
H1	Upper Left	.62
H2	Lower Left	.65
H3	Lower Right	.42
H4	Upper Right	.80

Figure 3-20
List of Commonalities of Quadrant Theory Parameters

Based upon the above observations, the factors were named as follows:

Factor 1 — Degree of Logic
logical (Quadrant II)
vs
emotional (Quadrant IV)

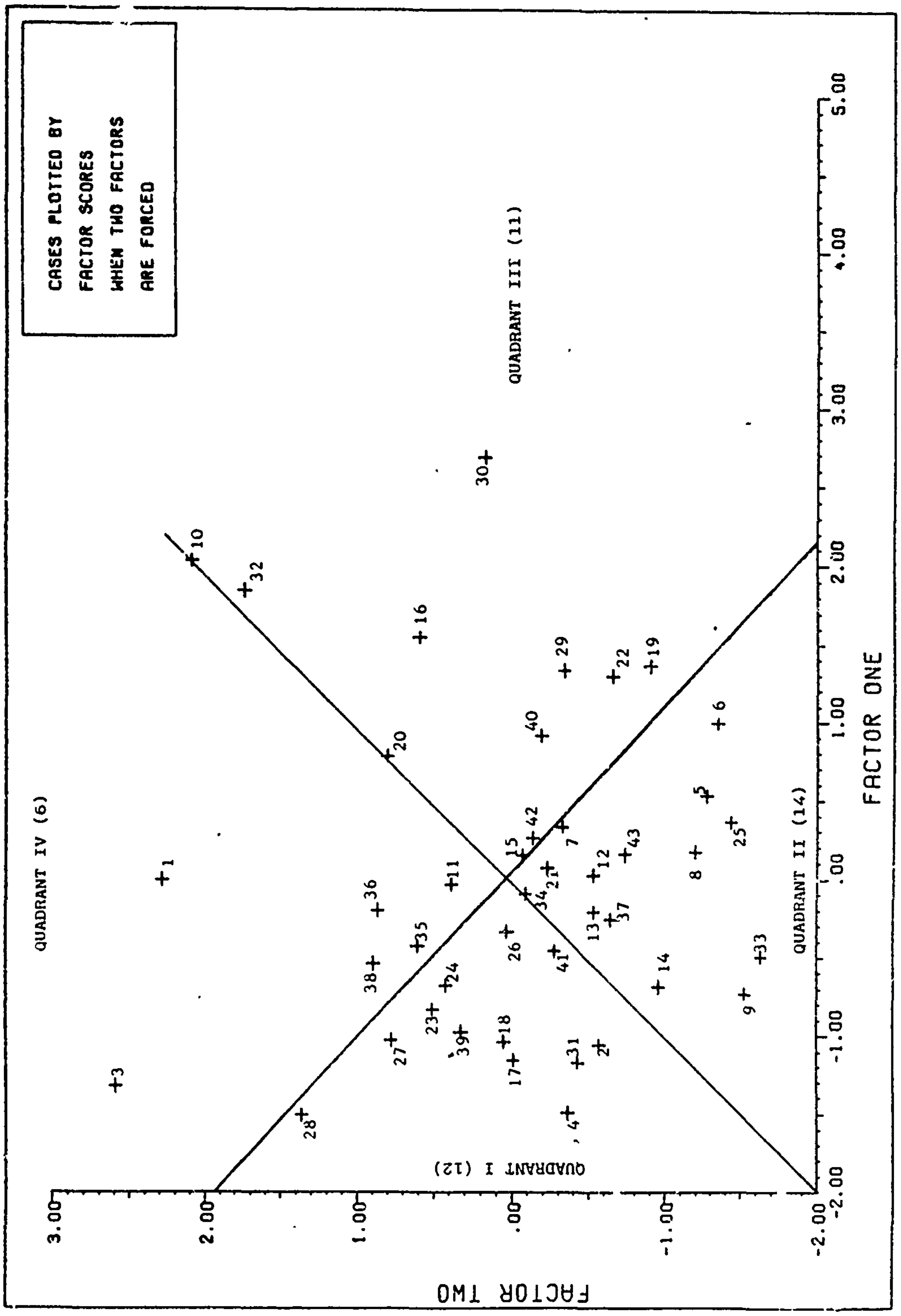
Factor 2 — Problem Solving Approach
detailed (Quadrant I)
vs.
creative (Quadrant III)

Classification

As previously mentioned, the factor scores represent the value of the latent factor that would have been assigned if the latent factor were measured directly. The factor scores from the Factor Analysis forcing two factors are listed in Figure 3-21. Upon examination of these factor scores, a model was developed to classify the 43 participants in terms of the Quadrant Theory. Each participant's factor scores are plotted on the Quadrant Theory coordinate axis (Figure 3-22) and the classification is determined from the location of the resulting point. The classification procedure results in four Quadrant theory categories. Hence, an individual is classified as either belonging to Quadrant I, II, III, or IV; depending upon the placement of that individual's factors score when plotted on Figure 3-22.

PARTICIPANT NUMBER	FACTOR 1	FACTOR 2	QUADRANT CLASSIFIED
1	-0.01	2.28	IV
2	-1.06	-0.57	I
3	-1.33	2.59	IV
4	-1.49	-0.37	I
5	0.53	-1.28	II
6	1.00	-1.35	II
7	0.33	-0.33	II
8	0.17	-1.20	II
9	-0.73	-1.53	II
10	2.02	2.08	III
11	-0.04	0.39	IV
12	0.03	-0.53	II
13	-0.21	-0.53	II
14	-0.69	-0.96	II
15	0.15	-0.07	III
16	1.54	0.59	III
17	-1.16	-0.01	I
18	-1.04	0.05	I
19	1.36	-0.90	III
20	0.77	0.80	III
21	0.07	-0.23	II
22	1.30	-0.65	III
23	-0.84	0.50	I
24	-0.68	0.42	I
25	0.36	-1.43	II
26	-0.34	0.03	I
27	-1.03	0.77	I
28	-1.51	1.36	I
29	1.33	-0.34	III
30	2.68	0.17	III
31	-1.17	-0.43	I
32	1.84	1.73	III
33	-0.50	-1.63	II
34	-0.10	-0.09	II
35	-0.43	0.60	IV
36	-0.21	0.86	IV
37	-0.26	-0.65	II
38	-0.54	0.89	IV
39	-1.00	0.32	I
40	0.91	-0.19	III
41	-0.46	-0.28	I
42	0.26	-0.14	III
43	0.16	-0.73	II

Figure 3-21
Summary of Factor Scores



CATEGORY TYPES: CASES PLOTTED IN FACTOR SPACE

Figure 3-22

A summary of the results of the classification of the 43 participants is shown in Figure 3-23.

QUADRANT	# OF PARTICIPANTS CLASSIFIED
I	12
II	14
III	11
IV	6

Figure 3-23
Results of Classification

This procedure determines four categories which provide a better classification of an individual's Psychological Profile. The original 22 parameters from the four instruments measure many of the same underlying factors. The new classification reduces this larger group of variables into a single descriptor representing an individual's dominant psychological traits. This descriptor categorizes people as predominantly Quadrant I, Quadrant II, Quadrant III, or Quadrant IV types.

In the decision making experiment which follows, this classification of Psychological Profiles will be used rather than the 16 Quadrant Theory variables (6 MBTI, 4 DSI, 2 VI, 4 HPSF). In this way, much of the redundancy in the parameters are removed providing a greater similarity of Psychological Profile within categories and greater diversion of these profiles between categories.

Conclusion

This chapter has reviewed several theories which are the foundation for the decision making experiment. Four hypotheses were stated which tie the theory to this specific research question: How do the environmental and decision maker factors presented in this chapter affect the Quantity of Information which optimizes decision quality?

CHAPTER 4

TEST POPULATION

This chapter provides a detailed description of the test population. The population is described in two major areas: biographical data and data on the psychological profile of the participants. The psychological profile is measured by the 22 original decision maker parameters from the four psychological instruments: the MBTI, DSI, VI, AND HPSF. An explanation of why this particular population was chosen as the subject for this experiment is also provided. All of the biographical and psychological data is stored in a data base using the dBASE II program on a KAYPRO IV microcomputer. Appendix B provides tables which summarize this data. These tables will be referenced throughout this chapter as the test population is described.

BIOGRAPHICAL DATA

The test population consists of 43 graduate students from two classes, GST-85M and GST-86M, specializing in Strategic and Tactical Sciences at the Air Force Institute of Technology. The GST-85M class consisted of 19 students in their last quarter of their Masters Degree program. The 24 students from the GST-86M class were in the second of six quarters in this program. The undergraduate degrees of these students varied from Mathematics and the Sciences to History and Psychology. Table 1 in Appendix B lists the undergraduate degrees of the experimental population and the number of individuals in each major subject.

The majority of the population is comprised of senior Captains and Majors in the US Air Force and the US Army with six to twelve years in service (see Table 2 in Appendix B). Most of these individuals have served one or more operational assignments as pilots, navigators, missile control officers, company commanders, or staff officers. Table 3 in Appendix B provides statistics on the population by previous job assignment. These statistics include the total number of persons in a job category and the percent of the population in each category.

Additional biographical data was collected on the age of each participant and his specific branch within the service (USAF or US Army). This data is summarized in Tables 4 and 5 of Appendix B, respectively. Although this data was collected on each participant, it was not used in the analysis. It was collected to provide a ready data base for future analysis of this experiment. Questions concerning the performance of specific subsets of the population may be investigated in future analysis using the data base.

JUSTIFICATION FOR CHOICE OF POPULATION

This particular population was chosen because it consists largely of individuals who have been decision makers prior to their current assignment. As noted in the Literature Review chapter, much of the past experimental research in decision making has been conducted using undergraduate and graduate students. Many of these studies have been criticized for their use of students in decision making roles since students rarely have any previous business or management decision making experience. This lack of experience casts doubt as to whether the results of these experiments can be extended to real world managers, corporate decision makers and military leaders.

By choosing a population of military decision makers, it is anticipated that results of this thesis experiment will have more credibility when extended to military decision makers in general, and possibly to all decision makers. However, it may not be totally correct to extend the results of this experiment to all decision makers because military decision makers may not be typical of all decision makers.

PSYCHOLOGICAL DATA

Also contained in the data base are the scores for each participant for the four psychological inventories. This section will provide an overview of the population as categorized by these instruments. The results of the individual scores for each of the decision maker parameters from the MBTI, DSI, VI AND HPSF are shown in Tables 6, 7, 8 and 9 of Appendix B. Each of these instruments also provides an overall descriptor of an individual based upon the dominant score or scores in one or more categories as measured by the respective instrument.

As stated in the Theory chapter, the MBTI consists of four pairs of opposite traits; E-I, S-N, T-F, and J-P. This results in 16 psychological descriptors each consisting of the dominant parameter of each of these pairs. For example, if an individual's scores were E > I, S > N, T > F, and J > P; he would be given the ESTJ descriptor. Table 10 of Appendix B lists the number of participants who were classified in each of these 16 psychological types. Note the large number of ISTJ types in Table 10. In terms of the MBTI, this shows that the population does not contain a heterogeneous mix of psychological types but rather is skewed towards the ISTJ type. This trend of the population to be somewhat homogeneous may affect the ability to conduct statistical tests in analyzing the results of the experiment. More will be explained later concerning this subject in the Results and Analysis Chapter.

The DSI and VI provide a single descriptor of an individual based upon the largest score in the four categories in each of these instruments. For example, if an individual's score in the DSI were 80 - Directive, 95 - Analytic, 73 - Conceptual, and 52 - Behavioral, then this person would be classified as an Analytic. Similar classifications are received for the VI in the categories of Pragmatist, Purist, Conceptual, and Humanist. Tables 11 and 12 in Appendix B provide summaries on these descriptors for the experimental population. The HPSF categorizes individuals in the same fashion as Rowe's DSI and VI instruments. Individuals are assigned to one of four categories: Lower Left, Upper Left, Upper Right, and Lower Right. A list of the number of people in each dominant category is provided in Table 13 of Appendix B. The HPSF further categorizes individuals as predominantly Total Left or Total Right. This Table also lists the number of Total Left and Total Right individuals in the population.

In all four instruments, it is apparent that the population is not uniformly distributed between the categories defined by each psychological inventory. In terms of the parameters of the Quadrant Theory, the population is predominantly Quadrant II types. The Quadrant I types are second in overall numbers. They are followed by the Quadrant III types. Finally in each instrument, the smallest number of people were categorized as dominant Quadrant IV types.

As previously stated for the MBTI, this may result in some problems when analyzing the results of the experiment. The goal of this research is to find whether or not people with different psychological profiles require different quantities of information in various decision environments. Not having a sufficient number of people in each psychological profile category may limit the ability to extend the results of this experiment to a larger population in those categories which are not sufficiently filled. The specific statistical test used to analyze the experimental results will determine how many people are sufficient in each category in order to establish statistically significant results.

CONCLUSION

Through the use of the Tables provided in Appendix B, the test population was described in detail. Biographical and psychological data was stored in a data base system which allowed access of the data in various formats. The next chapter describes the assumptions and the specific objectives of this thesis.

CHAPTER 5

PROBLEM STATEMENT

The purpose of this chapter is to state the specific research question which this thesis is investigating. Prior to the statement of the research question, several preliminary subjects must be reviewed. First, a discussion will be given on the ambiguities which arise from terms that are commonly used in decision making research but do not have universally accepted meanings. Second, assumptions will be stated which will help to clarify these ambiguities. The third part of this section develops a graphical illustration of the relationship between the quantity of information and the quality of the decision for a decision maker in a particular environment. Finally, the last section states the research question which is to be investigated using the decision making experiment.

AMBIGUITIES

One of the major problems in pursuing an investigation of this type is that there are many terms used universally which do not have commonly accepted meanings. The first of these terms is "the optimal decision." What exactly is meant by the word "optimal"? Do all decisions contain an optimal choice? If there is an optimal choice, is it optimal to all people and at all times? Finally, are optimal decisions dependent upon the motives of the Decision Makers, or are they dependent upon the people the decisions influence?

The second somewhat ambiguous term that is used universally is the "amount" of information provided to the Decision Maker. Considering the quantity of information without regard to the quality of the information, leaves many unanswered questions. Is the quality of each element of information the same, or do some elements outweigh other elements in terms of usefulness to the Decision Maker? If there is some differentiation in the quality of the elements of information, is the information presented to the Decision Maker in order of priority, or does the information arrive in a random manner without regard to the quality of the element? Does the Decision Maker distinguish between the worth of the elements of information, or are all elements given equal weight in the final decision?

ASSUMPTIONS

The following assumptions answer these questions of ambiguity. These assumptions will hold throughout this thesis.

Assumption 1

Many decisions do not have a clearly defined "best" solution. The optimal course of action for decisions of this type is highly subjective and varies from individual to individual. There are, however, numerous decisions which given sufficient information and time to analyze have optimal solutions. Only the latter type decisions will be investigated in this research. Only those decisions which have clearly optimal solutions, independent of the population viewing the decision or the time at which the decision is made, will be of concern. It is hypothesised that the quantity of information which optimizes this type of decision will also optimize a subjective decision (although it may be impossible to measure optimality in the case of a subjective decision scenario).

Assumption 2

Information, as used in this research paper, will refer only to "perfect" information. In reality, much of the information collected for use in decision making may be distorted. The information may be biased or incomplete. Information of this type is said to be "imperfect". It is most difficult to effectively use wrong information in an experiment designed to determine the optimal quantity of information. It will also be assumed that each piece of data has value or usefulness to the decision maker and there are only minor differences in the value of the individual pieces of data. It is hypothesised that not all decision makers between the worth of the elements of information in the same manner. It is further hypothesized that the decision maker's psychological type decision style or value preferences will determine the quantity and manner in wnich information is processed.

THE INFORMATION QUANTITY verses DECISION QUALITY CURVE

The objective of this research can be refined as follows: By the use of a decision making experiment, the objective is to determine if an upper bound exists on the Quantity of Information which a decision maker can effectively use. This concept of an upper bound has been commonly referred to as the problem of "information overload". The objective is to experimentally measure the factors which may contribute to information overload in various decision environments. The effects of these factors are to be illustrated gradually. To accomplish this goal, a graph is plotted by varying the Quantity of Information on the abscissa (increasing information with increasing distance from the origin) and the quality of the decision on the ordinate (increasing quality with increasing distance from the origin).

The concept of information overload, portrays the upper bound as a point from which the decision quality increases up to a specific quantity of information and then decreases with increasing information. Many of the studies reviewed in the Literature Search chapter subscribe to this Optimum Point Theory [7]. This theory is graphically depicted in Figure 5-1.

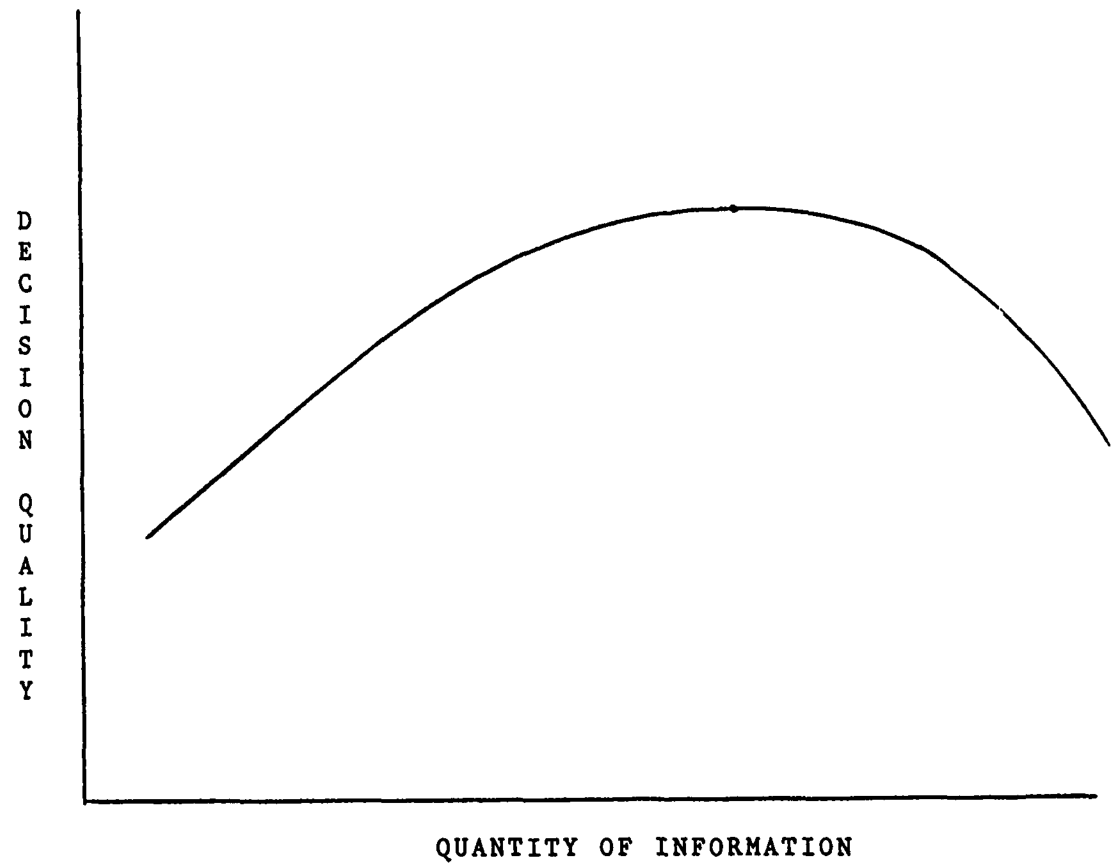


Figure 5-1
The Optimum Point Theory

This is only one possible portrayal of the information absorption process. Another perspective which does not subscribe to the Optimum Point Theory is the Unbounded Curve Theory, shown in Figure 5-2.

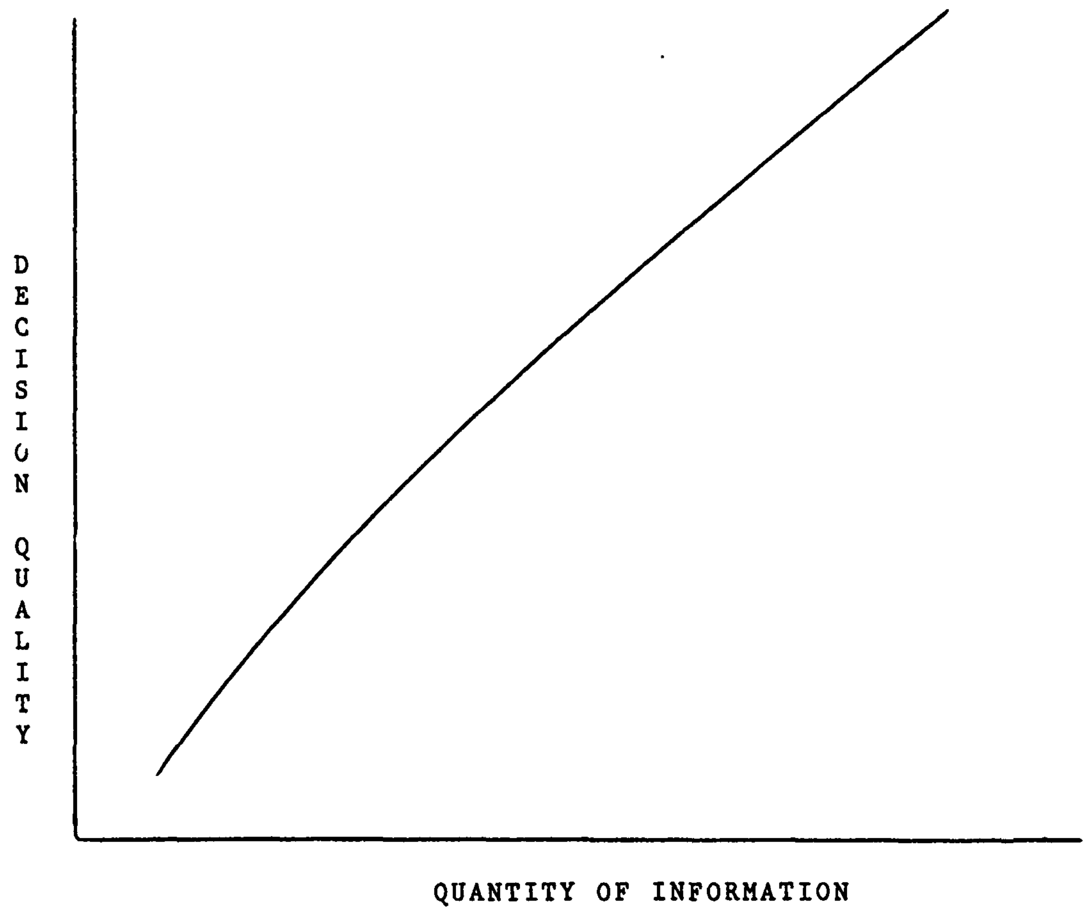


Figure 5-2
The Unbounded Curve Theory

Figure 5-2 predicts that the more information a Decision Maker has, the greater the chances are of increasing the quality of the decision.

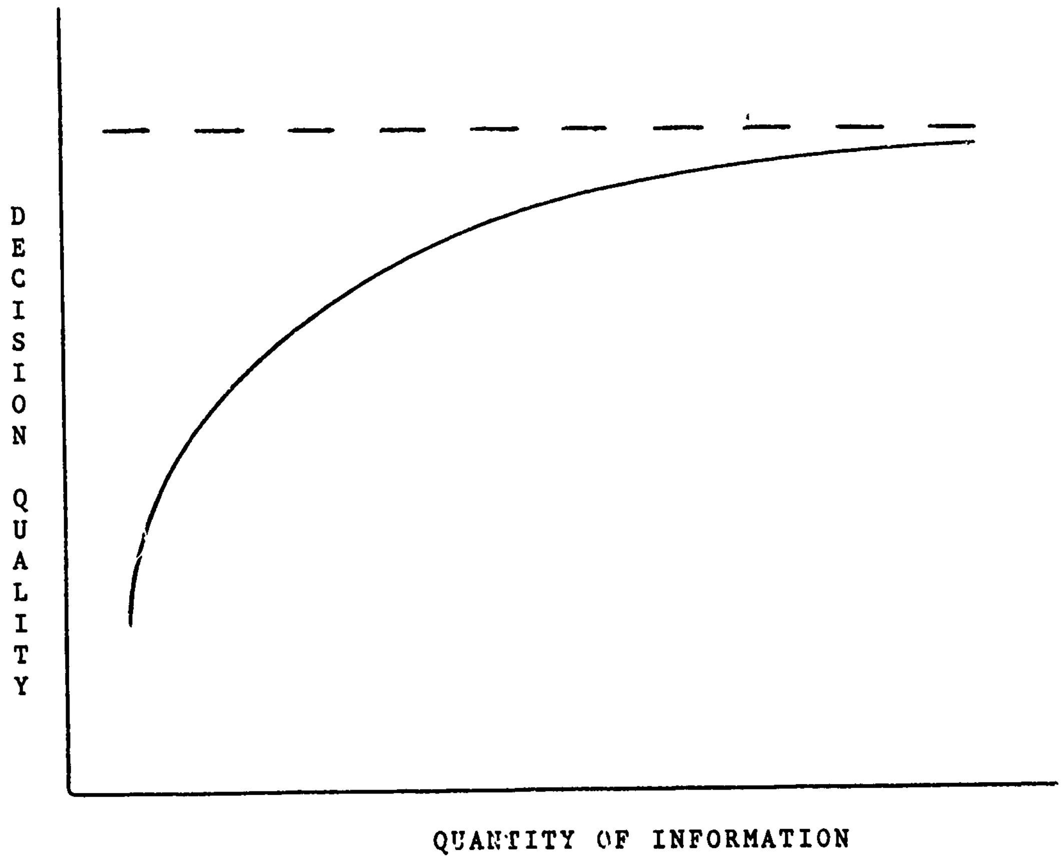


Figure 5-3
The Saturation Point Theory

Still another concept might indicate an upper bound which may be asymptotically approached as shown in Figure 5-3. Figure 5-3 is referred to as the Saturation Point Theory. After receiving a specific amount of information, any further information would not significantly improve the Decision Maker's ability to choose the optimal course of action.

The difference between the two theories and this theory is that the increase in information beyond a specified amount does not hinder the decision making process in the Saturation Point Theory. A situation in which a decision maker has the ability to determine the relative importance of each element of information and prioritize the information accordingly would support this theory. Additional information not likely to help in the decision making process would be given relatively low priority. This information would neither help nor hinder the final outcome. Rather than a decrease in decision making ability, there would simply be a saturation point which marks the quantity of information such that any additional information would cease to be of any value.

Each of these theories would establish very different policies on information acquisition. Assuming resources must be expended for information, the Optimal Point Theory would indicate a necessity to identify the specific quantity of information which yields the optimum solution for a specific decision maker in a particular environment. Failure to identify this quantity may result in additional resources being expended which cause an information overload and a decrease in the decision maker's ability to choose the best course of action. Increase in effort and cost with a decrease in quality or performance is an undesirable situation.

In the Saturation Point Theory this undesirable situation would not occur. However, failure to identify the point of saturation would result in the needless expenditure of resources without an increase in quality. The Unbounded Curve Theory suggests an expenditure of resources to acquire additional information always results in an increase in decision quality. Other possible shapes of the curve are depicted in Figure 5-4.

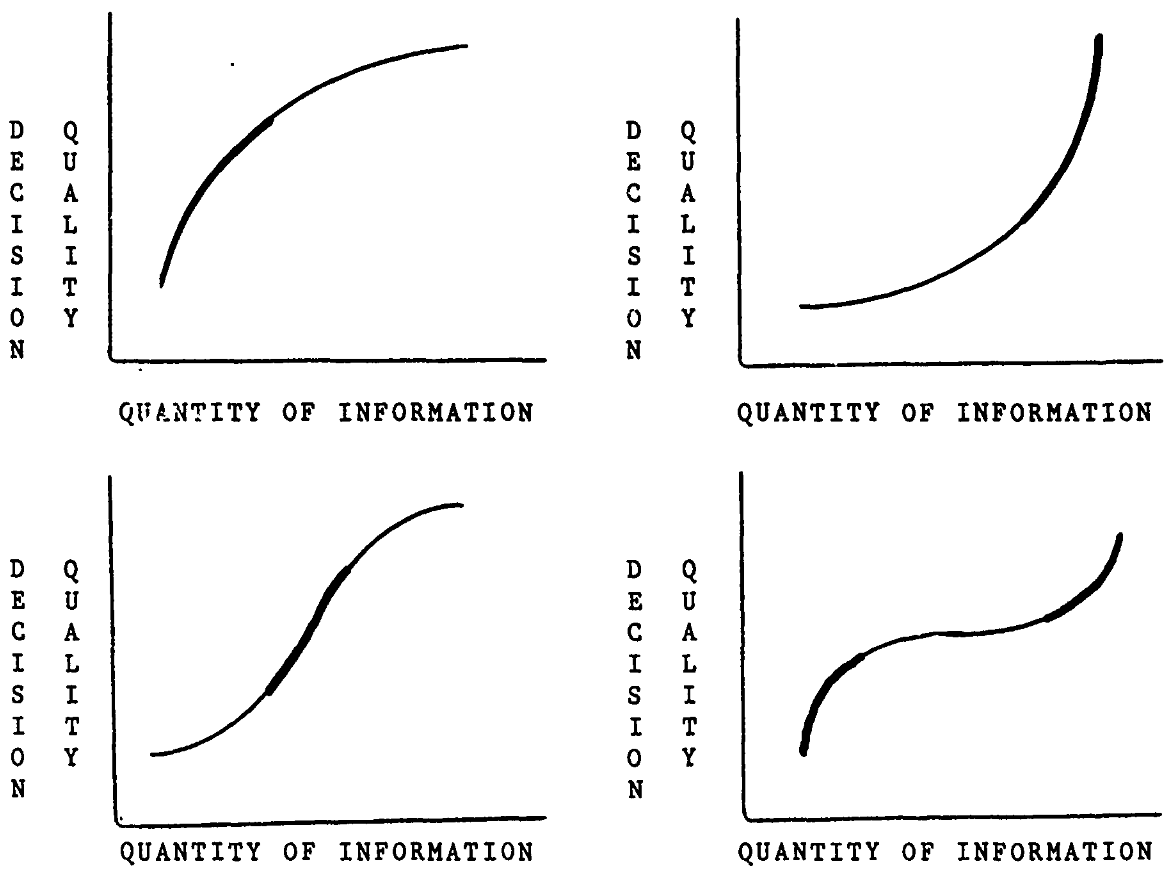


Figure 5-4
Other Possible Shapes of Curves

In each of these cases it would be advantageous to expend resources to acquire additional information only in particular regions of the curve. These regions are shown as the bold lined portions of the curves. It would not be worthwhile to acquire additional information in the thin lined portions of the curves due to the low return on the investment for information in these regions. These are only some suggestions as to the true shape, if one exists, of the INFORMATION QUANTITY versus DECISION QUALITY curve (hereafter referred to as The Curve).

RESEARCH QUESTION

It is hypothesised that the shape of The Curve can be determined through the use of a decision making experiment. The shape of the curve may not be universal for all types of decision makers in all environments tested. For example, an individual classified as a Quadrant I type may fit the Unbounded Curve Theory while a Quadrant II type may fit the Saturation Point Theory. The specific research question is to determine The Curve for each category of decision maker in each decision environment.

Once the curves have been identified for the experimental population, it is hypothesized that these curves would be representative of decision makers in each category. The curves could then be used to assist in planning the flow of information to decision makers at various levels of an organization. This could be accomplished as follows. First, the decision makers are tested for their individual characteristics and preferences. Second, dominant preferences assign the category for each decision maker. Finally, the decision making environment is examined to determine the level of each environmental factor; Stress, Time, and Decision Flexibility. Once these steps are accomplished, it is hypothesised that the optimal quantity of information could be provided to the individual decision maker in the specific decision environment. This optimal quantity would be determined by trends established by The Curves for the particular decision maker's category in the appropriate environment.

CHAPTER 6

EXPERIMENTAL DESIGN

The overall objective of this research is to discern possible relationships between the quality of a decision and the decision making parameters of Time, Decision Flexibility, Psychological Profile, and Quantity of Information. If relationships are found, the specific objective of this thesis is to illustrate these relationships or trends through the use of the Information Quantity versus Decision Quality curves, for the various psychological types of decision makers in different decision environments.

The statistical significance of the trends portrayed by these curves are to be calculated. Based upon the results of The Curves, the validity of the hypotheses stated in the Theory chapter will be determined. Through the use of the decision making experiment, it is desired to discover which of the decision making parameters under investigation do make a difference in decision quality. To summarize, the theory states that there are different psychological types of decision makers. These different types will make decisions differently, depending upon the environment with which they are faced and the Quantity of Information provided to them.

This chapter specifies the design of an experiment that can measure or at least determine some difference between the performances of individuals grouped by psychological type in various decision making situations. The experiment must be capable of measuring which parameters make a significant difference and which do not make a significant difference in decision quality. The end result of this design is a 16 cell model in which the Time and Decision Flexibility parameters are each varied at two levels and the Quantity of Information parameter is varied at four levels.

Throughout this chapter, the term "decision situation" will refer to a specific level of Time, Decision Flexibility, and Quantity of Information. The term "decision environment" will refer only to specific levels of the environmental factors, Time and Decision Flexibility.

As mentioned in the introduction of the Literature Search chapter, the environmental parameters are the independent or controlable parameters in the experiment and the decision maker parameters are the dependent parameters, fixed each participant. Quantity of Information is an independent parameter since it will be controlled in the experiment. The experimental design will incorporate the independent parameters of Time, Decision Flexibility, and Quantity of Information. The design of the decision situation specifies how each of these parameters are to be varied. Since the dependent parameter, Psychological Profile Category, is fixed for each individual, it will not be included in the design of the decision situation. Statistical tests will be used to measure the fluctuation in decision quality as the decision situation changes for each category of decision makers. One Information Quantity versus Decision Quality curve will be drawn for each category of decision makers in each decision environment as the Information Quality varies from low to high. This concept will be further developed in the next sections.

The first section of this chapter introduces a Decision Quality Function in terms of the decision making parameters under investigation. The second section develops the 16 cell design. The final section briefly discusses the analytical tools and procedures which will be used in determining the relationships between the experimental parameters and the quality of a decision.

DECISION QUALITY FUNCTION

Initially, it was postulated that the quality of a decision is a function of the decision environment, the individual's dominant psychological traits, and the Quantity of Information provided to the decision makers. This theory can be expressed using functional notation as follows.

Decision Quality = F (Environmental Factors, Decision Maker Factors, Quantity of Information)

More specifically, this equation can be written in terms of the 22 original decision maker parameters and the specific environmental parameters discussed in Chapter Three.

DQ = F (TM, DFLEX, E, I, S, N, T, F, J, P, DIR, ANA, CON, BEH, PRA, PUR, IDE, HUM, LL, UL, UR, TL, TR, QI)

See Figure 6-1 for definitions of the variables.

PARAMETER	NAME
TM	Time
DFLEX	Decision Flexibility
E	Extraversion
I	Introversion
S	Sensing
N	Intuition
T	Thinking
F	Feeling
J	Judging
P	Perception
DIR	Directive
ANA	Analytic
CON	Conceptual
BEH	Behavioral
PRA	Pragmatist
PUR	Purist
IDE	Idealist
HUM	Humanist
LL	Lower Left
UL	Upper Left
UR	Upper Right
LR	Lower Right
TL	Total Left
TR	Total Right
QI	Quantity of Information

Figure 6-1
Definitions of Variables

In terms of the Psychological Profile as measured by the Quadrant Theory categories this equation can be further distilled into its final form.

$$DQ = F\ (TM,\ DFLEX,\ CATEGORY,\ QI)$$

CELL DESIGN

The foundation of the 16 cell design consists of the environmental factors of Time and Decision Flexibility each varied at two levels, low and high. This foundation is divided into four distinct positions as shown in Figure 6-2. Each position within the cell design foundation defines a unique decision environment as shown in Figure 6-3.

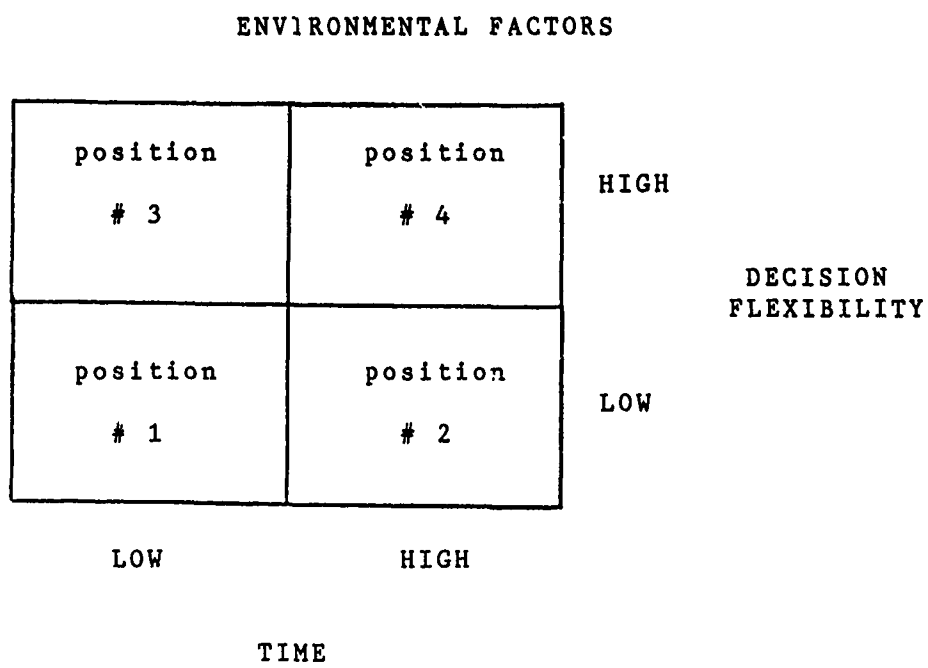


Figure 6-2
The Foundation of the 16 Cell Decision

POSITION	DECISION ENVIRONMENT	
	Time	Decision Flexibility
1	Low	Low
2	High	Low
3	Low	High
4	High	High

Figure 6-3
Unique Decision Environments Defined by the Four Positions of the Cell Design Foundation

The 16 cell design is completed with the addition of the four quantities or levels of information, Information Packets I, II, III, and IV. Information Packet I contains the least amount of information and Information Packet IV contains the largest amount of information. The complete cell design is shown in Figure 6-4. The position of each cell within the design is more easily seen in Figure 6-5.

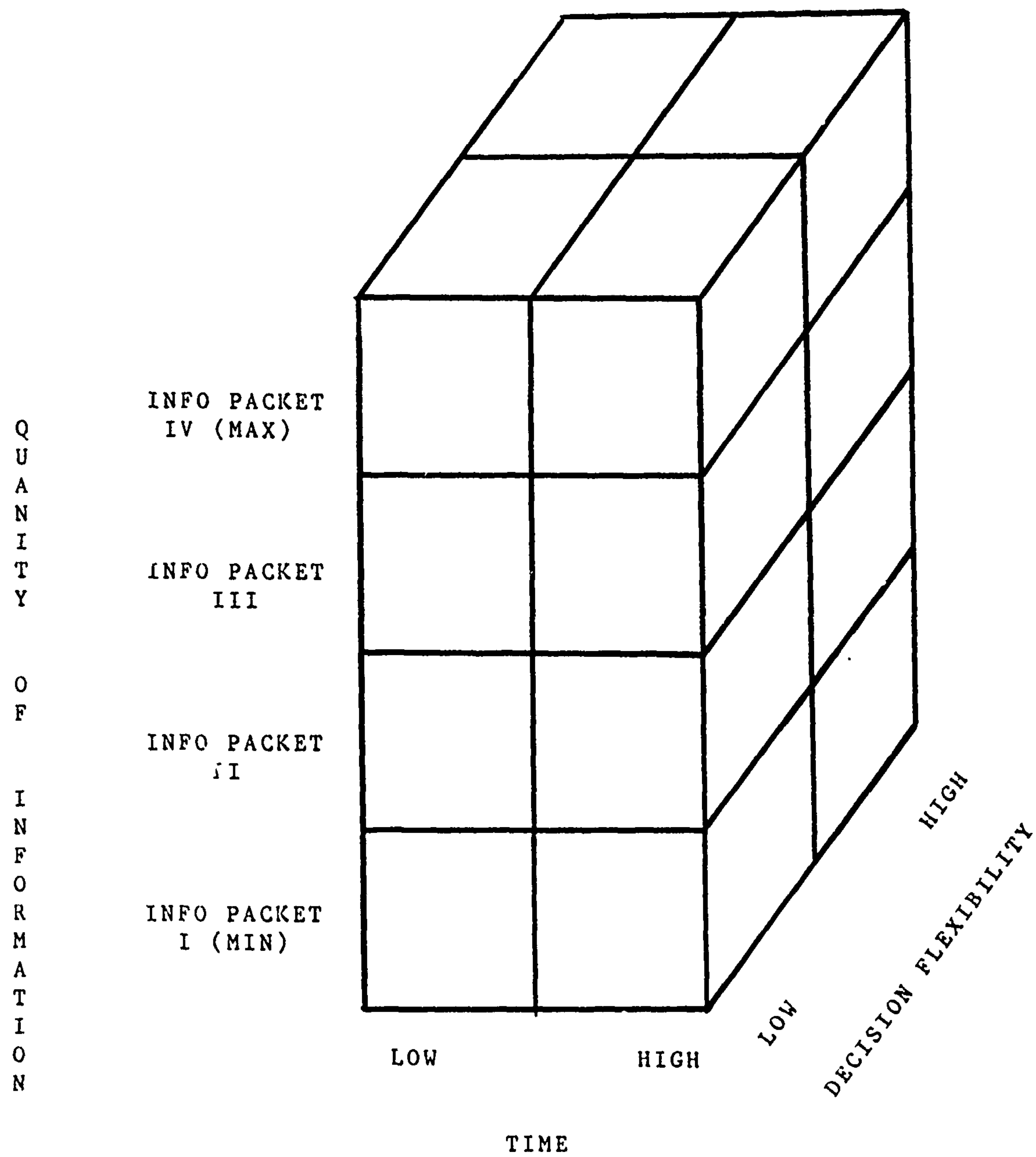


Figure 6-4
16 Cell Experimental Design

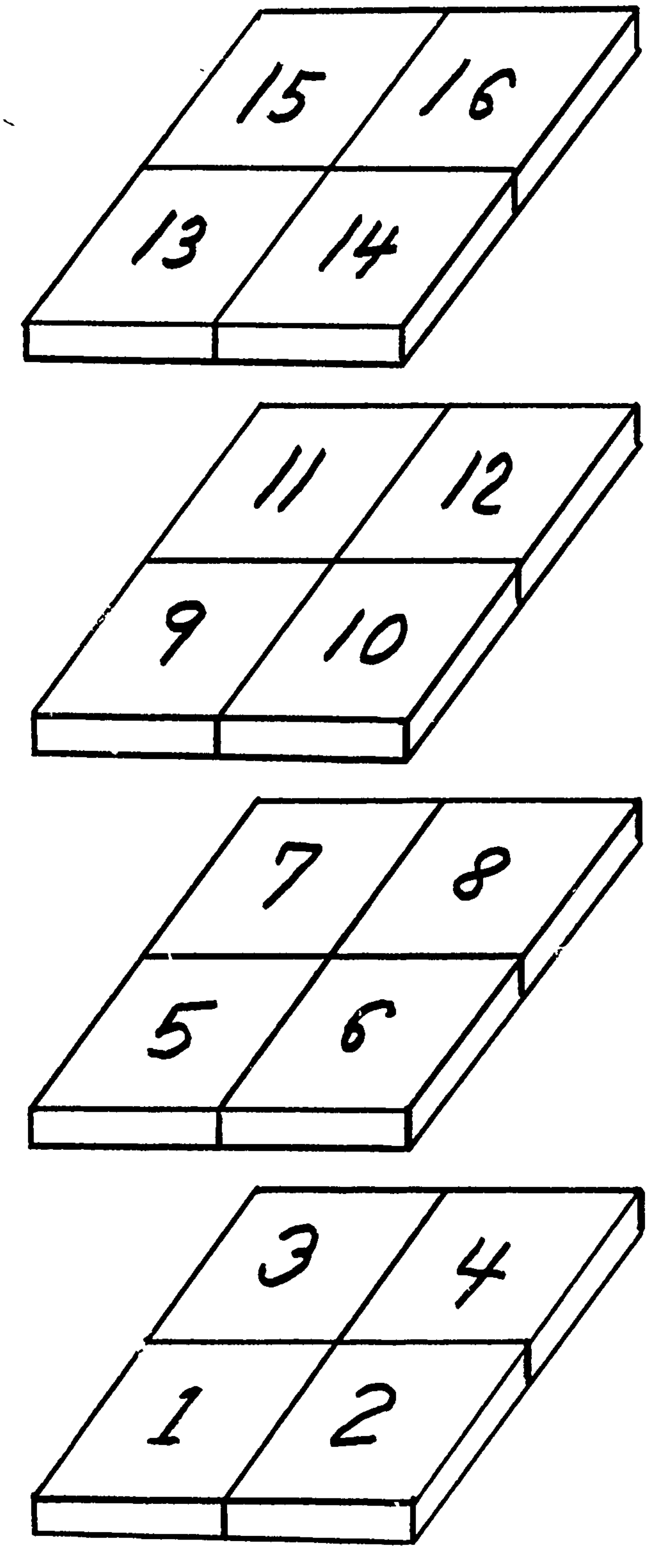


Figure 6-5
Positions of Cells Within The 16 Cell Design

The four decision environments are repeated at each levels of information. This gives rise to 16 unique decision situations correspond to the 16 cells of the model, as shown in Figure 6-6.

	DECISION ENVIRONMENT		INFORMATION PACKET
CELL #	Time	Dec Flex	
1	Low	Low	I
2	High	Low	I
3	Low	High	I
4	High	High	I
5	Low	Low	II
6	High	Low	II
7	Low	High	II
8	High	High	II
9	Low	Low	III
10	High	Low	III
11	Low	High	III
12	High	High	III
13	Low	Low	IV
14	High	Low	IV
15	Low	High	IV
16	High	High	IV

Figure 6-6
16 Unique Decision Situations of the Complete Cell Design

Within each cell of this design, different levels of the independent parameters will be tested. Each participant will be tested in each of the cells. This is done for strength in the analysis since equal cell populations may produce more meaningful results in many statistical tests. Furthermore, it is desired to test each type or category of individual in each cell or decision situation.

In any given cell, an individual receives only one combination of the parameters with each parameter set at a specific level. Each parameter will assume a fixed value. As previously stated, Time will be varied at low and high. Low Time allows the participant a maximum of four minutes maximum to complete the decision. High time allows the participant a maximum of eight minutes to complete the decision. Justifications for these values will be provided in the next chapter.

Decision Flexibility is also varied low and high. A participant in a high Decision Flexibility cell will be given 9 alternatives from which to choose a solution. Individuals in low Decision Flexibility cells will be given 3 solutions.

The participants will be required to make a decision which is structured around a scenario. Each individual will be given a scenario that will place that individual within the constraints of that cell's parameters. The scenarios provide the means of varying the levels of each parameter for each cell. Additionally, the scenarios provide a means of measuring the effect of the levels of each parameter on that individual's decision making ability or decision quality.

In each scenario, a participant must choose one solution from the list of alternatives. There will be 9 alternatives for high Decision Flexibility cells and 3 alternatives for low Decision Flexibility cells. alternatives are ranked from best to worst and a score is given based upon the "correctness" of the solution chosen. The measure of correctness of a solution will be explained in the Scenario chapter. This measure will be used to determine the quality of the decision. In high Decision Flexibility tests, a score of 9 is given to individuals who choose the best solution. A score of 8 is given if the second best solution is chosen. This continues for each alternative and finally a score of 1 is given if the worst solution is chosen. Similarly, in low Decision Flexibility cells scores of 3, 2, and 1 are given to the best, second best, and worst solutions, respectively. The quality of the decision is recorded for each participant in each cell of the experiment.

CONCLUSION

This chapter explained the design of the decision making experiment. This chapter outlined the Decision Quality Function, the formulation of the 16 cell model, and the technique for plotting of the Information Quantity versus Decision Quality curves for each category of decision maker in four decision environments. The next chapter describes in detail the Scenarios which will implement this experimental design.

CHAPTER 7

SCENARIOS AND TESTING PROCEDURE

The scenarios are the mechanism that transforms the experimental design into a data collection form for the decision making experiment. To accomplish this 16 scenarios are needed, one for each of the 16 cells in the experimental design. The scenarios must be able to incorporate two levels of Time, two levels of Decision Flexibility, and four levels of Quantity of Information.

The first section of this chapter will provide a set of criteria for the scenarios. The second section will provide an overview of the scenarios to include the list of topics. The next three sections will give an indepth look at the three major components of the scenarios: the list of items, the statements or packets of information, and the solutions. The sixth section will discuss how Time is to be varied within the scenarios. The next sections will include a summary of the finished product, the testing sequence, and the verification of the scenarios. The final section provides an overview of the testing procedure.

CRITERIA

The scenarios used in creating the decision making situations are based on the following criteria.

1. In each scenario, a situation is presented which requires one decision to be made. A list of six items must be rank ordered from the most important item to the least important item. This is to be cone based upon the decision situation and the information provided. The decision is to choose the best solution from a list of alternatives.

2. A set of information statements with varying quantities of information will be provided for each scenario. These are referred to as Information Packets. Since there are four levels of information in the experimental design, there will be four information packets.

3. The scenarios will be military oriented, in such areas as Operations, Logistics, and Maintenance.

4. There will be three solutions for a low Decision Flexibility environment problem and 9 solutions for a high Decision Flexibility environment.

5. The solutions must be able to be ranked from best to worst. The situations must allow ranking to be done objectively rather than subjectively. There must be a clearly best solution, a second best solution, and so on to a worst solution. This will provide an objective way to determine decision quality.

6. The optimal solution must be obtainable only from the information presented and will not require or use the individual's past experience or knowledge in arriving at a decision.

7. The quantity of information will be varied from five statements in Information Packet I to a maximum of fourteen statements in Information Packet IV by increments of three additional statements per Packet. Hence, the four quantities of information or Packets coincide with the four levels of information in the experimental design. In each scenario, only one of the four quantities of information is given to an individual.

8. The layout of information in each packet is identical, with only the quantity of information varying.

9. All information is valid. There is no incorrect information in any statement. However, in the scenarios containing more statements, some information is more important than other information.

10. Decision makers do not discuss scenarios with each other. All decisions are made as individuals. No feedback is provided to the decision makers until all testing is completed.

11. Participants will not be placed in identical situations twice. Scenarios are unique from the individual's perspective, although the same scenario will be given to more than one individual at a time.

OVERVIEW

The first st in creating the scenarios is to establish six items according to one of two item arrangements. The second step is to write information statements which establish the relationships between the items and groups of items according to two schemes. The third step in writing the scenarios is to create a list of solutions. This list must include the correct arrangement of the six items and a series of eight progressively inferior solutions. These nine solutions are the list of alternatives from which the decision maker must choose.

An outline of the basic format of the scenarios is shown in Figure 7-1A through 7-1C. Each scenario consists of three pages as described in the Figures. The General Instructions on page 1 remains the same for all 16 scenarios.

Scenario Name

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

A brief sentance describes the setting of the decision. (see Appendix D for examples) The specific instructions change in each scenario.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant items that are not listed.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page.

Do not rely on past experience or knowledge in choosing a solution.

page 1

Figure 7-1A
Basic Format for the Scenarios - Page 1

DECISION INFORMATION

Information Packet I

Statement 1
Statement 2
Statement 3
Statement 4
Statement 5

Additional Information for Packet II

Statement 6
Statement 7
Statement 8

Additional Information for Packet III

Statement 9
Statement 10
Statement 11

Additional Information for Packet IV

Statement 12
Statement 13
Statement 14

page 2

Figure 7-1B
Basic Format for the Scenarios - Page 2

TABLE I: List of Items

A.	item one	D.	item four
B.	item two	E.	item five
C.	item three	F.	item six

TABLE II: List of Solutions

1. alternative one
2. alternative two
3. alternative three

Additional Alternative Solutions
for High Decision Flexibility Tests

4. alternative four
5. alternative five
6. alternative six
7. alternative seven
8. alternative eight
9. alternative nine

page 3

Figure 7-1C
Basic Format for the Scenarios - Page 3

A list of the names of the scenarios, the scenario codes, and the assigned Information Packets is shown in Figure 7-2.

NAME	CODE	INFORMATION PACKET	# OF STATEMENTS
Space Weapons Platform	5A	I	5
Artic Survival	5B	I	5
Shuttle Mission Schedule	5C	I	5
Training Program Development	5D	I	5
Laser Design	8A	II	8
Desert Survival	8B	II	8
Stealth Aircraft Procurement	8C	II	8
Space Shuttle Job Priorities	8D	II	8
Communications Satellite Priorities	11A	III	11
Raft Survival	11B	III	11
Tank Procurement	11C	III	11
Obstacle Plan	11D	III	11
Nuclear Shelter Development	14A	IV	14
Island Survival	14B	IV	14
Missile Procurement	14C	IV	14
Tank Maintenance	14D	IV	14

Figure 7-2
Scenario Names and Information Packets Assigned

Figure 7-3 shows the relationship between the experimental design and the 16 scenarios. It should be noted that each cell in the experimental design has four possible scenario codes which could be assigned to it. For example, the Space Weapons Platform scenario (code 5A) could be assigned to cell 1, 2, 3, or 4. In fact, 25 percent of the experimental population will be given the Space Weapons Platform scenario in a cell 1 environment (Low Time, Low Decision Flexibility); 25 percent of the population will be given the Space Weapons Platform scenario in cell 2 (High Time, Low Decision Flexibility); 25 percent of the population will be given the scenario in cell 3 (Low Time, High Decision Flexibility); and 25 percent will be given it in cell 4 (high time, high decision flexibility). This was done as a precautionary measure to guard against the possibility that a particular scenario may be very easy or very difficult. A very easy or very difficult scenario may skew the decision quality scores in a particular cell due to the relative difficulty of the scenario rather than the decision environment and the quantity of information provided.

EXPERIMENTAL DESIGN CELL #	DECISION ENVIRONMENT		INFORMATION PACKET	SCENARIO CODES			
	Time	Dec Flex					
1	Low	Low	I	5A	5B	5C	5D
2	High	Low	I	5A	5B	5C	5D
3	Low	High	I	5A	5B	5C	5D
4	High	High	I	5A	5B	5C	5D
5	Low	Low	II	8A	8B	8C	8D
6	High	Low	II	8A	8B	8C	8D
7	Low	High	II	8A	8B	8C	8D
8	High	High	II	8A	8B	8C	8D
9	Low	Low	III	11A	11B	11C	11D
10	High	Low	III	11A	11B	11C	11D
11	Low	High	III	11A	11B	11C	11D
12	High	High	III	11A	11B	11C	11D
13	Low	Low	IV	14A	14B	14C	14D
14	High	Low	IV	14A	14B	14C	14D
15	Low	High	IV	14A	14B	14C	14D
16	High	High	IV	14A	14B	14C	14D

Figure 7-3
Relationship Between the Experimental Design and the 16 Scenarios

ITEMS

This section explains the relationship between the items which are to be rank ordered. There are two different arrangements of the six items used in each scenario. The difference in arrangement is to avoid the possibility of the participants discovering patterns in the scenarios. Scenarios using Information Packet I (5 statements) and Information Packet III (11 statements) will be structured using the first arrangement of the items. Scenarios which use Information Packet II (8 statements) and Information Packet IV (14 statements) will use the second arrangement of the items. Figure 7-4 shows the two arrangements of the items into groups.

Arrangement of Items in Scenarios Using
Information Packets I & III

Items	Group Number
A, B	1
C, D	2
E, F	3

Arrangement of Items in Scenarios Using
Information Packets II & IV

Items	Group Number
A	1
B, C	2
D, E	3
F	4

Figure 7-4
Arrangement of Items Into Groups

Items within a group are more closely related than items belonging to two different groups. For example, in the Desert Survival scenario, food and water may belong to the same group called nutritional requirements. A gun and a knife may belong to a different group called protection items. Once the items were created for each of the scenarios according to the group arrangement just specified. The items were assigned priorities from most significant to least significant. The letters A through F were then assigned to each item in a random fashion using a table of random digits. This was done to prevent a pattern from occuring where all the most important items were coded A and the least important items coded F.

STATEMENTS

The information statements are used to prioritize the six items within the three groups (for Information Packets I and III) or four groups (for Information Packets II and IV). Each statements either prioritizes between different groups, between items of the same group, or between a group and a single item from a different group. Figure 7-5 through Figure 7-8 shows the relationship (prioritization) which each statement establishes between the items and groups.

It is assumed that the optimal prioritization of the items is:

most significant A B C D E F least significant

INFORMATION PACKET I

Statement Number	Prioritization Established
1	group 1 > group 2
2	group 2 > group 3
3	item A > item B
4	item C > item D
5	item E > item F

Figure 7-5
Information Conveyed By Statements In Packet I

INFORMATION PACKET II

Statement Number	Prioritization Established
1	group 1 > group 2
2	group 2 > group 3
3	group 3 > group 4
4	item B > item C
5	item D > item E
6	item B > item D
7	item C > item E
8	group 1 > group 3

Figure 7-6
Information Conveyed By Statements In Packet II

INFORMATION PACKET III

Statement Number	Prioritization Established
1	group 1 > group 2
2	group 2 > group 3
3	item A > item B
4	item C > item D
5	item E > item F
6	item B > item D
7	item C > item E
8	item A > item F
9	item A > item C
10	item D > item F
11	item B > item E

Figure 7-7
Information Conveyed By Statements In Packet III

INFORMATION PACKET IV

Statement Number	Prioritization Established
1	group 1 > group 2
2	group 2 > group 3
3	group 3 > group 4
4	item B > item C
5	item D > item E
6	item B > item D
7	item C > item E
8	item A > item F
9	item A > item B
10	item C > item D
11	item E > item F
12	item A > item D
13	item B > item F
14	group 1 > group 3

Figure 7-8
Information Conveyed By Statements In Packet IV

The first five statements shown in the above figures are the essential statements which are needed to correctly prioritizes the six items from most significant to least significant. The additional statements provided in Packets II, III, and IV provide redundant information. That is, these statements provide information that can be established through transitive relationships derived from the first five statements in each packet. A simple example of the transitive statements which are implied by a set of primary statements is shown in Figure 7-9.

PRIMARY SET OF STATEMENTS

Statement 1 :	item A is more significant than item B
Statement 2 :	item B is more significant than item C
Statement 3 :	item C is more significant than item D

TRANSITIVE STATEMENTS IMPLIED BY THE PRIMARY SET

Transitive Statement	Justification
A is more significant than item C	Statements 1, 2
A is more significant than item D	Statements 1, 2, 3
B is more significant than item D	Statements 2, 3

Figure 7-9
Example of Transitive Statements Derived
From a Primary Set of Statements

Variation in the relationship of each statement in the Information Packets is introduced by changes in the grouping arrangements of the items. In the final form of the scenarios, the statements are randomly listed in the Information Packets. This is accomplished by using a table of random numbers to assign the order of each of the statements. Again, this was done to prevent the participants from identifying a pattern in the design of the scenarios.

By having the statements conform to the above conditions, the requirement for "perfect information" as stated in the Criteria for the Scenarios section is acheived. Incorrect information is not provided. All statements are consistent with the optimal prioritization scheme of the items (A through F). However, only five statements in each packet are essential in establishing the priorities while the remaining statements merely provide further redundant information. To reemphasize, in the final form of the scenarios the participants will receive a completely random assignment of the statements. The five key statements will be randomly arranged in the solution list, Table II.

As previously stated in the hypotheses of the Theory chapter, it is anticipated that the participants in the various psychological profile categories will vary in their responses (decision quality) due to the increase in redundant information. It is further predicted that some people will find it easier to make the rank ordering decision, while others may experience an information overload with increasing information and find making the decision more difficult. Finally, it is hypothesized that individuals within the same Quadrant Theory category will react similarly to the increase in information, but differences between categories will be noticeable. Detection of these differences will be accomplished by finding the mean score for the participants in each category in each for the cells. Then, as the information is increased, a comparison of the mean scores will be calculated using ANOVA to determine if there are statistically significant changes in scores (decision quality).

SOLUTIONS

As stated in the Criteria for the Scenarios section, the solutions must be rank ordered from best to worst in an objective way. The design of this experiment does not allow for subjective interpretation of decision quality. The purpose of having clearly identified best through worst solutions is so the decision quality may be measured objectively rather than subjectively.

To accomplish this nonsubjective scoring criteria, a mathematical formulation was derived to determine the worth of each solution. This formula assigns specific values to each item and specific weights to each position. That is, each item has its own value and each item can be placed in one of six positions. The derivation which follows again assumes that the best solution is A and the worst solution is F. The first step in the formulation is to assign values to each item as shown in Figure 7-10.

value of A > value of B
value of B > value of C
value of C > value of D
value of D > value of E
value of E > value of F

Figure 7-10
Criteria for Assignment of Values to Items

In order to obtain the optimal solution, the 15 relationships shown in Figure 7-11 must hold between the items.

A > B	A > C	A > D	A > E	A > F
	B > C	B > D	B > E	B > F
		C > D	C > E	C > F
			D > E	D > F
				E > F

Figure 7-11
Relationship Between Items

Figure 7-12 shows a list of nine progressively inferior solutions accompanied by the number of relationships violated by each inferior solution. In this way, decision quality can be directly measured by the number of errors contained in the solution chosen. Decision quality is inversely proportional to the number of errors in the alternative chosen.

SOLUTION	RELATIONSHIPS VIOLATED	# OF ERRORS
A B C D E F	none	0
A B C D F E	E > F	1
A B C E F D	D > E D > F	2
A B D E F C	C > D C > E C > F	3
A B D F E C	C > D C > E C > F E > F	4
A B E F D C	C > D C > E C > F D > E D > F	5
B A E F D C	C > D C > E C > F D > E D > F A > B	6
B A F E D C	C > D C > E C > F D > E D > F A > B E > F	7
C A F E D B	B > C B > D B > E B > F D > E D > F E > F A > C	8

Figure 7-12
List of Inferior Solutions

The second step in this derivation is to assign weights to each of the six positions which must be filled in accomplishing the prioritization decision. The criteria for the assignments of weights to positions is shown in Figure 7-13.

weight of position 1 > weight of position 2
weight of position 2 > weight of position 3
weight of position 3 > weight of position 4
weight of position 4 > weight of position 5
weight of position 5 > weight of position 6

Figure 7-13
Criteria for Assignment of Weights to Positions

Once the values have been assigned to the items and the weights to the positions, a mathematical algorithm is used to verify that each of the alternative solutions shown in Figure 7-12 is progressively inferior to the proceeding alternative. The worth of a solution to a decision maker is a measure of the quality of the decision. The worth is dependent upon the values assigned to each item and the weights assigned to each of the six positions. However, the worth equation will always hold if the values and weight conform to the constraints described in Figures 7-10 and 7-13.

The mathematical equation used to assign the worth of each alternative solution is shown below.

$$\text{worth of solution} = \text{SUM} \left[(\text{value of item } i) * (\text{weight of position } j) \right]$$

where i = A, B, C, D, E, F
j = 1, 2, 3, 4, 5, 6

and a particular value of i and j can only be used once.

Figure 7-14 lists the variables used in the derivation of the progressively inferior solutions.

ITEM	VARIABLE NAME FOR VALUE OF ITEM	POSITION	VARIABLE NAME FOR WEIGHT OF POSITION
A	vA	1	w1
B	vB	2	w2
C	vC	3	w3
D	vD	4	w4
E	vE	5	w5
F	vF	6	w6

SOLUTION	VARIABLE NAME FOR WORTH OF SOLUTION
1	W1
2	W2
3	W3
4	W4
5	W5
6	W6
7	W7
8	W8
9	W9

Figure 7-14
Definition of Variables

Solution	Worth Equation
1	W1 = (vA)(w1) + (vB)(w2) + (vC)(w3) + (vD)(w4) + (vE)(w5) + (vF)(w6)
2	W2 = (vA)(w1) + (vB)(w2) + (vC)(w3) + (vD)(w4) + (vF)(w5) + (vE)(w6)
3	W3 = (vA)(w1) + (vB)(w2) + (vC)(w3) + (vE)(w4) + (vF)(w5) + (vD)(w6)
4	W4 = (vA)(w1) + (vB)(w2) + (vD)(w3) + (vE)(w4) + (vF)(w5) + (vC)(w6)
5	W5 = (vA)(w1) + (vB)(w2) + (vD)(w3) + (vF)(w4) + (vE)(w5) + (vC)(w6)
6	W6 = (vA)(w1) + (vB)(w2) + (vE)(w3) + (vF)(w4) + (vD)(w5) + (vC)(w6)
7	W7 = (vB)(w1) + (vA)(w2) + (vE)(w3) + (vF)(w4) + (vD)(w5) + (vC)(w6)
8	W8 = (vB)(w1) + (vA)(w2) + (vF)(w3) + (vE)(w4) + (vD)(w5) + (vC)(w6)
9	W9 = (vC)(w1) + (vA)(w2) + (vF)(w3) + (vE)(w4) + (vD)(w5) + (vB)(w6)

Figure 7-15
Worth Equation For Each Solution

Figure 7-15 defines the worth equation for each solution shown in Figure 7-12. The worth equations establish the following relationships:

$$W1 > W2 > W3 > W4 > W5 > W6 > W7 > W8 > W9$$

These relationships hold for all values of vA, vB, vC, vD, vE, vF and all weights of w1, w2, w3, w4, w5, w6.

As long as the values of the items listed in Table I of the scenarios are progressively decreasing from A to F and the weights are progressively decreasing from the first position in the sequence to the last position in the sequence, the worth of each subsequent alternative will be inferior to the worth of the previous alternative. This relationship holds regardless of the values assigned to the items and the weights given to each position in the sequence. This will always be true since each subsequent solution is obtained by moving a higher value item to a less significant (smaller weight) position while simultaneously moving a lower value item into a more significant (larger weight) position while keeping all other items fixed in position.

The final step in creating the list of inferior solutions is to once again use a table of random digits to randomize the order of the listing of the solutions. The randomizing will be done for both the nine alternative solutions for the high Decision Flexibility tests and the three solutions for the low Decision Flexibility tests. The letters within the solution will also be randomized in a similar fashion. In this way a set of progressively inferior solutions is created which is independent of the values assigned to each item and the weights of each position.

TIME

The next element which is to be incorporated into the scenario is the variation of Time from low to high. Half of the 16 cells were assigned high Time and half were assigned low Time. Thus each participant was subject to both these environments. Participants with a low Time criteria had a maximum of four minutes to make the decision and those with a high Time indicator had a maximum of eight minutes to complete the test. These times were determined by trial testing with nonexperiment participants. The average of the longest time to complete a scenario was eight minutes when no time constraint was imposed on the individuals in the verification group. This led to a maximum time limit (high Time) of eight minutes. This maximum time was arbitrarily cut in half for the low Time cells. Thus, the low Time cells required that the decision be completed in a maximum of four minutes. More will be said on the verification procedure in the last section.

FINISHED PRODUCT

The 16 scenarios are shown in their final form in Appendix C. Each scenario has four possible presentations as shown in Figure 7-16.

PRESENTATION	DECISION ENVIRONMENT Time	Decision Flexibility
1	Low - 4 min	Low - 3 solutions
2	High - 8 min	Low - 3 solutions
3	Low - 4 min	High - 9 solutions
4	High - 8 min	High - 9 solutions

Figure 7-16
Possible Presentations of Each Scenario

As stated in the Overview section of this chapter, only 25 percent of the test population will receive a particular scenario in any given cell. This prevents the ease or difficulty of a particular scenario from skewing the scores in a particular cell. This means that 25 percent of the time a particular scenario will be presented according to presentation 1 shown in Figure 7-14; 25 percent of the time will be presented according to presentation 2; 25 percent of the time will be presented according to presentation 3; and 25 percent of the time will be presented according to presentation 4.

A participant in the experiment may then be given any one of the four "5 statement" scenarios in decision environment 1 (cell 1 from the experimental design). The participant may then take any one of the three remaining "5 statement" scenarios in decision environment 2 (cell 2). He may then take either one of the remaining "5 statement" scenarios in decision environment 3 (cell 3), and finally take the last "5 statement" scenario in decision environment

4 (cell 4). This same procedure will occur for the "8 statement" scenarios in satisfying the requirements for cells 5 through 8; the "11 statement" scenarios in satisfying the requirements for cells 9 through 12; and the "14 statement" scenarios in satisfying the requirements for cells 13 through 16. The next section will further explain the testing sequence for each participant in the experiment.

TESTING SEQUENCE

In order to satisfy the experimental design, each of the 43 participants must take one scenario in each of the 16 cells. As stated in the previous section, any one of the four scenarios with the same number of information statements may be taken in each of the cells in the experimental design for that particular level, as long as there are no repeat scenarios. That is, a participant will not receive the same scenario in more than one cell with just a change in Time and/or the number of solutions (Decision Flexibility). In addition to these requirements, each participant will take the 16 decision tests in a unique order. No two participants will receive the same series of cells in an identical order. Figure 7-17A and B lists the order in which each participant took the 16 scenarios. Note that all sequences are unique. The second number in each entry refers to the name of the scenario which was taken in that cell. Note the variation in scenario names within the same cell number.

This requirement of unique sequences was added as a precaution to prevent incorrectly interpreting the scores of individuals who may developed a "learning curve". It was anticipated that some individuals would begin to increase their decision quality due to increased familiarity with the type of decision which was being made. If all participants take the same sequence of tests (ie. cell 1 first, cell 2 second, ..., cell 16 last), some or all of the participants may develop a learning curve. Any increase in decision quality from the first cell to the last cell could be incorrectly interpreted as being an effect of the change in decision environment when the change may actually have been due to the learning curve effect.

Day # - Sequence # / Scenario Code

PARTICIPANT NUMBER	EXPERIMENTAL DESIGN CELL NUMBER 1	2	3	4	5	6	7	8
1	1-1 / 5A	2-5 / 5B	3-9 / 5C	4-13 / 5D	4-14 / 8A	1-2 / 8B	2-6 / 8C	3-10 / 8D
2	1-4 / 5D	2-8 / 5A	3-12 / 5B	4-16 / 5C	4-13 / 8D	1-1 / 8A	2-5 / 8B	3-9 / 8C
3	1-3 / 5C	2-7 / 5D	3-11 / 5A	4-15 / 5B	4-16 / 8C	1-4 / 8D	2-8 / 8A	3-12 / 8B
4	1-2 / 5B	2-6 / 5C	3-10 / 5D	4-14 / 5A	4-15 / 8B	1-3 / 8C	2-7 / 8D	3-11 / 8A
5	4-13 / 5D	1-1 / 5A	2-5 / 5B	3-9 / 5C	3-10 / 8D	4-14 / 8A	1-2 / 8B	2-6 / 8C
6	4-16 / 5C	1-4 / 5D	2-8 / 5A	3-12 / 5B	3-9 / 8C	4-13 / 8D	1-1 / 8A	2-5 / 8B
7	4-15 / 5B	1-3 / 5C	2-7 / 5D	3-11 / 5A	3-12 / 8B	4-16 / 8C	1-4 / 8D	2-8 / 8A
8	4-14 / 5A	1-2 / 5B	2-6 / 5C	3-10 / 5D	3-11 / 8A	4-15 / 8B	1-3 / 8C	2-7 / 8D
9	3-9 / 5C	4-13 / 5D	1-1 / 5A	2-5 / 5B	2-6 / 8C	3-10 / 8D	4-14 / 8A	1-2 / 8B
10	3-12 / 5B	4-16 / 5C	1-4 / 5D	2-8 / 5A	2-5 / 8B	3-9 / 8C	4-13 / 8D	1-1 / 8A
11	3-11 / 5A	4-15 / 5B	1-3 / 5C	2-7 / 5D	2-8 / 8A	3-12 / 8B	4-16 / 8C	1-4 / 8D
12	3-10 / 5D	4-14 / 5A	1-2 / 5B	2-6 / 5C	2-7 / 8D	3-11 / 8A	4-15 / 8B	1-3 / 8C
13	2-5 / 5B	3-9 / 5C	4-13 / 5D	1-1 / 5A	1-2 / 8B	2-6 / 8C	3-10 / 8D	4-14 / 8A
14	2-8 / 5A	3-12 / 5B	4-16 / 5C	1-4 / 5D	1-1 / 8A	2-5 / 8B	3-9 / 8C	4-13 / 8D
15	2-7 / 5D	3-11 / 5A	4-15 / 5B	1-3 / 5C	1-4 / 8D	2-8 / 8A	3-12 / 8B	4-[illegible] / 8C
16	2-6 / 5C	3-10 / 5D	4-14 / 5A	1-2 / 5B	1-3 / 8C	2-7 / 8D	3-11 / 8A	4-15 / 8B
17	4-13 / 5A	3-9 / 5D	2-5 / 5C	1-1 / 5B	1-2 / 8C	4-14 / 8B	3-10 / 8A	2-6 / 8D
18	4-16 / 5D	3-12 / 5C	2-8 / 5B	1-4 / 5A	1-1 / 8B	4-13 / 8A	3-9 / 8D	2-5 / 8C
19	4-15 / 5C	3-11 / 5B	2-7 / 5A	1-3 / 5D	1-4 / 8A	4-16 / 8D	3-12 / 8C	2-8 / 8B
20	4-14 / 5B	3-10 / 5A	2-6 / 5D	1-2 / 5C	1-3 / 8D	4-15 / 8C	3-11 / 8B	2-7 / 8A
21	3-9 / 5D	2-5 / 5C	1-1 / 5B	4-13 / 5A	4-14 / 8B	3-10 / 8A	2-6 / 8D	1-2 / 8C
22	3-12 / 5C	2-8 / 5B	1-4 / 5A	4-16 / 5D	4-13 / 8A	3-9 / 8D	2-5 / 8C	1-1 / 8B
23	3-11 / 5B	2-7 / 5D	1-3 / 5A	4-15 / 5C	4-16 / 8D	3-12 / 8C	2-8 / 8B	1-4 / 8A
24	3-10 / 5A	2-6 / 5D	1-2 / 5C	4-14 / 5B	4-15 / 8C	3-11 / 8B	2-7 / 8A	1-3 / 8D
25	2-5 / 5C	1-1 / 5B	4-13 / 5A	3-9 / 5D	3-10 / 8A	2-6 / 8D	1-2 / 8C	4-14 / 8B
26	2-8 / 5B	1-4 / 5A	4-16 / 5D	3-12 / 5C	3-9 / 8D	2-5 / 8C	1-1 / 8B	4-13 / 8A
27	2-7 / 5A	1-3 / 5D	4-15 / 5C	3-11 / 5B	3-12 / 8C	2-8 / 8B	1-4 / 8A	4-16 / 8D
28	2-6 / 5D	1-2 / 5C	4-14 / 5B	3-10 / 5A	3-11 / 8B	2-7 / 8A	1-3 / 8D	4-15 / 8C
29	1-1 / 5B	4-13 / 5A	3-9 / 5D	2-5 / 5C	2-6 / 8D	1-2 / 8C	4-14 / 8B	3-10 / 8A
30	1-4 / 5A	4-16 / 5D	3-12 / 5C	2-8 / 5B	2-5 / 8C	1-1 / 8B	4-13 / 8A	3-9 / 8D
31	1-3 / 5D	4-15 / 5C	3-11 / 5B	2-7 / 5A	2-8 / 8B	1-4 / 8A	4-16 / 8D	3-12 / 8C
32	1-2 / 5C	4-14 / 5B	3-10 / 5A	2-6 / 5D	2-7 / 8A	1-3 / 8D	4-15 / 8C	3-11 / 8B
33	3-9 / 5A	1-1 / 5C	4-13 / 5B	2-5 / 5D	2-6 / 8A	3-10 / 8B	1-2 / 8D	4-14 / 8C
34	3-12 / 5D	1-4 / 5B	4-16 / 5A	2-8 / 5C	2-5 / 8D	3-9 / 8A	1-1 / 8C	4-13 / 8B
35	3-11 / 5C	1-3 / 5A	4-15 / 5D	2-7 / 5B	2-8 / 8C	3-12 / 8D	1-4 / 8B	4-16 / 8A
36	3-10 / 5B	1-2 / 5D	4-14 / 5C	2-6 / 5A	2-7 / 8B	3-11 / 8C	1-3 / 8A	4-15 / 8D
37	2-5 / 5D	4-13 / 5B	3-9 / 5A	1-1 / 5C	1-2 / 8D	2-6 / 8A	4-14 / 8C	3-10 / 8B
38	2-8 / 5C	4-16 / 5A	3-12 / 5D	1-4 / 5B	1-1 / 8C	2-5 / 8D	4-13 / 8B	3-9 / 8A
39	2-7 / 5B	4-15 / 5D	3-11 / 5C	1-3 / 5A	1-4 / 8B	2-8 / 8C	4-16 / 8A	3-12 / 8D
40	2-6 / 5A	4-14 / 5C	3-10 / 5B	1-2 / 5D	1-3 / 8A	2-7 / 8B	4-15 / 8D	3-11 / 8C
41	1-1 / 5C	3-9 / 5A	2-5 / 5D	4-13 / 5B	4-14 / 8C	1-2 / 8D	3-10 / 8B	2-6 / 8A
42	1-4 / 5B	3-12 / 5D	2-8 / 5C	4-16 / 5A	4-13 / 8B	1-1 / 8C	3-9 / 8A	2-5 / 8D
43	1-3 / 5A	3-11 / 5C	2-7 / 5B	4-15 / 5D	4-16 / 8A	1-4 / 8B	3-12 / 8D	2-8 / 8C

Figure 7-17a

Day # - Sequence # / Scenario Code

PARTICIPANT NUMBER	EXPERIMENTAL DESIGN CELL NUMBER 9	10	11	12	13	14	15	16
1	3-11 / 11A	4-15 / 11B	1-3 / 11C	2-7 / 11D	2-8 / 14A	3-12 / 14B	4-16 / 14C	1-4 / 14D
2	3-10 / 11D	4-14 / 11A	1-2 / 11B	2-6 / 11C	2-7 / 14D	3-11 / 14A	4-15 / 14B	1-3 / 14C
3	3-9 / 11C	4-13 / 11D	1-1 / 11A	2-5 / 11B	2-6 / 14C	3-10 / 14D	4-14 / 14A	1-2 / 14B
4	3-12 / 11B	4-16 / 11C	1-4 / 11D	2-8 / 11A	2-5 / 14B	3-9 / 14C	4-13 / 14D	1-1 / 14A
5	2-7 / 11D	3-11 / 11A	4-15 / 11B	1-3 / 11C	1-4 / 14D	2-8 / 14A	3-12 / 14B	4-16 / 14C
6	2-6 / 11C	3-10 / 11D	4-14 / 11A	1-2 / 11B	1-3 / 14C	2-7 / 14D	3-11 / 14A	4-15 / 14B
7	2-5 / 11B	3-9 / 11C	4-13 / 11D	1-1 / 11A	1-2 / 14B	2-6 / 14C	3-10 / 14D	4-14 / 14A
8	2-8 / 11A	3-12 / 11B	4-16 / 11C	1-4 / 11D	1-1 / 14A	2-5 / 14B	3-9 / 14C	4-13 / 14D
9	1-3 / 11C	2-7 / 11D	3-11 / 11A	4-15 / 11B	4-16 / 14C	1-4 / 14D	2-8 / 14A	3-12 / 14B
10	1-2 / 11B	2-6 / 11C	3-10 / 11D	4-14 / 11A	4-15 / 14B	1-3 / 14C	2-7 / 14D	3-11 / 14A
11	1-1 / 11A	2-5 / 11B	3-9 / 11C	4-13 / 11D	4-14 / 14A	1-2 / 14B	2-6 / 14C	3-10 / 14D
12	1-4 / 11D	2-8 / 11A	3-12 / 11B	4-16 / 11C	4-13 / 14D	1-1 / 14A	2-5 / 14B	3-9 / 14C
13	4-15 / 11B	1-3 / 11C	2-7 / 11D	3-11 / 11A	3-12 / 14B	4-16 / 14C	1-4 / 14D	2-8 / 14A
14	4-14 / 11A	1-2 / 11B	2-6 / 11C	3-10 / 11D	3-11 / 14A	4-15 / 14B	1-3 / 14C	2-7 / 14D
15	4-13 / 11D	1-1 / 11A	2-5 / 11B	3-9 / 11C	3-10 / 14D	4-14 / 14A	2-7 / 14B	2-6 / 14C
16	4-16 / 11C	1-4 / 11D	2-8 / 11A	3-12 / 11B	3-9 / 14C	4-13 / 14D	1-1 / 14A	2-5 / 14B
17	2-7 / 11A	1-3 / 11D	4-15 / 11C	3-11 / 11B	3-12 / 14C	2-8 / 14B	1-4 / 14A	4-16 / 14D
18	2-6 / 11D	1-2 / 11C	4-14 / 11B	3-10 / 11A	3-11 / 14B	2-7 / 14A	1-3 / 14D	4-15 / 14C
19	2-5 / 11C	1-1 / 11B	4-13 / 11A	3-9 / [illegible]	3-10 / 14A	2-6 / 14D	1-2 / 14C	4-14 / 14B
20	2-8 / 11B	1-4 / 11A	4-16 / 11D	3-12 / 11C	3-9 / 14D	2-5 / 14C	1-1 / 14B	4-13 / 14A
21	1-3 / 11D	4-15 / 11C	3-11 / 11B	2-7 / 11A	2-8 / 14B	1-4 / 14A	4-16 / 14D	3-12 / 14C
22	1-2 / 11C	4-14 / 11B	3-10 / 11A	2-6 / 11D	2-7 / 14A	1-3 / 14D	4-15 / 14C	3-11 / 14B
23	1-1 / 11B	4-13 / 11A	3-9 / 11D	2-5 / 11C	2-6 / 14D	1-2 / 14C	4-14 / 14B	3-10 / 14A
24	1-4 / 11A	4-16 / 11D	3-12 / 11C	2-8 / 11B	2-5 / 14C	1-1 / 14B	4-13 / 14A	3-9 / 14D
25	4-15 / 11C	3-11 / 11B	2-7 / 11A	1-3 / 11D	1-4 / 14A	4-16 / 14D	3-12 / 14C	2-8 / 14B
26	4-14 / 11B	3-10 / 11A	2-6 / 11D	1-2 / 11C	1-3 / 14D	4-15 / 14C	3-11 / 14B	2-7 / 14A
27	4-13 / 11A	3-9 / 11D	2-5 / 11C	1-1 / 11B	1-2 / 14C	4-14 / 14B	3-10 / 14A	2-6 / 14D
28	4-16 / 11D	3-12 / 11C	2-8 / 11B	1-4 / 11A	1-1 / 14B	4-13 / 14A	3-9 / 14D	2-5 / 14C
29	3-11 / 11B	2-7 / 11A	1-3 / 11D	4-15 / 11C	4-16 / 14D	3-12 / 14C	2-8 / 14B	1-4 / 14A
30	3-10 / 11A	2-6 / 11D	1-2 / 11C	4-14 / 11B	4-15 / 14C	3-11 / 14B	2-7 / 14A	1-3 / 14D
31	3-9 / 11D	2-5 / 11C	1-1 / 11B	4-13 / 11A	4-14 / 14B	3-10 / 14A	2-6 / 14D	1-2 / 14C
32	3-12 / 11C	2-8 / 11B	1-4 / 11A	4-16 / 11D	4-13 / 14A	3-9 / 14D	2-5 / 14C	1-1 / 14B
33	4-15 / 11D	2-7 / 11B	3-11 / 11C	1-3 / 11A	1-4 / 14B	4-16 / 14A	2-8 / 14C	3-12 / 14D
34	4-14 / 11C	2-6 / 11A	3-10 / 11B	1-2 / 11D	1-3 / 14A	4-15 / 14D	2-7 / 14B	3-11 / 14C
35	4-13 / 11B	2-5 / 11D	3-9 / 11A	1-1 / 11C	1-2 / 14D	4-14 / 14C	2-6 / 14A	3-10 / 14B
36	4-16 / 11A	2-8 / 11C	3-12 / 11D	1-4 / 11B	1-1 / 14C	4-13 / 14B	2-5 / 14D	3-9 / 14A
37	3-11 / 11C	1-3 / 11A	2-7 / 11B	4-15 / 11D	4-16 / 14A	3-12 / 14D	1-4 / 14B	2-8 / 14C
38	3-10 / 11B	1-2 / 11D	2-6 / 11A	4-14 / 11C	4-15 / 14D	3-11 / 14C	1-3 / 14A	2-7 / 14B
39	3-9 / 11A	1-1 / 11C	2-5 / 11D	4-13 / 11B	4-14 / 14C	3-10 / 14B	1-2 / 14D	2-6 / 14A
40	3-12 / 11D	1-4 / 11B	2-8 / 11C	4-16 / 11A	4-13 / 14B	3-9 / 14A	1-1 / 14C	2-5 / 14D
41	2-7 / 11B	4-15 / 11D	1-3 / 11A	3-11 / 11C	3-12 / 14D	2-8 / 14C	4-16 / 14A	1-4 / 14B
42	2-6 / 11A	4-14 / 11C	1-2 / 11D	3-10 / 11B	3-11 / 14C	2-7 / 14B	4-15 / 14D	1-3 / 14A
43	2-5 / 11D	4-13 / 11B	1-1 / 11C	3-9 / 11A	3-10 / 14B	2-6 / 14A	4-14 / 14C	1-2 / 14D

Figure 7–17b

VERIFICATION

The scenarios were verified to determine whether or not they conformed to the criteria set in section 2 of this chapter and to insure that words and phrases were clearly understood. The verification was accomplished in an iterative manner by professors and students who were not part of the experiment. The first draft of the scenarios was given to nonparticipants. The decisions were scored and any recommended changes in word usage or ambiguous interpretations of the statements were appropriately changed. After the necessary corrections were made, the 16 scenarios were given to other nonparticipants and any recommendations for changes were made.

These first two verification groups were not given any time limitations when solving the decisions. However, they were told to record the length of time required to make the decisions. As stated in the section on Time in this chapter, the longest time required by each nonparticipant to make a single decision was calculated. This time was approximately eight minutes. The high time cells were then set at a maximum of eight minutes and the low time cells were set at one half of this time or four minutes. Finally, additional nonparticipants were given the 16 scenarios, with the time constraints added. The results were recorded and any recommendations for changes were implemented.

TESTING PROCEDURE

The decision making experiment was conducted over a four day period. The tests were taken in classrooms at AFIT. Each day, the participants received four scenarios with Time, Decision Flexibility, and Quantity of Information (Information Packet) varying in each scenario in accordance with the 16 cells of the Experimental Design. The decision quality score was recorded and appropriate entries made in the data base after each day's testing.

The General Instructions on the first page of each scenario (Scenario chapter, Figure 7-1A) were read to the participants on the first day of testing and reviewed at the start of testing on each of the remaining three days. A general description of the scenarios was explained on the first day of testing to aquaint the participants with the decision making instrument. Additionally, the participants were told to record the length of time it actually took to complete each decision scenario. The time was recorded an an integer value by truncating the seconds to the nearest minute (i.e. 3 minutes and 45 seconds would be recorded as a time of 3). The elapsed time was recorded on the chalkboard so participants only had to write down the elapsed time (integer) from the board. This data was collected for each participant on each test to determine if the time constraints imposed (4 minutes low time and 8 minute high time) were actually constraining the participants. The actual time required to make the decision was not a subject of analysis in the experiment. It only served to clarify whether or not the time constraints imposed were meaningful.

CONCLUSION

This chapter explained in detail how the scenarios were developed from the criteria set forth in the second section. Additionally, the testing procedure was outlined. In each step of the scenario development, care was taken to insure the decision quality results would not be biased by nonexperimentally controlled factors such as the learning curve and recognizable patterns in the solutions or item arrangements. A table of random digits was used to randomize the order of the items, the information statements, and the solutions to avoid the recognition of patterns. The sequence of testing was made unique for each participant to also avoid biases in collecting scores on decision quality as the quantity of information and the decision environment changed. Finally, the scenarios were verified by three groups of nonparticipants to alleviate any poorly written information statements or poor choice of words. Finally, the scenarios were used to test the decision making performance of the population in 16 different decision situations.

CHAPTER 8

RESULTS AND ANALYSIS

This chapter presents the techniques and methods used to analize of the results of the experiment. The method of scoring will be reviewed and a summary of the scores will be provided. Following that, an overview of the analysis will be presented. Finally, the results of each analytical technique used will be explained and examined.

SCORING

As stated in the Scenario chapter, participants received decision quality scores based upon the number of errors in the solution chosen (Scenario chapter, Figure 7-12). The scores for the high and low Decision Flexibility cells are shown in Figure 8-1. Larger scores mean fewer errors and higher decision quality.

DECISION QUALITY SCALE

Low Decision Flexibility Tests: # of errors	score	High Decision Flexibility Tests: # of errors	score
0	3	0	9
1	2	1	8
2	1	2	7
		3	6
		4	5
		5	4
		6	3
		7	2
		8	1

Figure 8-1
Summary of Number of Errors and Decision Quality

Figure 8-2 shows the number of participants who scored in each level of decision quality for high Decision Flexibility cells.

CELL NUMBER	SCORE 1	2	3	4	5	6	7	8	9
3	5	1	3	1	1	2	7	4	19
4	9	0	1	1	0	3	9	2	18
7	0	5	0	3	5	2	3	4	21
8	0	1	1	0	7	7	4	3	20
11	6	0	2	3	2	1	7	6	16
12	2	1	0	2	0	0	12	3	23
15	5	2	0	3	3	4	3	10	13
16	3	1	2	0	3	1	6	9	18

Figure 8-2
Summary of Decision Quality Score for Each Cell
With High Decision Flexibility

Figure 8-3 shows the number of participants who scored in each level of decision quality for low Decision Flexibility cells.

CELL NUMBER	SCORE 1	2	3
1	13	4	26
2	22	0	21
5	3	13	27
6	6	9	28
9	8	7	28
10	15	10	18
13	12	8	22
14	8	10	25

Figure 8-3
Summary of Decision Quality Scores for Each Cell With Low Decision Flexibility

OVERVIEW OF ANALYSIS

Once each individual's decision quality score is obtained for each cell, the analysis of the experiment begins. The objective of this analysis is to determine if changes in the amount of information cause changes in decision quality. These trends will be investigated in the four decision environments for each category of decision maker.

Four graphs representing the four decision environments will be constructed with Quantity of Information on the abscissa (increasing information with increasing distance from the origin) and Decision Quality on the ordinate (increasing quality with increasing distance from the origin). There will be two basic types of graphs, those with nine elements on the ordinate (due to the nine possible choices the decision maker can select) and those with three elements on the ordinant (for three choices). The graphs are further divided in terms of Time, low or high. Hence, there are four graphs representing the four decision environments: Low Time/Low Flexibility, High Time/Low Flexibility, Low Time/High Flexibility, and High Time/High Flexibility. These graphs are shown in Figure 8-4.

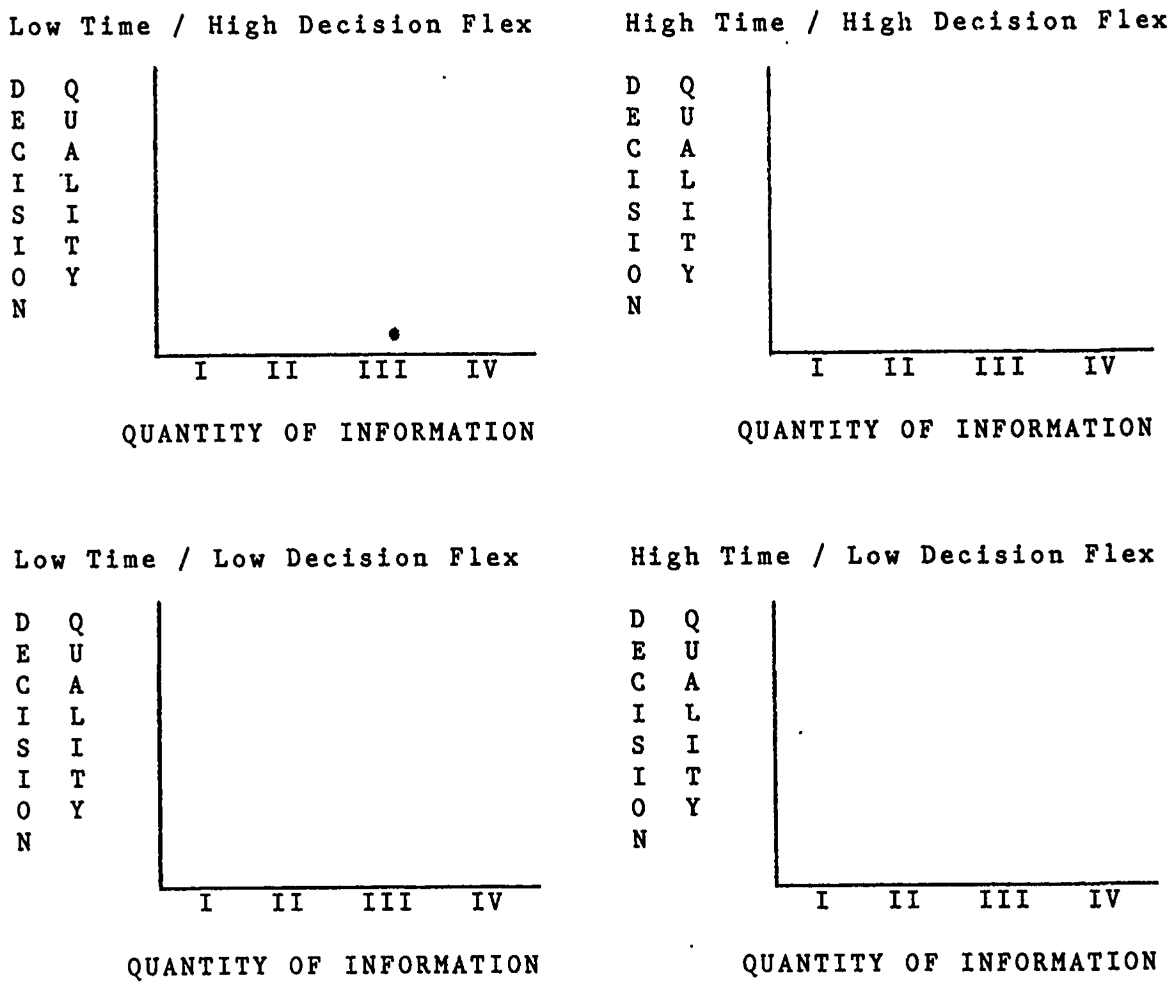


Figure 8-4
Graphs of the Four Decision Environments

The 16 cells of the experimental design can then be overlayed on these four decision environment graphs as shown in Figure 8-5.

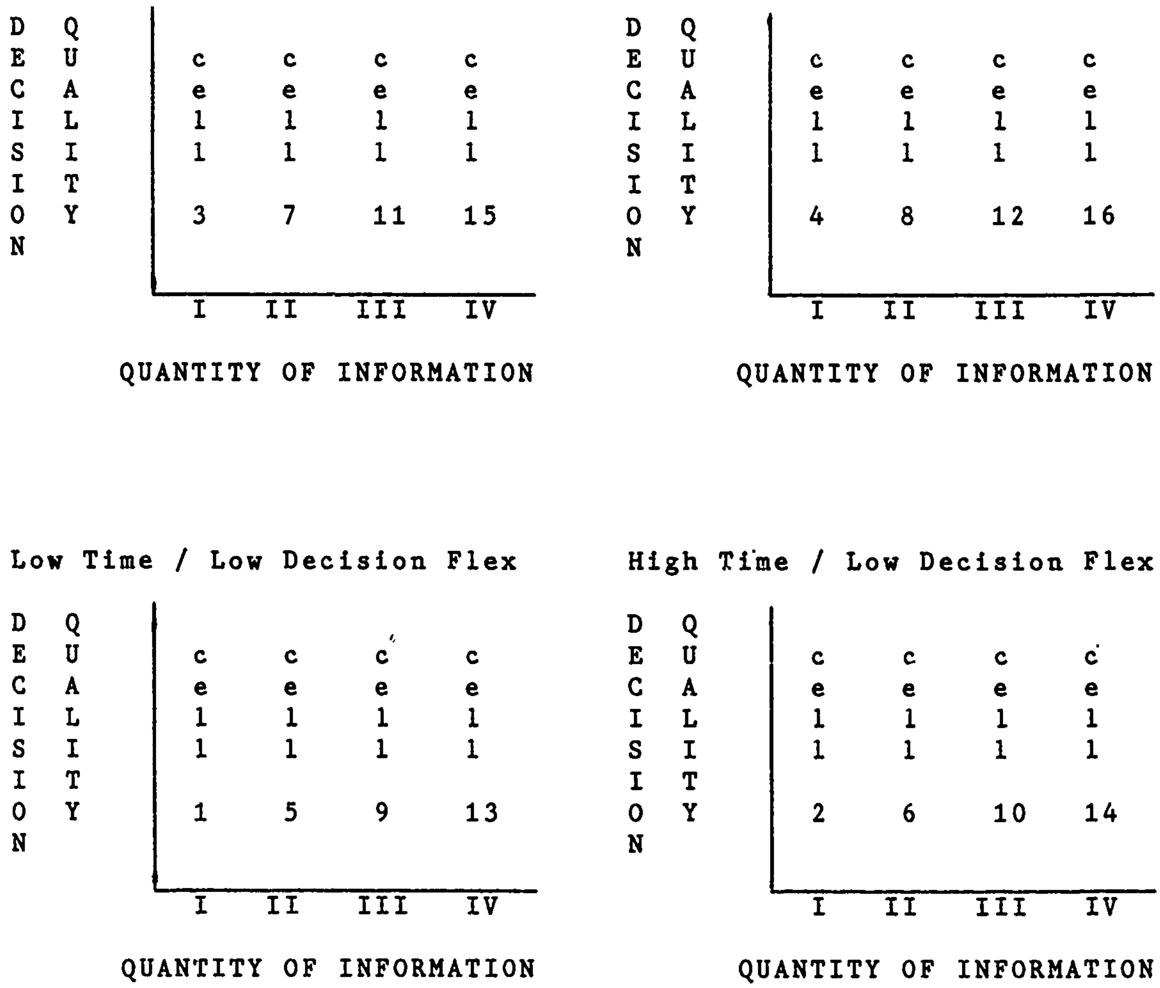


Figure 8-5
Cells Overlayed on the Four Decision Environment Graphs

The Information Quantity versus Decision Quality curve for a specific category of decision maker will be determined as follows. First, the mean score of all participants in a specific category will be calculated for each cell. Then each of the means will be plotted on the respective graphs in accordance with Figure 8-5. Finally, the curves will be examined to determine if any of the proposed shapes of the curves (the Optimum Point Theory, the Unbounded Curve Theory, the Saturation Point Theory) hold for the particular category of decision maker in a particular environment.

Statistical tests will then be conducted to establish which curves are formed by statistically significantly different mean scores. Only curves which meet a specified level of significance can be considered as depicting significant trends in the quality of the decision when the Quantity of Information is varied.

The curve for each category of decision maker will then be drawn in each graph across the Quantity of Information levels. The cell means will then be compared across the Quantities of Information to determine if there is an significant difference between the curves of different categories of decision makers. This design will enable the analysis to discern a difference between the categories of decision makers.

After the curves are plotted and their significance determined, additional statistical tests can be conducted to determine if the curves for a specific category are statistically significantly different across decision environments. Other tests may be conducted to further explain the relationships, or lack of relationships within or between the curves. These techniques will be explained further in this chapter.

OVERVIEW OF RESULTS

Trends in information usage within categories of decision makers were discovered by this analysis. Certain types of decision maker had a significant fall-off in decision quality when placed in certain decision making environments. Trends between types of decison makers were evident, but had less significance. Two of these later trends were found to be statistically significant. Some of the weakness in significance was due to the large variance associated with the mean scores for each decison maker category. In general, the trends across categories of decison maker showed small consistency or commonality.

There was statistically significant difference within the performance of certain decision maker types in terms of the parameters measured. Several techniques were used to discern a difference in the performance of the categories of decision maker. These techniques include ANOVA, ANCOVA, and Descriminant Analysis. The experiment measured a significant effect in performance within certain types of decision makers when environmental factors of Time and Decision

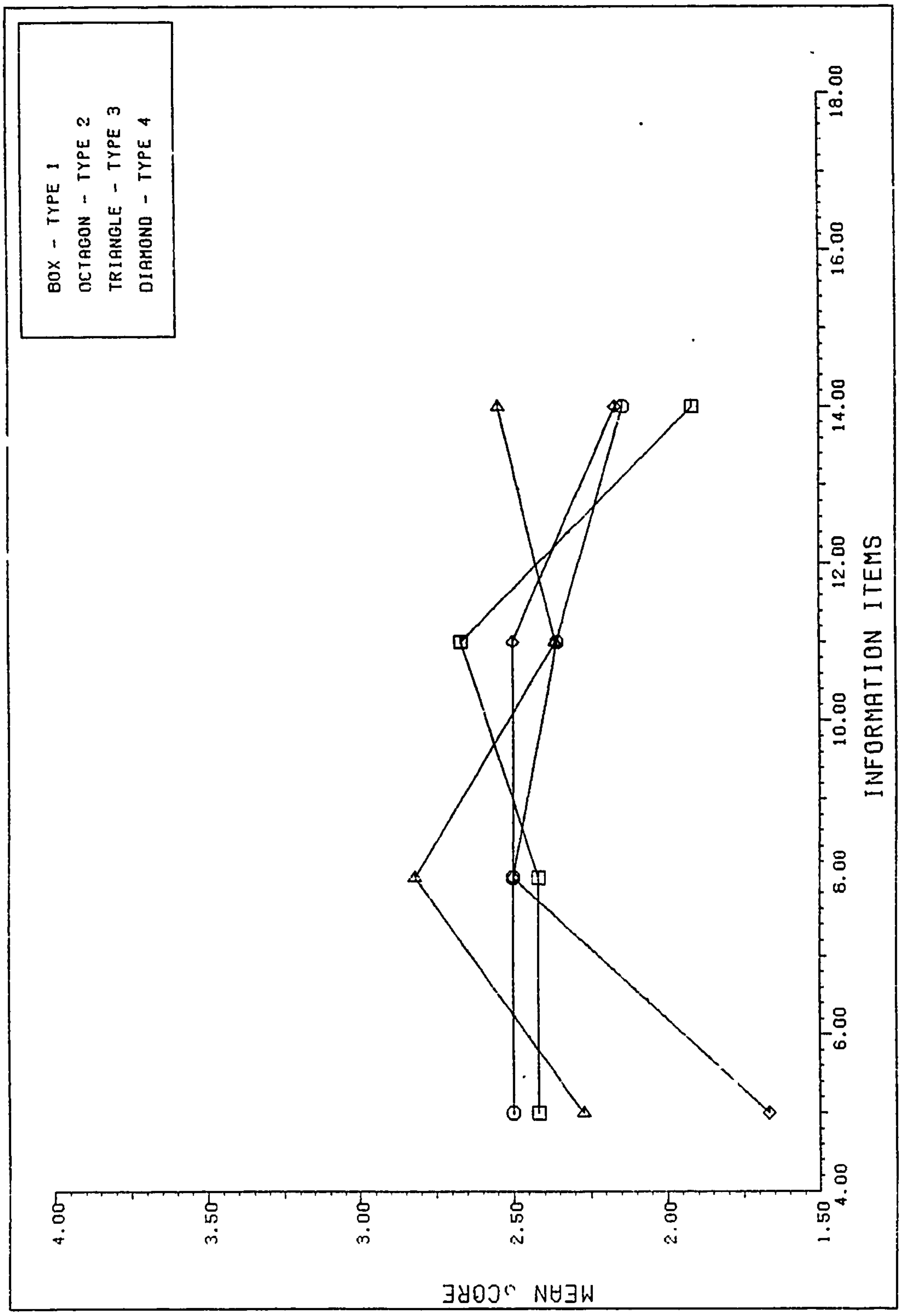
Flexibility were varied. Differences between types of decision makers showed less significance in terms of parameters and variations of environmental factors. Certain of these between type differences were significant at higher alpha values. The remainder of this chapter will review the results of the experiment and discuss the techniques used to analyze these results.

MAIN HYPOTHESES

The technique of Analysis of Variance (ANOVA) from the SPSS was used to analyze the results of the scenarios. This is a method for discovering the relation between a dependent variable and one or more independent variables. ANOVA was used for the simplicity in analysis and description of the results. In the case of this analysis, the assumptions for the General Linear Model may limit the use of ANOVA. This analysis is perilously close to using a categorical dependent variable, score. The assumption for this thesis is that the score variable in both cases (high Flexibility and low Flexibility) is both ordinal and interval and thus allows the use of ANOVA and ANCOVA as descriptive tools.

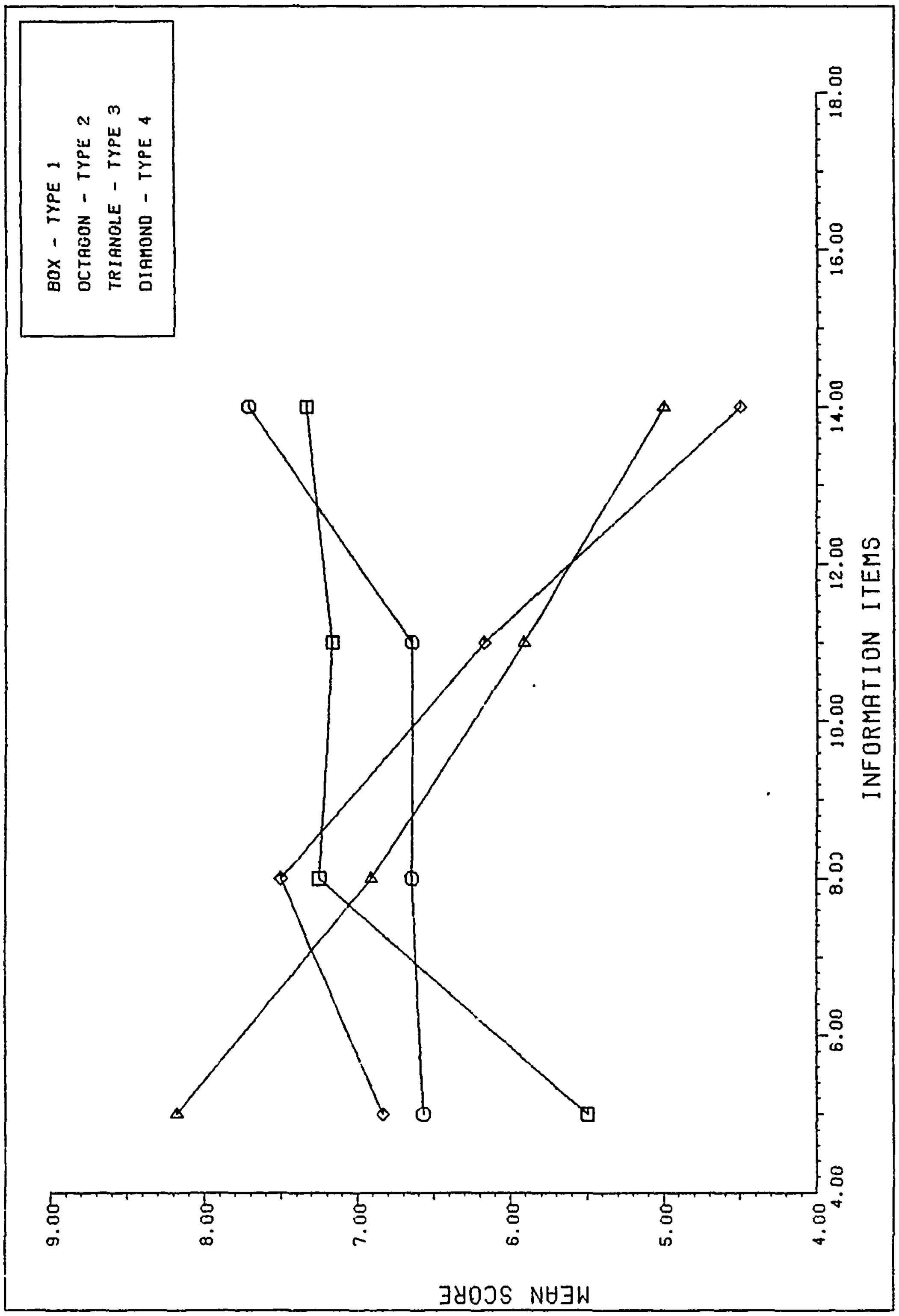
The initial analysis compared the scores achieved by the participants, as the dependent variable, to the Quantity of Information. This was done separately for each Quadrant Theory category. The ANOVA was accomplished for each quadrant type in each of the four environments for a total of 16 one way ANOVAs.

The ANOVAs determined the mean decision quality scores for each category of decision maker in each cell. The mean scores for each category were plotted on the four decision environment graphs, described in the previous section. When the means were connected, the Curves for each category of decision maker in each environment were produced. These curves are shown in Figures 8-6 through 8-9.



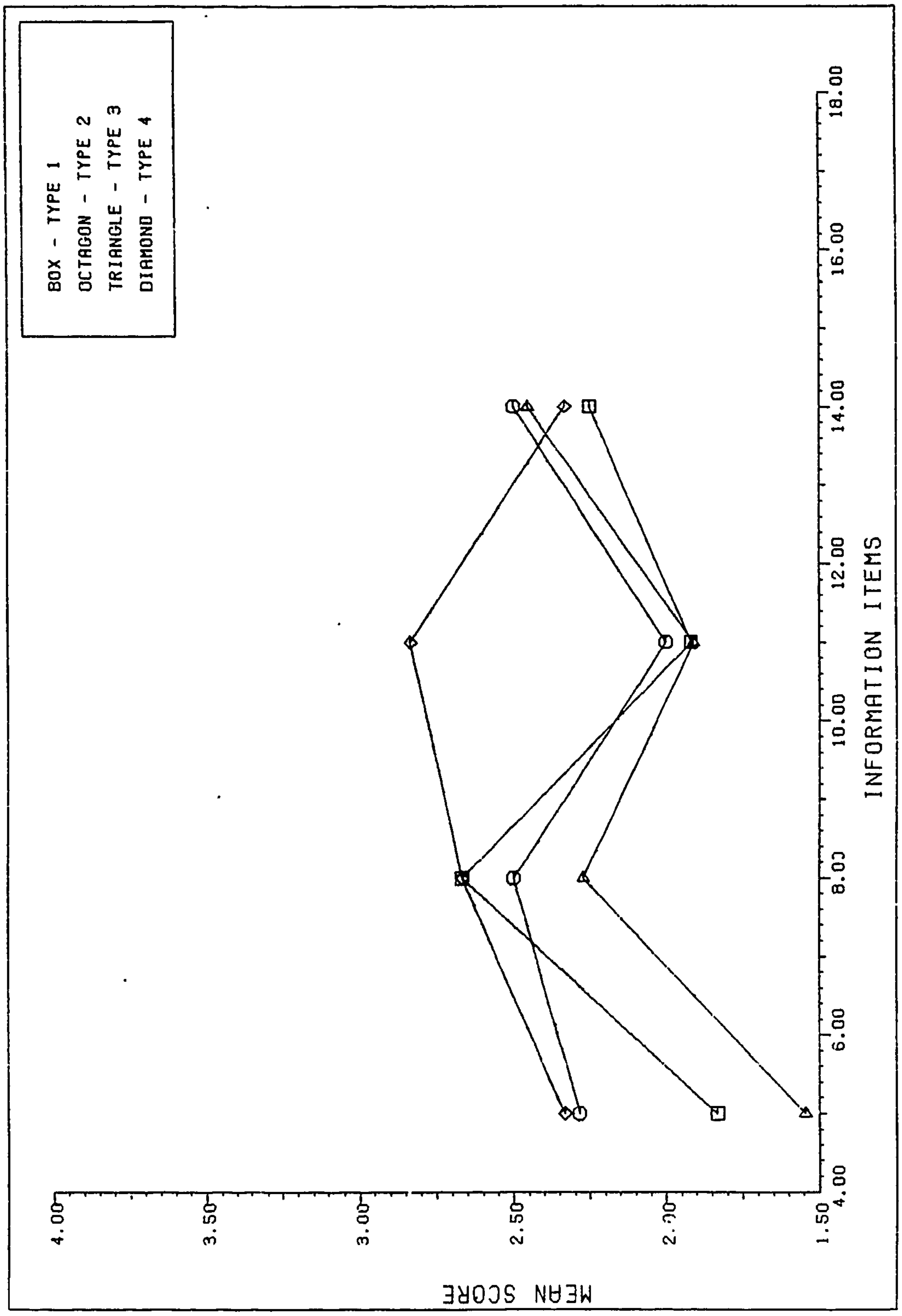
DECISION ENVIRONMENT: LOW TIME/LOW FLEXIBILITY

Figure 8-6



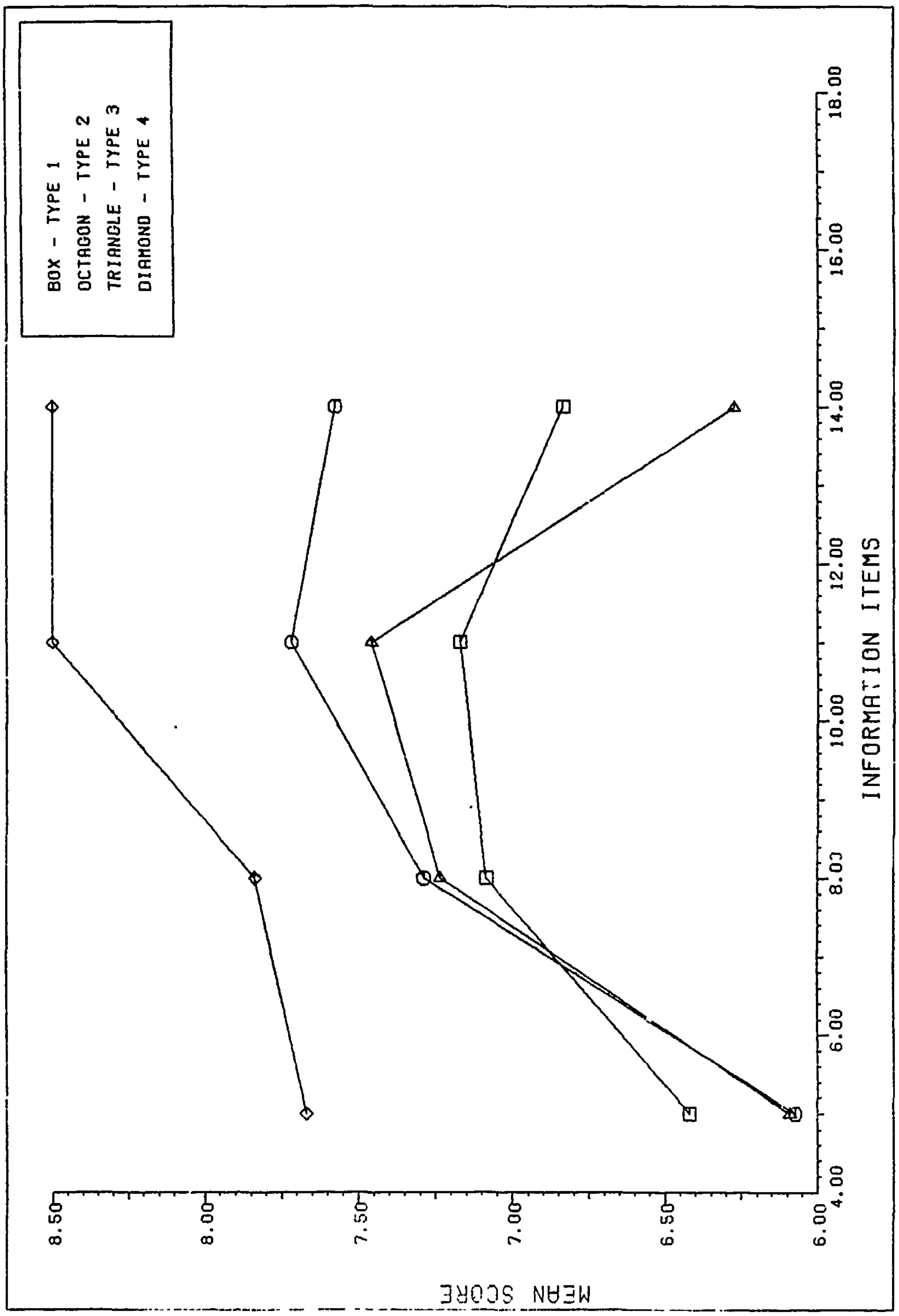
DECISION ENVIRONMENT: LOW TIME/HIGH FLEXIBILITY

Figure 8-7



DECISION ENVIRONMENT: HIGH TIME/LOW FLEXIBILITY

Figure 8-8



DECISION ENVIRONMENT: HIGH TIME/HIGH FLEXIBILITY

Figure 8-9

In the figures which follow, the decision environments will be referred to by the following codes.

DECISION ENVIRONMENT		CODE
Time	Flexibility	
Low	Low	LL
High	Low	HL
Low	High	LH
High	High	HH

A summary of the descriptive trends represented by the curves shown in Figures 8-6 through 8-9 and their significance levels are shown in Figure 8-10.

QUAD	# IND	DECISION ENVIRONMENT	DESCRIPTIVE TREND	SIGNIF 0.1	ALPHA 0.2	MIN ALPHA
I	12	LL	Optimum Point	no	yes	.17
II	14	LL	none	no	no	*
III	11	LL	none	no	no	*
IV	6	LL	Optimum Point	no	no	*
I	12	HL	Optimum Point	no	yes	.11
II	14	HL	none	no	no	*
III	11	HL	Inflection Point	yes	yes	.07
IV	6	HL	Optimum Point	no	no	*
I	12	LH	Saturation Point	no	no	.30
II	14	LH	none	no	no	*
III	11	LH	Neg Sloped Line	yes	yes	.06
IV	6	LH	Optimum Point	no	no	*
I	12	HH	none	no	no	*
II	14	HH	Saturation Point	no	no	.30
III	11	HH	none	no	no	*
IV	6	HH	none	no	no	*

* minimum alpha for significance is greater than 0.30

Figure 8-10
Summary Of Curves For Quadrant Theory Category

An examination of the descriptive trends would conclude that the Quadrant I types may experience an information overload in low Decision Flexibility environments. This category tends to reach an information saturation point in a high Decision Flexibility environment. No trends are apparent for this group in decision environment 4. The Quadrant II types show no trends in decision environments 1 through 3. There may be a point of information saturation in decision environment 4, however, the variance is too large to make this trend significant.

The Quadrant III types showed no consistency in trends between decision environments. This is probably due to the large variance in mean scores. Finally, the Quadrant 4 types showed a slight tendency to be overloaded with information in decision environments 1, 2, and 3. No trend can be seen for this category in decision environment 4. To reemphasize, these trends are not significant. They cannot be used to predict the performance of decision makers in the various categories. The trends described are only valid for the experimental population. Even then, the trends are not very meaningful due to the lack of a significant difference between the mean scores.

An additional ANOVA was performed in each cell, using score as the criterion variable and Quadrant category as the predictor variable. This was done to determine if the means for the scores were significantly different between categories within the same decision situation. Figure 8-11 summarizes the results of these ANOVAs. Once again, there is a lack of significant differences between the means.

INFORMATION PACKET	DECISION ENVIRONMENT	MINIMUM ALPHA	DIFFERENCE AMONG CATEGORIES **
I	LL	.30	none
II	LL	*	none
III	LL	*	none
IV	LL	*	none
I	HL	.23	none
II	HL	*	none
III	HL	.15	none
IV	HL	*	none
I	LH	.16	none
II	LH	*	none
III	LH	*	none
IV	LH	.01	Q3, Q2
I	HH	*	none
II	HH	*	none
III	HH	*	none
IV	HH	.30	none

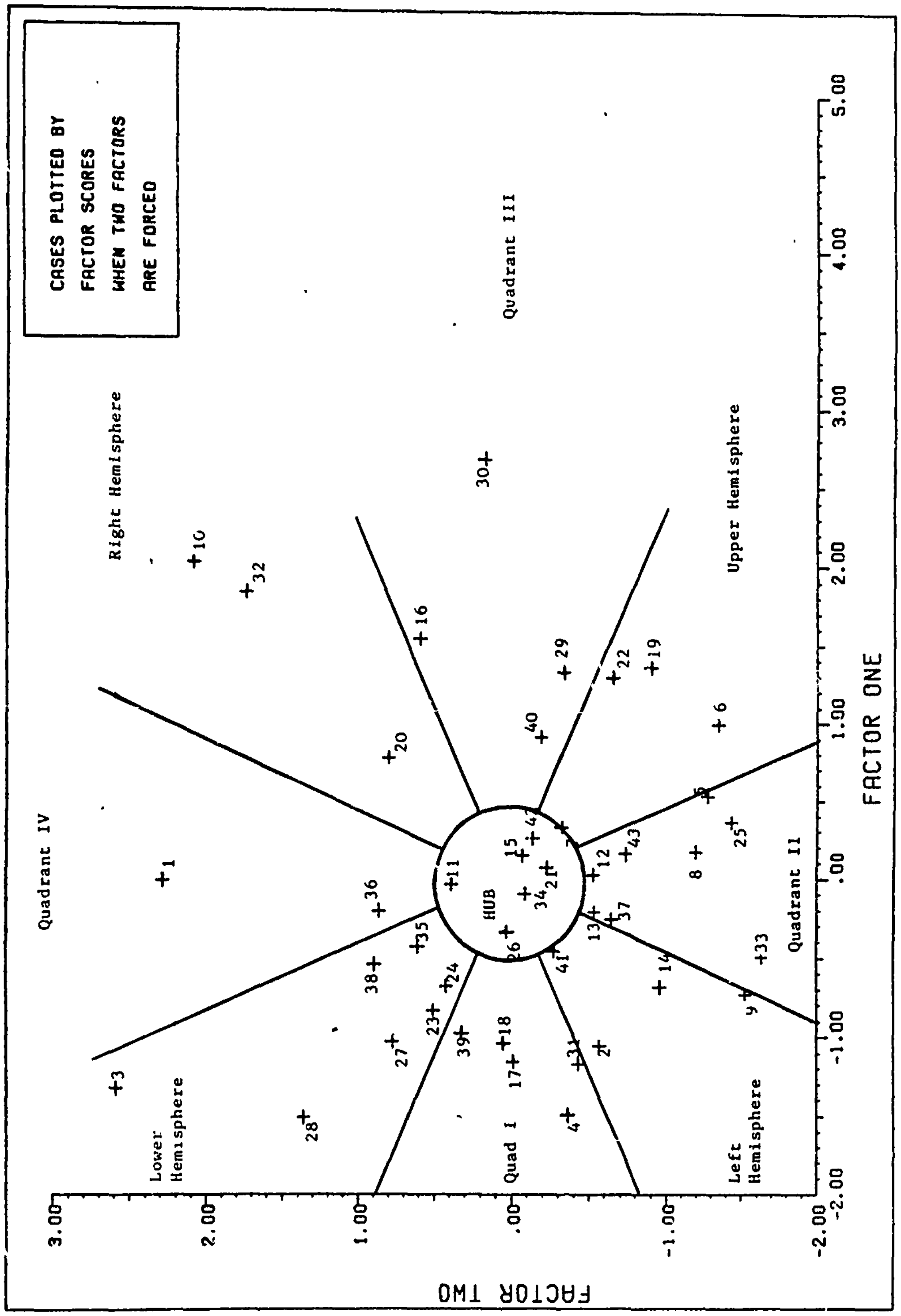
* minimum alpha for significance is greater than 0.30
** established using Tukey Multiple Range Test for alpha = 0.05

Figure 8-11
Summary of Significance Level Of Mean Scores Between Quadrant Categories For Fixed Quantity Of Information

RECLASSIFICATION

In an effort to account for the variance of the scores, further refinement in analysis was attempted. Reexamining the results of the Factor Analysis described in the Theory chapter, the Quadrant Theory was expanded. It was reasoned that the Quadrant Theory was not detailed or specific enough to adequately categorize the test population.

A new classification procedure was developed to determine the dominant Psychological Profile for each participant. Each participant's factor scores from the Factor Analysis forcing two factors was plotted on the Refined Quadrant Theory graph, shown in Figure 8-12. Not all participants in this new classification procedure were assigned to only one quadrant. This new classification procedure attempts to account for people who exhibit strong preferences for traits of two adjacent quadrants. These individuals were classified as belonging to one of four hemispheres shown on the graph.



CATEGORY TYPES: CASES PLOTTED IN FACTOR SPACE

Figure 8-12

Participants who obtained factor scores less than 0.5 in either factor fell inside the center of the graph. This last group called the "hub" group, consists of individuals who may be situationally dependent as to their preferences for exhibiting the traits of each quadrant. They may strongly exhibit the logical traits associated with Quadrant I dominant individuals in one situation and strongly exhibit the interpersonal characteristics of Quadrant IV individuals in another situation. Dependence on psychological tests to measure psychological profile may reinforce the idea of dominance to such an extreme that the potential for flexibility and style change is overlooked [28]. This classification model, unlike the psychological instruments from which it was derived, accounts for this possibility with the inclusion of the hub or center group.

A summary of the results of the reclassification of the 43 participants is shown in Figure 8-13.

QUADRANT THEORY AREA OF GRAPH	CATEGORY NUMBER	# OF PARTICIPANTS CLASSIFIED
Q1	1	5
Q2	2	8
Q3	3	4
Q4	4	2
Left Hemisphere	5	4
Upper Hemisphere	6	3
Right Hemisphere	7	3
Lower Hemisphere	8	7
Hub (center group)	9	7

Figure 8-13
Results of Reclassification

When the analysis, explained previously for the four quadrant types, was accomplished for the Refined Quadrant Theory classification scheme, similar results were achieved. These results are shown in Figure 8-14. Where the CORR CAT column represents the corresponding minimum alpha for the original Quadrant Theory Curves. With few exceptions, the results were uniformly worse. That is, even less significant differences were found using the Refined Quadrant Theory. However, this may be a result of the significantly smaller sample sizes in each quadrant.

FURTHER ANALYSIS

Faced with these results, it was determined that certain of the design assumptions may have been in error. Perhaps some of the variables eliminated at the outset of the experiment may account for more of the variance in the results. In this portion of the analysis, several techniques were used to attempt to discern the importance of the various parameters in predicting or explaining the results in the scores for the experiment.

PSYCH PROF	# IND	DEC ENV	MIN ALPHA	CORR CAT	IMPROVE	DESCRIPTIVE TREND
RQ1	5	LL	*	.17	no	
RQ2	8	LL	*	*		
RQ3	4	LL	*	*		
RQ4	2	LL	*	*		
LFH	4	LL	.13			Optimum Point
UPH	3	LL	.22			
RTH	3	LL	*			
LWH	7	LL	.02			Optimum Point
C	7	LL	*			
RQ1	5	HL	.27	.11	no	
RQ2	8	HL	*	*		
RQ3	4	HL	.15	.07	no	Unbounded Curve
RQ4	2	HL	*	*		
LFH	4	HL	*			
UPH	3	HL	.003			"V" Shaped
RTH	3	HL	*			
LWH	7	HL	.24			
C	7	HL	*			
RQ1	5	LH	.10	.30	yes	
RQ2	8	LH	*	*		
RQ3	4	LH	*	.06	no	
RQ4	2	LH	*	*		
LFH	4	LH	.19			"U" Shaped
UPH	3	LH	.25			
RTH	3	LH	*			
LWH	7	LH	.20			
C	7	LH	*			
RQ1	5	HH	*	*		
RQ2	8	HH	.29	.30	yes	
RQ3	4	HH	*	*		
RQ4	2	HH	*	*		
LFH	4	HH	*			
UPH	3	HH	*			
RTH	3	HH	.26			
LWH	7	HH	.18			
C	7	HH	*			

* minimum alpha for significance is greater than 0.30

Figure 8-14
Summary Of Significance Levels Of Mean Scores For The Refined Quadrant Theory Categories

DISCRIMINANT ANALYSIS

The first technique used was Discriminant Analysis from the SPSS. This technique attempts to select a set of discriminating variables that measure characteristics on which groups are expected to differ. Discriminant analysis attempts to weigh and linearly combine the variables in order that the groups are as statistically as distinct as possible (26:435). Using this, it was conjectured that if a psychological variable were important, it would prove to be significant in discriminating between scores.

All of the psychological variables were allowed to go into the analysis, including the ones originally eliminated after the Factor Analysis. Certain of these variables did enter the analysis, but the significance was low. The end results was that the function defined by the discriminant procedure was ineffective in telling the difference between the scores. This indicates that the original elimination of several of the psychological variables did not adversely affect the analysis.

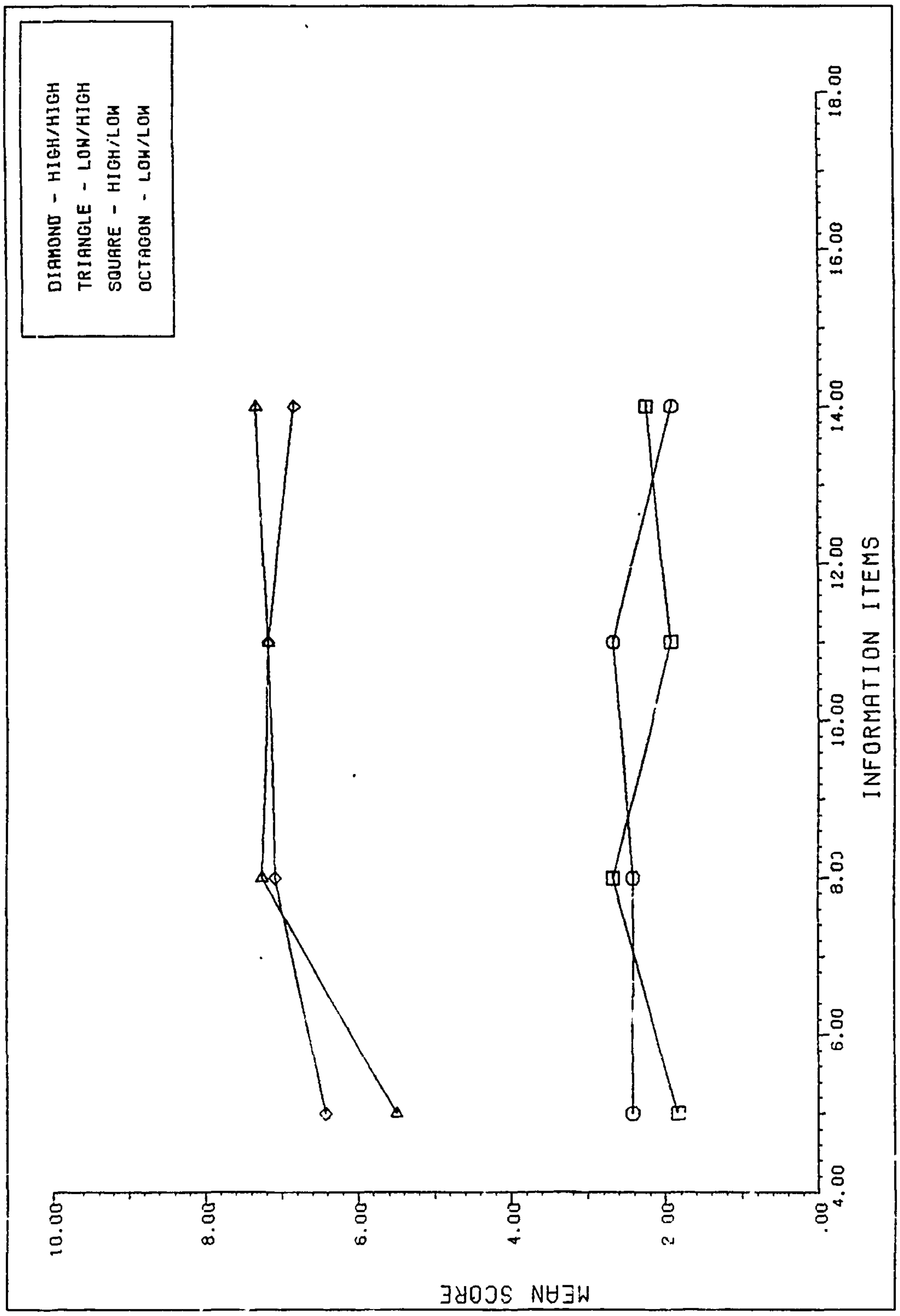
ANALYSIS OF COVARIANCE

The second technique used to discern whether any significant parameter had been eliminated from the model was introducing the psychological variables in the ANOVA as covariates. Covariates are introduced into the ANOVA to

VARIABLE	SIGNIFICANCE
M1	.0515
M2	.0585
M5	.0130
M6	.1009
M7	.9428
M8	.1517
D2	.0517
D4	.0173
V1	.1848
V3	.2583
H5	.3090
H6	.0672

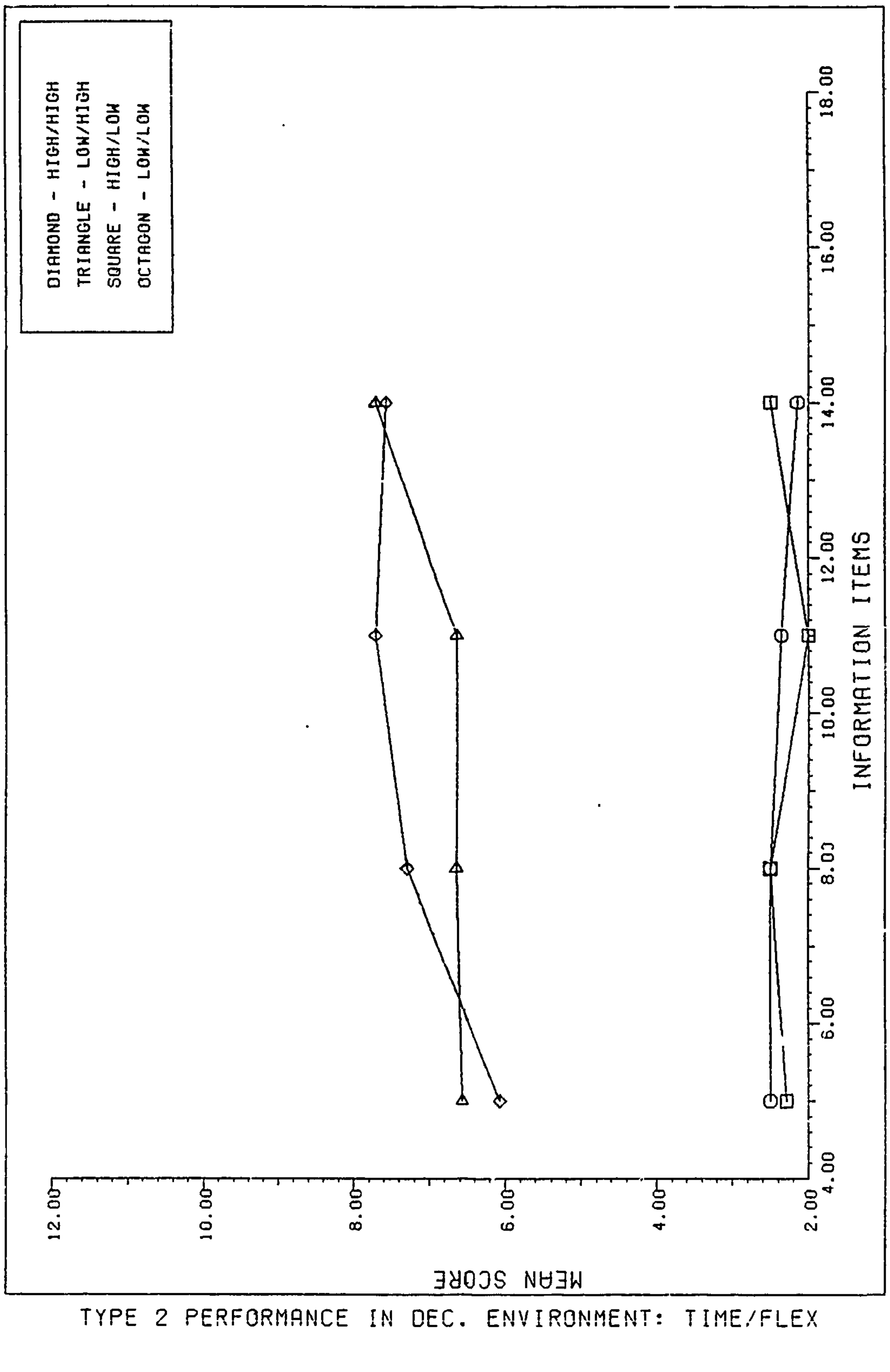
Figure 8-15
Significant Variables in High Flexibility ANCOVA Model
R-Square = 0.127

A further ANCOVA was conducted on a strict quadrant type basis. The performance of each quadrant type was examined across the various environments. The results in general mirrored the other analyses. The performance of a given type was generally the same across environments. However, in the case of Type 4, there was a significant difference of .006 in their performance in the high flexibility environment as time was varied. Type 4 individuals did worse when constrained by time. These results can be seen in Figures 8-16 through 8-19.



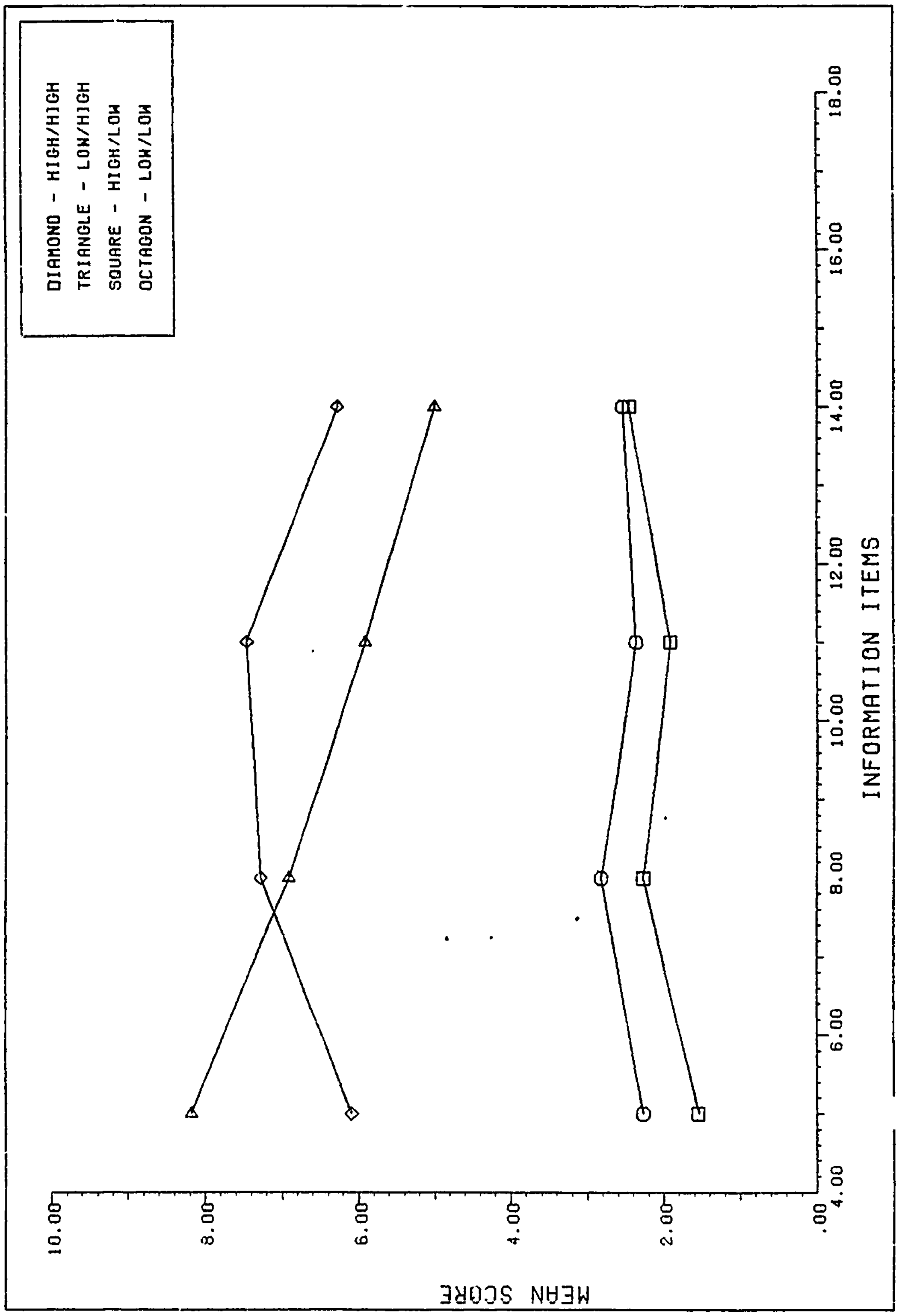
TYPE 1 PERFORMANCE IN DEC. ENVIRONMENT: TIME/FLEX

Figure 8-16



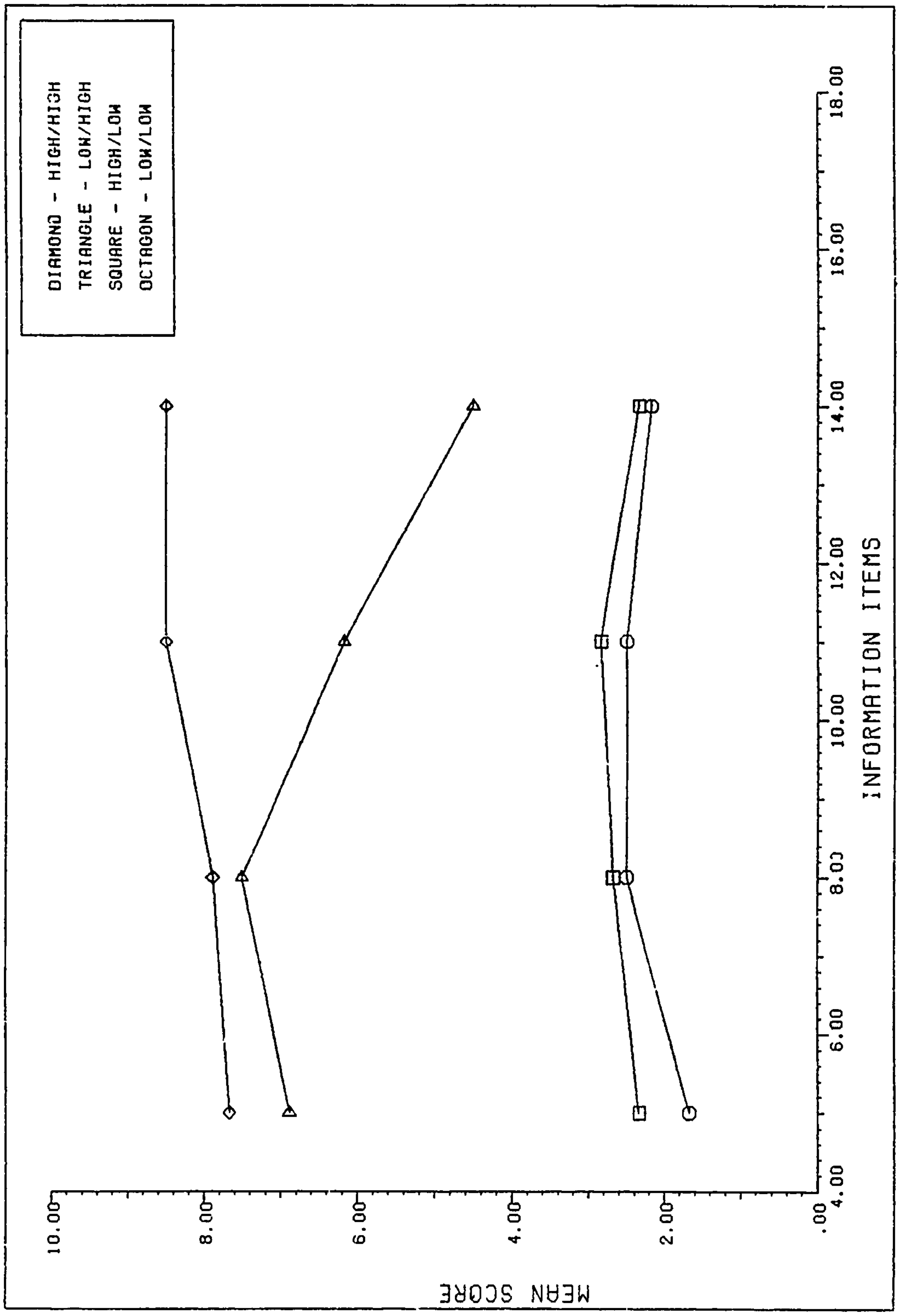
TYPE 2 PERFORMANCE IN DEC. ENVIRONMENT: TIME/FLEX

Figure 8-17



TYPE 3 PERFORMANCE IN DEC. ENVIRONMENT: TIME/FLEX

Figure 8-18



TYPE 4 PERFORMANCE IN DEC. ENVIRONMENT: TIME/FLEX

Figure 8-19

What is seen in this quadrant specific analysis is that there are some interesting results as shown in Figure 8-20. In general, the R-square increases for these models - significantly in the case of type 4 in the high flexibilityy case at a value of .591. Type 3 shows significance of .378 in the high flexibility case as well. The other types show improvements in R-square, but not strong significance.

The chart also shows the significance of the main effects and interaction. Note that for type 4, Time and the interaction of Time and Quantity of Information are significant in the high flexibility case. Likewise, Time and Quantity of Information by themselves are significant for type 3 in the high flexibility case. The interaction of Time and Quantity of Information have fair significance for type 3 in the high flexibility case and for type 1 in the low flexibility case.

Now, what does this mean? Initially it can be said that type 4 does worse in terms of decision quality when placed under a time constraint in the high information environment under increasing amounts of information. Similarly, type 3 shows a decreasing performance when subject to the same situation of time, flexibility and increasing information. On the other hand, type 1 and type 2 show relative insensitivity to change of environment and information and tend to perform consistently. Apparently opposite quadrant types are affected differently when faced with many alternatives and time constraints. Remembering back to the descriptions of quadrant types, this implies that the "Detailed" and "Logical" types are more robust with respect to change than are their more sensitive counterparts, the "Emotional" and "Creative" types. This then is a partial answer to the research question. This is a description of how certain types perform under various parameter modifications.

In attempting to more fully answer this question, psychological variables were introduced in the model in a stepwise fashion. Again, the various significance levels are listed in Figure 8-20. Note that the same variables are not significant across types. These variables describe dimensions that account for the variation within a given type. These other dimensions are those variables that are descriptive of the adjacent quadrant. Figure 8-21 provides a summary of the psychological parameters which explain variation in performance, as well as listing of the relationship between these parameters and the particular quadrant type. This suggests that the refined category model may be more descriptive in accounting for performance. That is, the specific type can explain only so much variation, if more is to be explained, further dimensions must be included. As noted previously, the refined model did not produce the accuracy required because of the size of the population. There were scant numbers in several of the refined category groups.

QUADRANT TYPE

	I		II		III		IV	
Flexibility:	Low	High	Low	High	Low	High	Low	High
R-Square:	.198	.166	.134	.304	.229	.378	.289	.591
Effects								
QI	.245	.286	.547	.185	.033	.161	.187	.398
Time	.288	.901	.737	.541	.010	.612	.166	.001
Tm X QI	.061	.802	.580	.558	.624	.067	.864	.049
Variables								
M1					.102	.066		
M2								
M3	*	*	.015	*			*	*
M4	*	*					.070	*
M5	*	*	*	.001	*	*	*	.000
M6	*	*						
M7	.082	.051	*	.009	*	*		
M8								
D1			*	.005				
D2					*	.018		
D3			*	.003				
D4								
V1					*	.037		
V2								
V3	*	.021	*	.007				
V4					*	.009		
H1	*	.027						
H2								
H3								
H4								
H5			*	.000				
H6								

* variable entered but not significant in explaining variation

Figure 8-20
Significance of Covariates In Quadrant Type Model

QUAD TYPE	DECI FLEX	VARI EXPL	SIGNIFICANT PARAMETERS IN EXPLAINING VARIATION		
I	Low	.198	M7 Judging	I	Within
	High	.166	M7 Judging	I	Within
			H1 Lower Left	I	Within
			V3 Idealist	III	Opposite
II	Low	.134	M3 Sensing	I	Adjacent
	High	.304	M5 Thinking	II	Within
			D3 Conceptual	III	Opposite
			D1 Directive	I	Adjacent
			V3 Idealist	III	Adjacent
			M7 Judging	I	Adjacent
			H5 Total Left	*	
III	Low	.229	M1 Extraversion	*	
	High	.378	V1 Pragmatist	I	Opposite
			D2 Analytic	II	Adjacent
			V4 Humanist	IV	Adjacent
			M1 Extraversion	*	
IV	Low	.289	M4 Intuition	III	Adjacent
	High	.591	M5 Thinking	II	Opposite

* non Quadrant Theory variable

Figure 8-21
Psycological Parameters Explaining Variation In Performance

RESIDUALS

A direct examination of the residuals of the scores was performed. The residuals are a measure of the deviation in the score from a predicted score determined by the SPSS Regression program. The residuals were examined in normal probability plots of the standardized residuals and scatter plots of the the residuals versus the predicted values. The normal plots showed a normal distribution of error. There was no detectable pattern in the scatter plots. This indicates that the amount of variance in the score was essentially random, without statistically detectable trends.

Each of the cells of the model was examined to determine if there were any trends in the answers. A simple histogram of the scores in each cell was constructed. These 16 histograms showed the distribution of answers was essentially the same throughout the model. Histograms of the entire high Flexibility and low Flexibility models produced similar results.

OTHER TECHNIQUES

For the sake of a clearer understanding of the data, several other observations were attempted. However, a closer look at the population produced no further explanation. An ANOVA of the scores by the participants showed some interesting points, but did not add to the clarity. The ANOVA showed that the population performed essentially the same in the low flexibility case - there was no significant difference in the means. In the high flexibility case there was some difference. Certain elements of the population did perform consistently better or worse than the rest of the population. However, there was no commonality in the characteristics of either those who did well, or those who did poorly. Of course this is to be expected from the results shown previously. An interesting point to note is that several participants who performed poorly in the high Flexibility case did very well in the low Flexibility case. The reverse was true for several participants who did well in the high Flexibility case, and poorly in the low Flexibility case. Again, no commonality in performance versus characteristics was noted.

Further examination of individual results was conducted to see if there was a detectable difference or commonality in performance across the scenarios Curves were drawn for each participant in each environment. Many of these curves showed no recognizable trend in performance as the decision situation changed. Even when allowances were made for the participant scoring poorly on the first two scenarios, due to the lack of familiarity with the type of decision, no pattern could be detected.

As previously mentioned, the researchers considered that there may be a learning curve that could help explain the large variance of the mean scores. It was anticipated that the participants quality of performance may have been lower in cells which were taken first. As the participants became familiar with the type of decision, it was anticipated that quality of the performance would increase due to a learning curve effect. The mean scores for all participants in the first two tests were compared with the mean scores of subsequent tests. Once again, there was no statistical difference in the test scores. This analysis of overall performance across the scenarios showed no significant improvement in the later scenarios over the initial scenarios. The learning curve that was anticipated did not appear as a significant trend in the data.

Although the actual time each individual took to complete each scenario was not an element of any hypothesis, it was given a cursory examination. In the same ANOVA that introduced the psychological variables as covariates, it was noticed that there was some relation between the time limitation of the scenario and the actual time to complete that scenario. When placed under a time constraint, the general trend was for the participants to use less time to complete the scenarios. In addition, the scenarios took more time to complete when more information was presented. Although participants took less time, their performance was consistent, that is, decision quality was unaffected. The increase in time to complete the decision in higher information environments may be explained by increased reading time. The faster time intervals obtained under constrained time may be indicative of a perceived need to hurry on the part of the participant. However, there appeared to be no relationship between actual time and quality of decision.

CONCLUSION

The results of this experiment show that there are significant differences in certain decision maker types performance in different environments. This is at least a partial answer to the research question, and a partial validation of the theory. The initial and susequent analysis show trends in the results, but lacked adequate significance. The next chapter will attempt to further explain reasons for these results, and make recommendations on how to improve the significance in future research.

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

The results of this research appeared to verify a substantial segment of the theory. The formost question in the minds of the researchers was why a more complete validation of the theory was not forthcoming. This chapter explains why fuller, more significant results did not appear and offers suggestions to improve future research.

After examining the results, the experiment and the theory, the authors determined that the population, the scenarios and the theory itself could hold a rationale for the end product of the thesis. Each of these areas will be looked at in turn to attempt to determine what explanations each could hold for the thesis.

POPULATION

A primary point in the population data is the similarity within the members. As described in the theory chapter, the population is heavier in the quadrant two type of individual. In addition, the quadrant four type is the least well represented. This tendency of the population to be alike may account for the similarity of results in the experiment.

The homogeneity of performance of the population could be explained by deeper analysis. In a previous section it was stated that one purpose of new research would be to discover if military decision makers function differently than those in the civilian community. Previous research seems to indicate a difference in performance in individuals of different psychological types. This experiment did not indicate this difference in performance. Hence, there maybe a difference between military and civilian test groups. Perhaps military decision makers generally make their decisions in a standard fashion. The fact that the military demands congruity in behavior and dress may extend to the way an individual approaches decision making. Since military officers have a broad base of similar experience and training, this could possibly account for the similar results of the experiment.

The population was examined in terms of motivation and desire. A survey form was given out at the end of the scenario testing. Answers from this indicate that the participants were not hostile towards the experiment or the concept of the thesis. In general, the participants rated their own performance and motivation mid-way between supremely motivated and not caring. In personal interviews, many of the participants indicated an interest in the outcome and a concern that the experiment should turn out well. Although it is not possible to measure the "care factor" present in the participants, the authors of this thesis are confident the individuals performed seriously and honestly.

Other factors may have entered into the participants performance. Such items as physical fatigue, time of day or preoccupation with other activities both personal and academic could have an influence. The experiment attempted to alleviate some of this by the short times for each session spread out over several days. In addition, a lull in the quarter academic activities was selected to give the participants the scenarios. Obviously nothing could be done about the participants personal attitudes, but problems here were probably avoided by limiting the experiment to only volunteers. Perhaps the performance would have been different if some variety of incentive was provided.

The size of the population could be a factor in explaining the results of the experiment. Because the sample in each cell of the category type was fairly small, some statistical significance in the model may have been lost. The total population of 43 when spread over four quadrants (or even 9 categories in the case of the further refined analysis) may have resulted in insufficient data to adequately analyze.

SCENARIOS

The scenarios as an instrument of measurement may be the largest potential problem. Did they in fact measure what was intended? Did they actually place a participant in a decision making situation where he would perform as he would ordinarily behave? If these scenarios do not perform as advertised, then the results and conclusions of the experiment may be invalid.

The number of participants scoring in each level of decision quality for each scenario is listed in Figures 9-1 and 9-2. Although each scenario was verified in an attempt to remove misleading statements, scenario 5C appears to be misleading when used in Low Flexibility tests. As can be seen from Figure 9-1, 21 participants of the 22 who were given this scenario in a Low Flexibility environment chose the worst solution, which yields a decision quality score of 1. One possible explanation for this may be the statements used to prioritize the items in the scenario. The possibility of other misleading statements in the scenarios may account for some of the variation in the scores.

The authors recommend that the scenarios be further tested. They should be presented to several populations, specifically civilian and other government and business types. In addition, the scenarios should be presented to as many of the different psychological types as possible. In this way, some verification other than that within this experiment may help prove or disprove the usefulness of the scenarios.

LOW DECISION FLEXIBILITY TESTS

SCENARIO CODE	1	2	3	TOTAL
5A	7	2	12	21
5B	0	0	21	21
5C	21	0	1	22
5D	8	7	6	21
8A	0	3	18	21
8B	6	3	13	22
8C	3	8	11	22
8D	0	8	13	21
11A	6	5	10	21
11B	5	4	13	22
11C	3	7	11	21
11D	9	1	12	22
14A	5	1	15	21
14B	3	6	13	22
14C	11	6	15	22
14D	1	5	14	20

Figure 9-1
Summary Of Decision Quality Scores In Each Scenario

HIGH DECISION FLEXIBILITY TESTS

SCENARIO CODE	1	2	3	4	5	6	7	8	9	TOTAL
5A	1	0	0	2	0	0	6	2	11	22
5B	3	0	0	0	1	5	0	0	13	22
5C	5	1	4	0	0	0	8	1	2	21
5D	5	0	0	0	0	0	2	3	11	21
8A	0	0	0	0	0	0	1	4	17	22
8B	0	2	0	0	1	0	6	1	11	21
8C	0	4	0	3	6	5	0	0	3	21
8D	0	0	1	0	5	4	0	2	10	22
11A	2	0	0	1	1	0	5	2	11	22
11B	0	0	1	1	0	1	6	2	10	21
11C	6	0	0	2	1	0	3	4	6	22
11D	0	1	2	1	0	0	5	1	12	21
14A	1	1	0	0	2	2	4	1	9	22
14B	1	0	0	0	2	1	2	4	11	21
14C	3	2	0	3	0	1	2	3	7	21
14D	3	0	0	0	2	1	1	11	4	22

Figure 9-2
Summary Of Decision Quality Scores In Each Scenario

THEORY

The authors have an understandable reluctance to let go entirely of this theory. Perhaps there need to be certain modifications made. Certainly past research indicates that the theory should hold. Further research into the literature and other experimental efforts may suggest directions in which to take and perhaps modify this theory.

If indeed all elements of the experiment are valid, then the results may indicate that in general military decision makers perform similarly regardless of type and situation. This concept has vast implications for the future design and implementation of Decision Support Systems and Management Information Systems.

RECOMMENDATIONS

In conclusion, several things can be done to carry this experiment further and possibly improve it. The authors believe the theory is valid. The scenarios need to be verified in increasing detail. Without good scenarios, the experiment is suspect. If the scenarios prove to be valid, then the experiment needs to be applied to larger and more varied segments of the population. Even if the scenarios are not adequate, research should continue to find a valid means of measuring the decision making process in individuals. Research in this area can only help to improve the ability of all segments of society to optimize the decision making process.

APPENDIX A

GLOSSARY

GLOSSARY

Analytic: breaking up things or ideas into parts and examining them to see how they fit together.

Artistic: enjoying or skillful in painting, drawing, music, or sculpture. Having the ability to coordinate color, design, and texture for pleasing effects.

Conceptual: the ability to conceive thoughts and ideas in your mind - to develop abstract ideas generalized from specific instances.

Controlled: being restrained, holding back, being in charge of your emotions.

Conservative: tending toward maintaining traditional and proven views, conditions, and institutions.

Creative: having unusual ideas, innovative thoughts and the ability to put things together in new and imaginative ways.

Critical: judging the value or feasibility of an idea or product. Looking for faults.

Detailed: paying attention to the small items or parts of an idea or project.

Dominant: ruling or controlling, having strong impact on others.

Emotional: having feelings that are easily stirred and displaying those feelings.

Empathetic: being able to understand how another person is feeling, and able to communicate that understanding.

Extrovert: more interested in people and things outside of self than internal thoughts and feelings. Typically, quickly, and easily exposes thoughts, reactions, feelings, etc. to others.

Financial: competent in the monitoring and handling of quantitative issues related to costs, budgets, and investments.

Holistic: being able to perceive and understand the "big picture" without dwelling on the individual elements of an idea, concept, or situation.

Imaginative: the ability to form mental images of things not present to the senses or never wholly perceived in reality; ability to confront and deal with a problem in a new way.

Implementation: being able to carry out an activity, and ensure actual fulfillment by concrete measures and results.

Innovating: being able to introduce new or novel ideas, methods, or devices.

Intellectual: having superior reasoning powers. Being able to acquire and retain knowledge.

Interpersonal: able to develop and maintain meaningful and pleasant relationships easily and with many different kinds of people.

Introvert: one whose energy is directed more toward inward reflection and understanding than toward people and things outside of self. Typically, slower to expose reactions, feelings, and thoughts to others.

Intuitive: knowing something without actually thinking it out, instant understanding without the need for facts or proof.

Logical: a method of reasoning based on knowing what to expect because of what has happened before.

Mathematical: perceiving and understanding numbers and being able to manipulate them to a desired end.

Metaphorical: the ability to understand and make use of visual and verbal figures of speech in place of literal descriptions in order to suggest a likeness or an analogy, i.e. "heart of gold".

Musical: having an interest in or talent for music and/or dance.

Organized: the ability to arrange people, concepts, objects, elements, etc. into a coherent relationship with each other.

Planning: formulating a method or means to achieve a desired end in advance of taking action to implement.

Problem Solving: having the ability to reason out solutions to difficult problems.

Quantitative: oriented to the numerical relationships and inclined towards the measurement of amounts, proportions, and dimensions.

Rational: making choices on the basis of reason as opposed to emotion.

Reader: reading a lot and enjoying it.

Rigorous Thinking: having a thorough, detailed approach to a problem.

Sequential: dealing with things and ideas one after another or in order.

Simultaneous: being able to process and make sense out of two or more mental inputs at the same time, such as visual, musical, and verbal, as well as being able to attend to two or more activities at the same time.

Spatial: being able to perceive and understand the relative position of objects in space, and the ability to manipulate them into a desired relationship.

Spiritual: having to do with spirit or soul as apart from the body or material things.

Symbolic: the ability to use and understand objects, marks, and signs as representative of facts and logical ideas.

Synthesizer: one who unites separate ideas, elements, or concepts into a newly perceived unified whole.

Technical: the ability to understand and apply engineering and scientific knowledge.

Teaching/Training: able to explain ideas and procedures in a way that people can understand and apply them.

Verbal: having good speaking skills. Being clear and effective with your words.

Writer: one who communicates clearly with the written word and enjoys it.

APPENDIX B

TABLES OF POPULATION BIOGRAPHICAL AND PSYCHOLOGICAL DATA

TABLE I

UNDERGRADUATE DEGREES OF THE TEST POPULATION

MAJOR SUBJECT	# IN POPULATION
Biology	1
Chemistry	1
Economics	2
Engineering	9
Geography	3
History	2
Management	1
Math	8
Physics	3
Psychology	2
TOTAL *	32

* information was provided on a volunteer basis

TABLE II

CATEGORIZATION OF POPULATION BY RANK, SERVICE, AND TIME IN SERVICE

TIME IN SERVICE	USAF 1LT	USAF CPT	USAF MAJ	USA 1LT	USA CPT	USA MAJ	TOTAL
2- 3	1						
4- 5		1			1		2
6- 7		3			2		5
8- 9		7			2		9
10-11		3	2				5
12-13		1	5				6
14-15		1	3				4
TOTAL *	1	16	10		5		32

* information was provided on a volunteer basis

TABLE III

PREVIOUS JOB ASSIGNMENTS

PREVIOUS JOB ASSIGNMENT	# IN POPULATION	PERCENT OF POPULATION
Pilot	22	51%
Navigator	7	16%
Other (USAF)	9	21%
Company/Battery Commander (ARMY)	5	12%

TABLE IV

POPULATION CATEGORIZED BY AGE

AGE	# IN POPULATION
23-24	1
25-26	1
27-28	3
29-30	11
31-32	4
33-34	6
35-36	4
37-38	2
TOTAL *	32

* information was provided on a volunteer basis

TABLE V

SPECIFIC BRANCH OF SERVICE

SERVICE: USAF

BRANCH	# IN POPULATION
MAC	9
SAC	16
TAC	10
OTHER	3
Subtotal	38

SERVICE: ARMY

BRANCH	# IN POPULATION
INF	2
ARM	2
ADA	1
Subtotal	5
TOTAL	43

TABLE VI

PARTICIPANT'S SCORES FROM THE MBTI

CASE	E	I	S	N	T	F	J	P
1	8	19	15	10	6	11	14	11
2	2	26	28	4	19	3	27	2
3	12	13	21	8	10	9	25	1
4	5	24	28	3	31	0	27	3
5	7	19	11	9	25	11	4	11
6	3	24	13	7	26	2	14	13
7	10	15	24	8	19	4	18	13
8	13	12	16	10	17	3	26	2
9	13	16	32	2	26	1	20	8
10	15	13	1	25	2	15	2	27
11	10	15	18	7	10	8	13	11
12	8	22	22	5	17	2	13	13
13	16	12	27	5	30	1	17	10
14	4	18	24	6	23	1	25	1
15	8	20	15	13	5	12	20	6
16	6	20	6	19	16	7	8	20
17	13	13	29	1	23	2	27	1
18	6	24	29	4	29	0	26	1
19	10	16	6	21	6	13	14	15
20	15	11	7	10	10	7	16	11
21	6	20	17	14	18	8	21	5
22	15	10	7	17	19	4	11	19
23	15	9	20	4	20	3	22	5
24	22	6	26	32	1	4	18	11
25	7	19	24	6	33	0	14	14
26	3	23	17	9	25	1	21	7
27	6	18	34	2	8	10	22	5
28	1	25	27	1	11	6	23	5
29	9	18	3	24	23	2	13	14
30	15	14	0	25	14	8	5	22
31	0	28	34	0	26	4	28	0
32	23	5	4	21	15	10	1	28
33	7	17	23	5	30	1	27	2
34	12	15	17	9	16	6	24	4
35	22	7	11	11	15	4	17	9
36	11	17	13	12	15	8	20	10
37	7	20	14	9	21	2	22	5
38	12	14	19	6	11	9	16	13
39	14	11	29	0	19	4	20	8
40	20	7	11	10	12	9	9	20
41	15	9	17	11	15	5	21	5
42	10	19	16	10	19	2	21	8
43	16	9	20	6	26	2	14	10

TABLE VII

PARTICIPANTS' SCORES FROM THE DSI

CASE	DIRECTIVE	ANALYTIC	CONCEPTUAL	BEHAVIORAL
1	59	60	93	88
2	91	93	73	43
3	58	62	76	104
4	92	98	48	62
5	72	114	75	39
6	75	102	85	38
7	87	90	88	35
8	78	102	82	38
9	85	128	39	48
10	64	72	86	78
11	78	108	63	51
12	74	97	70	59
13	82	99	64	55
14	80	103	68	49
15	75	118	72	35
16	65	80	82	73
17	86	84	69	61
18	75	84	75	66
19	74	104	78	44
20	77	104	69	50
21	76	107	67	50
22	88	77	82	53
23	88	76	68	68
24	102	63	67	68
25	91	111	63	35
26	82	92	67	59
27	84	95	61	60
28	82	76	57	85
29	72	87	74	67
30	63	87	108	42
31	71	118	62	49
32	67	75	75	83
33	95	112	63	30
34	84	104	68	44
35	91	95	54	60
36	87	70	80	63
37	80	106	63	51
38	85	78	59	78
39	94	76	72	58
40	99	89	60	52
41	83	109	68	40
42	74	89	79	58
43	112	81	57	50

TABLE VIII

PARTICIPANT'S SCORES FROM THE VI

CASE	PRAGMATIST	PURIST	IDEALIST	HUMANIST
1	60	82	65	88
2	78	100	74	43
3	78	75	68	104
4	90	105	58	62
5	90	86	75	39
6	71	102	80	38
7	58	90	108	35
8	86	110	67	38
9	78	115	66	48
10	76	70	81	78
11	101	68	72	51
12	62	100	82	59
13	106	82	69	55
14	65	98	91	49
15	87	90	61	35
16	68	80	88	73
17	81	95	66	61
18	54	91	105	66
19	75	117	74	44
20	71	78	70	50
21	74	89	88	50
22	62	98	103	53
23	88	77	83	68
24	90	71	90	68
25	109	78	76	35
26	64	85	93	59
27	71	88	67	60
28	46	91	82	85
29	89	80	88	67
30	52	71	94	42
31	55	115	91	49
32	82	68	68	83
33	74	109	67	30
34	77	81	78	44
35	82	95	63	60
36	50	85	102	63
37	98	93	53	51
38	91	90	55	78
39	97	92	69	58
40	84	72	99	52
41	63	101	82	40
42	70	94	70	58
43	108	99	57	50

TABLE IX

PARTICIPANTS' SCORES FROM THE HPSF

CASE	LOWER LEFT	UPPER LEFT	UPPER RIGHT	LOWER RIGHT	TOTAL LEFT	TOTAL RIGHT
1	87	74	72	50	107	81
2	105	116	23	17	147	26
3	107	68	47	48	116	63
4	117	93	32	39	140	47
5	86	131	38	23	144	40
6	68	114	78	24	121	68
7	87	80	60	65	111	83
8	78	119	56	27	131	55
9	90	129	35	26	146	40
10	63	47	99	120	73	146
11	101	90	54	39	127	62
12	81	132	44	29	142	48
13	83	104	45	57	124	68
14	98	138	39	181	57	38
15	92	105	39	39	131	56
16	56	78	93	56	89	99
17	84	117	26	45	134	47
18	90	93	27	42	122	46
19	68	[illegible]	57	32	123	59
20	62	65	80	102	84	121
21	78	95	[illegible]	48	115	56
22	74	95	93	39	112	81
23	105	96	51	39	134	60
24	95	98	57	23	128	53
25	89	105	71	27	129	65
26	99	92	54	53	127	71
27	87	107	42	39	129	54
28	96	105	29	39	134	54
29	72	93	87	44	110	87
30	45	84	114	51	86	110
31	110	77	47	57	124	69
32	72	36	133	80	72	128
33	90	131	44	24	147	45
34	86	107	65	50	128	76
35	111	65	39	84	117	82
36	105	83	56	45	125	67
37	93	125	41	33	145	49
38	89	104	36	42	128	52
39	105	86	33	59	127	61
40	65	110	66	54	116	80
41	122	96	38	45	145	55
42	65	114	59	53	119	74
43	68	93	65	74	107	92

TABLE X

POPULATION CATEGORIZED BY MBTI PSYCHOLOGICAL TYPES

PSYCHOLOGICAL TYPE	NUMBER IN POPULATION	PERCENT OF POPULATION
INFP	1	2
ENFP	1	2
INFJ	0	0
ENFJ	0	0
INTP	2	5
ENTP	3	7
INTJ	0	0
ENTJ	2	5
ESTJ	6	14
ISTJ	22	51
ESTP	1	2
ISTP	2	5
ESFJ	0	0
ISFJ	3	7
ESFP	0	0
ISFP	0	0

TABLE XI

DOMINANT DECISION STYLES AS MEASURED BY THE DSI

DECISION STYLE	NUMBER IN POPULATION	PERCENT OF POPULATION
Directive	9	21
Analytic	27	63
Conceptual	4	9
Behavioral	3	7

TABLE XII

DOMINANT VALUE PREFERENCES AS MEASURED BY THE VI

VALUE PREFERENCE	NUMBER IN POPULATION	PERCENT OF POPULATION
Pragmatist	12	28
Purist	19	44
Idealist	9	21
Humanist	3	7

TABLE XIII

CATEGORIZATION OF THE POPULATION BY HPSF

BRAIN DOMINANCE PROFILE	NUMBER IN POPULATION	PERCENT IN POPULATION
Lower Left	12	28
Upper Left	26	60
Upper Right	3	7
Lower Right	2	5
Left Hemisphere	38	88
Right Hemisphere	5	12

APPENDIX C

THE SCENARIOS

SCENARIO SOLUTION KEY

CODE	SCENARIO TITLE	RANK ORDERED SOLUTIONS Score: 9	8	7	6	5	4	3	2	1	3	2	1
5A	Space Weapons Platform	3	8	1	2	5	7	9	6	4	1	3	2
5B	Artic Survival	6	9	5	4	7	3	2	1	8	3	1	2
5C	Shuttle Mission Schedule	9	5	2	4	1	7	3	8	6	2	1	3
5D	Training Program Development	4	9	8	7	1	2	6	3	5	3	1	2
8A	Laser Design	1	8	4	9	2	6	5	7	3	1	2	3
8B	Desert Survival	6	5	3	7	2	9	8	4	1	3	2	1
8C	Stealth Aircraft Procurement	4	6	5	3	1	2	8	7	9	1	2	3
8D	Space Shuttle Job Priorities	5	1	6	3	8	2	4	7	9	1	2	3
11A	Communications Satellite Priorities	6	9	7	4	2	5	8	3	1	3	2	1
11B	Raft Survival	5	8	1	2	7	4	6	9	3	1	3	2
11C	Tank Procurement	1	8	3	4	9	5	2	7	6	1	2	3
11D	Obstacle Plan	5	9	6	1	4	3	8	2	7	1	2	3
14A	Nuclear Shelter Development	7	5	6	8	2	3	9	1	4	2	3	1
14B	Island Survival	1	3	9	4	7	8	2	6	5	1	2	3
14C	Missile Procurement	9	6	5	8	4	2	7	3	1	3	1	2
14D	Tank Maintenance	3	6	8	2	4	1	5	9	7	2	1	3

Space Weapons Platform Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

As the project officer of a new Space Based Weapons Platform, you must establish priorities on several components which are being considered as part of the system.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution

DECISION INFORMATION

1. Survivability of the platform against offensive strikes is a more important consideration than its own offensive capability.

2. You want to have as much flexibility as possible in your potential use of weapons. Nuclear arms can only be used on order of the President, and then only in response to a first strike.

3. Should the platform be required to move, the need can come at any point in the system's orbit. Solar power obviously requires sunlight.

4. Shielding is preferred to other defensive systems.

5. Once in orbit, the platform will be able to perform its designated function as an offensive weapons platform. It will need to change orbits only in an emergency.

TABLE I: List of Items

A.	passive deflector field	D.	long range offensive laser
B.	offensive nuclear missiles	E.	defensive type beam weapon
C.	liquid fuel propulsion	F.	solar power propulsion

TABLE II: List of Solutions

1. A E D B C F
2. A E D C F B
3. A E D B F C

TABLE I: List of Items

A. passive deflector field

B. offensive nuclear missiles

C. liquid fuel propulsion

D. long range offensive laser

E. defensive type beam weapon

F. solar power propulsion

TABLE II: List of Solutions

1. A E D C F B
2. A E B C F D
3. A E D B C F
4. D A F C B E
5. A E B F C D
6. E A F C B D
7. A E C F B D
8. A E D B F C
9. E A C F B D

Arctic Survival Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are an instructor preparing a course on arctic survival. As part of your class you must establish priorities on a set of survival items.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Personal care items are more important than environmental protection items

2. Communication items are essential in order to perform the mission, but it is even more important to survive the elements.

3. Medical attention is rarely required, however it must be made available if needed. Daily resupply of food is always essential.

4. Clothing alone is not adequate protection from the harsh environment for periods of time in excess of 8 hours.

5. Radios have a tendency to be unreliable in subfreezing weather, however flares and distress flags can be used to signal in this type of weather.

TABLE I: List of Items

A.	medicine/first aid	D.	clothing
B.	shelter	E.	signal device
C.	radio	F.	food

TABLE II: List of Solutions

1. F A B D C E
2. F A B E C D
3. F A B D E C

TABLE I: List of Items

A.	medicine/first aid	D.	clothing
B.	shelter	E.	signal device
C.	radio	F.	food

TABLE II: List of Solutions

1. A F C E D B
2. A F E C D B
3. F A E C D B
4. F A D E C B
5. F A B E C D
6. F A B D E C
7. F A D C E B
8. B F C E D A
9. F A B D C E

Shuttle Mission Scheduling Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are an Operations Officer tasked with scheduling military space shuttle missions.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. We wish to have the most highly qualified personnel included on these missions. Crew sizes, however, have been firmly established.

2. We want to get the equipment into orbit provided personnel constraints are satisfied.

3. Even though we want a maximum number of missions scheduled, they must be launched on time. There is a fixed number of days per year on which launches may be attempted.

4. It is critical that the right equipment is placed into orbit, even if that equipment does not initially function correctiy. Repairs can be made at a later date, once the equipment is in orbit.

5. Equipment must be placed in orbit even if all mission requirements are not met.

TABLE I: List of Items

A.	qualifications of personnel	D.	type of equipment
B.	capability of equipment	E.	number of missions
C.	number of people scheduled	F.	timeliness of missions

TABLE II: List of Solutions

1. C A D B E F

2. C A D B F E

3. C A D F E B

TABLE I: List of Items

A.	qualifications of personnel	D.	type of equipment
B.	capability of equipment	E.	number of missions
C.	number of people scheduled	F.	timeliness of missions

TABLE II: List of Solutions

1. C A B E F D
2. C A D F E B
3. A C F E B D
4. C A B F E D
5. C A D B E F
6. D C E F B A
7. C A F E B D
8. A C E F B D
9. C A D B F E

Training Program Development Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a staff officer charged with developing a training program which conforms to your commander's goals and the various constraints of your training facility.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. In most cases the desired training area is available. Clerical support is not always as responsive and generaly requires more coordination.

2. The commander sees computers as the way of the future and recommends them over all other forms of training equipment.

3. The method of instruction far outweighs the type of equipment used in the training.

4. Audio-visual aids should be used primarily as supplements to live instruction whenever possible.

5. Once the equipment is on hand, all other support requirements can generaly be met.

TABLE I: List of Items

A. simulators used in training	D. location of training area
B. audio-visual training	E. computers used in training
C. live instruction training	F. clerical support

TABLE II: List of Solutions

1. C B E A D F
2. C B E F D A
3. C B E A F D

TABLE I: List of Items

A.	simulators used in training	D.	location of training area
B.	audio-visual training	E.	computers used in training
C.	live instruction training	F.	clerical support

TABLE II: List of Solutions

1. C B A D F E
2. C B F D A E
3. B C D F A E
4. C B E A F D
5. E C D F A B
6. B C F D A E
7. C B A F D E
8. C B E F D A
9. C B E A D F

Laser Design Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

In designing a Laser weapon you must know certain characteristics of the Laser and the intended target. Some of these characteristics are more critical in the design of the weapon than others.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Nuclear power is essential regardless of target type.

2. It is more important to know whether a target is outside of the atmosphere than to determine its ex[illegible] [illegible]ange.

3. Knowing a target's exact range and speed outweighs the intensity of the Laser. Since you cannot kill him if you cannot sight him regardless of the strength of the weapon.

4. In the design of the Laser, equipping the weapon with a target speed tracker designator requires little effort compared with the task of equipping it with an effective range finder.

5. The condition that the power source be nuclear outweighs any specific requirements for the intensity of the Laser.

6. Once a Laser is built, it may be adjusted to compensate for the properties of a particular target to insure maximum lethality. However, the target type must be known prior to beginning the design of the weapon.

7. Exact knowledge of a target's velocity is less critical than knowing whether the target is endoatmospheric.

8. A Laser designed to engage space targets requires much more up-front planning than one designed for interatmospheric targets.

TABLE I: List of Items

A.	energy output	D.	speed of target
B.	endoatmospheric (air) targets	E.	range of target
C.	nuclear power supply	F.	exoatmospheric (space) targets

TABLE II: List of Solutions

1. C F B E D A
2. C F B E A D
3. C F B D A E

TABLE I: List of Items

A.	energy output	D.	speed of target
B.	endoatmospheric (air) targets	E.	range of target
C.	nuclear power supply	F.	exoatmospheric (space) targets

TABLE II: List of Solutions

1. C F B E D A
2. C F E A D B
3. B C A D E F
4. C F B D A E
5. F C D A E B
6. C F D A E B
7. F C A D E B
8. C F B E A D
9. C F E D A B

Desert Survival Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a student facing a survival training exercize in the desert. As part of your pre-training test you will be provided with a group of items which you must rank order.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. While a firearm will insure long term protection, it is more important to insure proper intake of liquids to prevent dehydration.

2. At this point being untrained in the edible plants in this region, it is more important to possess some form of survival rations than a means of skinning animals or digging roots.

3. Protection from wild animals is secondary to adequate daily intake.

4. In this environment an individual can survive slightly over a day at most without water and over several days without food.

5. As a means of defense, it is advisable to avoid all potentially dangerous animals in this environment. Any effort to frighten curious animals will generally cause the animal to move on.

6. Surviving the cold nights is more important than knowing your exact location.

7. Starvation, dehydration and exposure are the three causes of death in this region. Exposure is the leading cause of fatalities.

8. Orienteering can be easily accomplished during daylight using distant natural land formations, however, you are subject to wild animal attacks day and night.

TABLE I: List of Items

A.	water	D.	hand gun
B.	blanket	E.	knife
C.	compass	F.	food

TABLE II: List of Solutions

1. B A F E C D

2. B A F D C E

3. B A F D E C

TABLE I: List of Items

A. water
B. blanket
C. compass
D. hand gun
E. knife
F. food

TABLE II: List of Solutions

1. F B C E D A
2. B A D C E F
3. B A F E C D
4. A B C E D F
5. B A F D C E
6. B A F D E C
7. B A D E C F
8. A B E C D F
9. B A E C D F

Stealth Aircraft Procurement Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are an analyst on the Stealth aircraft procurement committee.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. The ability of the aircraft to get in and out of its mission area quickly is constrained by the amount of funding available for the program.

2. We are severely limited in the types of stealth producing ECM available, although we have a number of materials to use for the construction of the aircraft.

3. We would prefer to rely heavily on ECM-type techniques to achieve stealth, but we are constrained by bombing-type mission.

4. Obviously, we want to maximize the speed of the machine. This is subject to the available stealth technology.

5. There are a number of missions possible for a stealth type aircraft. These include bombing, reconnaissance, fighters etc. Current national policy and strategy suggest the primary type of mission of this aircraft would be a bombing mission.

6. We want this aircraft to meet all the mission requirements within the funding limitations fixed by congress.

7. We have a great deal of stealth technology to choose from, we can use whatever we want as long as the aircraft meets its mission requirements.

8. Many unique features must be designed into an aircraft used in a recon mission. The type of stealth material used does not affect a recon mission.

TABLE I: List of Items

A. stealth material technology
B. speed of aircraft
C. bombing mission
D. ECM stealth technology
E. recon mission
F. cost

TABLE II: List of Solutions

1. F C E D A B
2. F C E D B A
3. F C E A B D

TABLE I: List of Items

A. stealth material technology
B. speed of aircraft
C. bombing mission
D. ECM stealth technology
E. recon mission
F. cost

TABLE II: List of Solutions

1. F C D B A E
2. F C A B D E
3. F C D A B E
4. F C E D A B
5. F C E A B D
6. F C E D B A
7. C F B A D E
8. C F A B D E
9. E F B A D C

Space Shuttle Job Priorities Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a member of the Space Shuttle Planning Board.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

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DECISION INFORMATION

1. The type of mission we send up is important, but for the sake of national prestige and visibility it is even more important to maximize the amount of time the shuttle is in orbit.

2. Shuttle mission types are obviously affected by the weight limitations of the cargo, we want to meet these limitations as long as emphasis is placed on military efforts.

3. We have certain cargo limitations that must be met. These limitations however are subject to the type of mission to be launched.

4. Industry and the government in general have numerous missions they would like to see performed. These will all be assigned priorities once the military missions are performed.

5. Non-military missions are assigned priorities based on several considerations. Shuttle cargo bay capacity is not a factor in prioritizing non-military missions.

6. The various cargo limitations must be considered in light of the requirement that we maintain the maximum amount of time in orbit.

7. Any single item of cargo that is currently planned in the various mission profiles is capable of being carried in the cargo bay. The shuttle has only a limited weight capability.

8. Since there are very strict cargo limitations, we will adapt the classification of a mission to fit those requirements.

TABLE I: List of Items

A. classification of mission (ie. secret, top secret, etc.)

B. civilian mission

C. number of orbits

D. bulk (volume) of cargo

E. weight of cargo

F. military mission

TABLE II: List of Solutions

1. C F B E D A
2. C F B E A D
3. C F B D A E

TABLE I: List of Items

A. classification of mission (ie. secret, top secret, etc.)

B. civilian mission

C. number of orbits

D. bulk (volume) of cargo

E. weight of cargo

F. military mission

TABLE II: List of Solutions

1. C F B E A D

2. C F D A E B

3. C F E D A B

4. F C D A E B

5. C F B E D A

6. C F B D A E

7. F C A D E B

8. C F E A D B

9. B C A D E F

Communications Satellite Priorities Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a project officer tasked with the responsibility of establishing priorities for a new communications satellite.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. If we can get sufficient number of communication channels operating, we will be satisfied with virtually any range capability.

2. The satellite will have to be capable of handling a large number of communications channels regardless of how long it remains in orbit.

3. The satellite must be appropriately hardened but this is subordinate to the requirements for the best communication capabilities.

4. We want the satellite to meet its mission parameter requirements, but this cannot even be considered unless it is properly hardened.

5. It is very difficult to harden the exterior of a solar powered satellite. For this reason, the use of solar power is being questioned.

6. We want the satellite to maintain its orbit as long as possible but this is constrained by the added weight due to individual component hardening.

7. The maximum size of the satellite is fixed. NASA is willing to compromise added exterior hardening for additional service channels.

8. We would like to have the individual components appropriately hardened but this is subject to ensuring the transmission range is at a maximum.

9. Weight is a fairly significant limitation, as is bulk. Hardening individual components as opposed to shielding the entire satellite adds both bulk and weight.

10. One of our most important goals is to have the most effective type of power source in this satellite. This has been found to be solar power. However, solar power requires increased weight and bulk which cuts into the time the satellite can remain in orbit, which is a secondary concern.

11. We would like this satellite to be solar powered as long as the transmition range requirements are met.

TABLE I: List of Items

A.	solar powered mission	D.	shielding outer skin (exterior hardening)
B.	number of channels	E.	transmit range
C.	individual component shielding (interior hardening)	F.	number of orbits per mission

TABLE II: List of Solutions

1. B E D A F C
2. B E D C F A
3. B E D C A F

TABLE I: List of Items

A. solar powered mission	D. shielding outer skin (exterior hardening)
B. number of channels	E. transmit range
C. individual component shielding (interior hardening)	F. number of orbits per mission

TABLE II: List of Solutions

1. D B F A C E
2. B E C F A D
3. E B F A C D
4. B E C A F D
5. B E A F C D
6. B E D C A F
7. B E D A F C
8. E B A F C D
9. B E D C F A

Raft Survival Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

As part of your job as a safety officer you must prioritize what equipment would be most valuable to the survivors of a plane crash at sea. You are to assume that the survivors' inflatable life raft functions properly and that all survivors are inside the raft.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. While food is quite important, the hostility of the local sharks is of greater concern.

2. Even if your radio fails you can assume a rescue, although it may take much longer. Priorities should be established such that if this occurs you will not suffer starvation prior to being rescued.

3. Without proper shielding from the sun, you will become seriously dehydrated even if you have proper supplies to treat the ailments of this condition.

4. Certainly you wish to possess adequate food. It can take weeks for a human to starve to death. Disease and injury take their toll much quicker. You can anticipate rescue within a week or two.

5. In a ditching at sea, injuries are quite likely. Your chances of using a signaling device are better if you are healthy.

6. The area is a known habitat of sharks. The Sun is also brutal. The raft is generally secure and sturdy and provides some protection to the dangers below, but little to the danger above.

7. Even after the rescue team has spotted and acknowledged your smoke device or flares, you are still in great danger from the shark threat until you are aboard the rescue helicopter or boat.

8. Of course being rescued is primary in your mind, and you wish to possess the proper equipment. However, this will do you little good unless your personal survival needs are met.

9. The environment is quite hostile; hostile enough to outweigh personal survival needs.

10. In a tropical climate, the sun can be very dangerous. Even if the rescuers can be informed of your general location it will take them days to reach you.

11. The rescue attempt will have forces spread over thousands of square miles of ocean. It is obviously helpful to let these forces know the general area in which you are located; but being without proper charts and instruments, it is impossible for you to know your precise position. For this reason, most rescues are accomplished through visual sightings.

TABLE I: List of Items

A.	signaling device	D.	radio
B.	food	E.	shark repellent
C.	medicine/first aid	F.	cover

TABLE II: List of Solutions

1. F E C B A D
2. F E C A D B
3. F E C B D A

TABLE I: List of Items

A. signaling device
B. food
C. medicine/first aid
D. radio
E. shark repellent
F. cover

TABLE II: List of Solutions

1. F E C A D B
2. F E B A D C
3. C F D A B E
4. F E A D B C
5. F E C B A D
6. E F A D B C
7. F E B D A C
8. F E C B D A
9. E F D A B C

Tank Procurement Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a member of the committee to study the plans for procurement of the Army's new super tank.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing solution.

DECISION INFORMATION

1. We would like as large a tank as possible within the funding resource requirements.

2. The tank must be capable of packing a big punch in armament regardless of the logistical support requirements.

3. While response characteristics of the vehicle are important, equipment size parameters have a higher priority in planning.

4. The various manufacturers are nearly all capable of producing a vehicle that meets the traveling speed requirements. However, choice of a manufacturer is still a difficult decision when evaluating many other requirements.

5. There are a number of options on the size of the gun but many constraints on the size of the tank.

6. The program planners are more concerned with the procurement decisions that must be made than the size parameters.

7. The vehicle must be capable of going against certain types of weapons in very difficult terrain where it will be unable to move quickly. In this role, it is critical that the tank not present a large target. Although this mission is relatively rare, the tank must be capable of accomplishing this task.

8. There are many builders to choose from. A number of these builders are being considered. One of the primary considerations in awarding the contract is the estimated price quoted by each manufacturer.

9. We would like as fast a turnaround as possible on the resupply and recovery of the vehicle within the given funding resourses.

10. The tank will operate close to our own lines of supply. Its primary mission is to advance quick, strike deep and return before the enemy knows that it has left our lines.

11. In the evaluation of the manufacturers, some are preferred to others although all have essentially the same proposals as to the design of the armament.

TABLE I: List of Items

A. manufacturer
B. cost
C. tank resupply - recovery speed
D. movement speed
E. tank size
F. gun size

TABLE II: List of Solutions

1. B A E F D C
2. B A E F C D
3. B A E D C F

TABLE I: List of Items

A.	manufacturer	D.	movement speed
B.	cost	E.	tank size
C.	tank resupply - recovery speed	F.	gun size

TABLE II: List of Solutions

1. B A E F D C
2. A B D C F E
3. B A E D C F
4. B A F D C E
5. B A D C F E
6. E B C D F A
7. A B C D F E
8. B A E F C D
9. B A F C D E

Obstacle Plan Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a Combat Engineer on a Reforger Exercise. You must design an obstacle plan to slow down the opposing armor force. You have several types of obstacles to employ, some are more deadly than others.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Because of the added element of surprise, buried mines are more lethal to unsuspecting vehicles than wire obstacles which are generaly visible for many hundreds of meters.

2. Ditches are often mixed with scatterable mines to form an "obstacle in depth" pattern with the mines being more formidable than the ditches but both creating a greater danger than with either alone.

3. Scatterable mines are the fastest type obstacle to emplace and pose a greater threat than some obstacles which require more time to employ. Log cribs are one of the most time consuming obstacles to be constructed.

4. Linear obstacles such as trenches and wire pose a greater threat to armored vehicles than road craters which are more easily by-passed.

5. Considering linear obstacles, ditches generally require three crossing attempts before they are successfully breached. Wire requires, on the average, two attempts before breaching.

6. Minefields have the ability not only to slow the aggressor but also to possibly eliminate him and are therefore prefered to tank obstacles.

7. Tank obstacles are more formidable than barriers.

8. Buried mines are often used to supplement crater obstacles, however, the latter obstacle is less of a potential threat than the first.

9. Because of their ease of placement and removal, scatterable mines are preferred to buried mines.

10. It is easier to blow up a log-crib obstacle than fill a road crater, since the main gun of a tank can be effectively used to remove the log-crib but it requires specialized engineering equipment to fill in a crater.

11. Point obstacles such as roadblocks are more easily by-passed than linear obstacles.

TABLE I: List of Items

A. log-crib roadblocks	D. tank craters
B. tank ditches	E. scatterable mines
C. wire entanglements	F. buried mines

TABLE II: List of Solutions

1. E F B D C A

2. E F B D A C

3. E F B C A D

TABLE I: List of Items

A. log-crib roadblocks
B. tank ditches
C. wire entanglements
D. tank craters
E. scatterable mines
F. buried mines

TABLE II: List of Solutions

1. E F D C A B
2. F E A C D B
3. E F C A D B
4. E F D A C B
5. E F B D C A
6. E F B C A D
7. B E A C D F
8. F E C A D B
9. E F B D A C

Nuclear Shelter Development Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a civil disaster planning officer given the responsibility of developing a nuclear bomb shelter for your isolated base. Several factors must be considered in the design. Some factors are more important than others.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Due to the ability of radiation to propagate through the atmosphere it is more important to insure proper shielding for these hazards than to attempt to locate the shelter at a specific point.

2. While the requirement for the distance from ground zero is subject to change, the funding requirement is fixed.

3. Specific limits have been set on the total cost of this project, but only a tentative time schedule has been established.

4. Price constraints will dictate the blast hardness levels.

5. While the proposed contracts specify a minimum standard for protection of the shelter, the building construction estimates will determine which firm receives the final contract.

6. Due to the large distance from the nearest expected target, the number of people the shelter can protect is more important than the construction resources criteria.

7. The shelter will be designed to house a maximum number of people. Its location will be situated to provide easy access to the majority of the population.

8. The current philosophy is: since the shelter is not a key target, our goal is to offer adequate shelter to the maximum number of people rather than excellent protection to a select group.

9. Congress is willing to allocate additional funds to the project in order to insure the shelter accommodates the required number of personnel.

10. Further strides in radiation research are a long time in coming. Because of this, it has been decided to award contracts for the construction of the shelter rather than wait for improved radiation handling techniques.

11. Blast resistance is secondary to shelter capability due to the low probability of a direct hit on or near the shelter.

12. Having the shelter completed as soon as possible outweighs the additional protection which may be provided by allowing a much more lenient completion schedule.

13. Of the many hazards of a nuclear explosion, blast is the greatest danger for structures at the distance we expect from the impact.

14. Each of the prospective locations for the shelter is approximately the same distance from the expected points of attack, however specific protection levels must be maintained.

TABLE I: List of Items

A.	blast protection	D.	location (distance from ground zero)
B.	cost	E.	radiation protection
C.	time required to build	F.	size of shelter

TABLE II: List of Solutions

1. F B C E D A
2. F B C A E D
3. F B C A D E

TABLE I: List of Items

A.	blast protection	D.	location (distance from ground zero)
B.	cost	E.	radiation protection
C.	time required to build	F.	size of shelter

TABLE II: List of Solutions

1. B F D E A C
2. F B A D E C
3. F B E D A C
4. C F D E A B
5. F B C A D E
6. F B C E D A
7. F B C A E D
8. F B A E D C
9. B F E D A C

Island Survival Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You have crashed near an island. Your aircraft is sinking fast and you must quickly evaluate the items you need for survival.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Given the proper tools one can construct a variety of effective signaling devices.

2. Given the proper implements, you could construct a crude radio from aircraft debris that reaches the island, because of your expert Electrical Engineering background.

3. Even after successfully transmitting a rescue message one must be prepared to survive in the hostile environment many more days before rescue finally arrives.

4. Since rescue attempts may require up to several days to accomplish, it is essential that physical care items are on hand to insure survival until rescue arrives.

5. A weapon may offer protection from harmful animals, however, it is better to have medical supplies for treatment of injuries.

6. With proper tools, all physical needs can be met by making or finding physical care items.

7. The ability to a build shelter and make equipment to deal with the hostile environment outweighs the need for weapons.

8. It is more important to treat a health problem immediately rather than depend on quick rescue and subsequent medical care.

9. Medical needs can be supplied from your equipment and local vegetation. Some of the local vegetation requires uprooting, digging or cutting to properly use.

10. Short range signaling devices are only successfully used when a rescue vehicle is fairly close. Proper shelter provides more of a benefit than does such a device.

11. Natural medicines can be found from certain plants on the island. Priorities dictate that these plants be collected and stored prior to beginning work on a shelter.

12. As a last resort, a hand gun with its short range effects can be used as a signaling device.

13. Being rescued is a high priority. A hand gun is not very useful in obtaining this goal.

14. The vast majority of island rescues are initiated with distress calls via radio.

TABLE I: List of Items

A. tools
B. shelter
C. hand gun
D. signaling device
E. medical supplies
F. radio

TABLE II: List of Solutions

1. A E B F D C

2. A E B F C D

3. A E B D C F

TABLE I: List of Items

A. tools	D. signaling device
B. shelter	E. medical supplies
C. hand gun	F. radio

TABLE II: List of Solutions

1. A E B F D C
2. E A D C F B
3. A E B F C D
4. A E F D C B
5. B A C D F E
6. E A C D F B
7. A E F C D B
8. A E D C F B
9. A E B D C F

Missile Procurement Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

You are a procurement officer for a potential missile system. Several items have to be considered prior to awarding the contract.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. We want the best possible range on this missile, provided its ability to relocate is not compromised.

2. We would like to maximize the capability of the missile, but we are limited by the type of missile that is required.

3. Although we want to maximize the warhead yield, we are more concerned with whether or not the missile will be mobile.

4. We have some leeway in choosing our fuel type. Future Plans Office is definite on the numbers of targets each missile should be capable of targeting.

5. Although we have a number of choices as to the type of missile we want to build, we are more concerned with the missile's ability to engage multiple targets.

6. Congress has imposed strict guidelines to insure the safety of civilians living near the missile sites. These constraints include restrictions on the type of fuel used to propel the missile. Congress is willing to sacrifice relocatability for safety.

7. Congress is willing to accept a reduction in damage expectancy per warhead to insure that specified safety standards are maintained. This is subject to the type of missile we choose to deploy.

8. Each missile must be able to hit the required number of targets. It is also preferred that the missile possess maximum capabilities.

9. We are going against very hard targets, fairly close to our own borders.

10. The number of targets each missile must hit remains fairly constant. Our accuracy, however, continues to increase.

11. We have a large number of geographical locations where the missiles may be deployed, however, there are relatively few choices for our propulsion system.

12. The missile should be based in the best possible geographic location. This location is of course constrained by the missile's speed, its maximum time of flight and its radius of kill.

13. The maximum number of warheads would provide the most effective mission for this missile. This would also limit the possible geographic areas in which to locate the missile.

14. It is important that we maximize the range capability of this missile. There are a number of geographic locations available to aid in making this choice.

TABLE I: List of Items

A. number of warheads per missile
B. mobility of missile
C. geographical location (basing) of missile
D. yield of warhead
E. fuel type
F. range

TABLE II: List of Solutions

1. A E B D C F

2. A E B F C D

3. A E B D F C

TABLE I: List of Items

A. number of warheads per missile
B. mobility of missile
C. geographical location (basing) of missile
D. yield of warhead
E. fuel type
F. range

TABLE II: List of Solutions

1. B A C F D E
2. A E F C D B
3. E A C F D B
4. A E D C F B
5. A E B F C D
6. A E B D C F
7. E A F C D B
8. A E D F C B
9. A E B D F C

Tank Maintenance Scenario

BRIEF DESCRIPTION OF DECISION SITUATION:

SPECIFIC INSTRUCTIONS:

As a maintenance officer you have the responsibility for developing a tank maintenance program.

GENERAL INSTRUCTIONS:

You must prioritize the items listed in Table I from the most significant item to the least significant item.

This list of items is not necessarily complete, there may be other significant items that are not listed.

The decision you must make is to choose the BEST solution from the alternatives listed in Table II, after analyzing the Decision Information.

Decisions must be made ONLY on the information provided in the description of the decision situation and the additional information on the following page(s).

Do NOT rely on past experience or knowledge in choosing a solution.

DECISION INFORMATION

1. Although we want to ensure a maximum short term inventory, this is subject to the cost of the individual parts.

2. We want to maintain these tanks with as much ease of repair as possible. It is important to get them back into use. This of course depends on how much funding is available for the overall program.

3. While maintaining sufficient short term part requirements, the need for interchangability is a driving factor.

4. The interchangability of the components is a serious consideration. We will not let the cost of the individual components influence our attempts to achieve this.

5. Requests for a specific part cannot always be met even with the best inventory system. The requirement for parts to be interchangeable is therefore of prime importance.

6. We want to have as many parts stocked for repair as possible, subject to cost constraints.

7. Our goal is to minimize the number of tanks unavailable due to repair. We want the tanks to roll as soon as possible after repair is required. Most repairs are relatively simple, require one day or less to fix and use only a few short term stock parts. Major repairs are rare, usually take several weeks to fix and require some long term stock parts.

8. An adequate short term inventory should be maintained, but the cost of the program must be kept down.

9. We want to minimize the costs involved in this maintenance, but not at the sacrifice of keeping the parts interchangable.

10. It is important that the maintenance of these tanks be simple, but greater priority lies in the interchangability of the parts between tanks.

11. The number of parts stocked in the long term inventory is constrained by the amount of money we can invest in the overall maintenance program.

12. Keeping the cost of the maintenance program down must be considered. The overall program can be made or broken on the cost of the individual parts.

13. There must be an adequate number of parts on hand. Ease of maintenance depends on having these parts available.

14. Ease of maintenance must be considered subject to the constraint of adequate long term inventory of parts.

TABLE I: List of Items

A.	long term stock	D.	ease of repair
B.	interchangeability of components	E.	short term stock
C.	cost per part	F.	overall program cost

TABLE II: List of Solutions

1. B C F E D A

2. B C F E A D

3. B C F A D E

TABLE I: List of Items

A. long term stock
B. interchangeability of components
C. cost per part
D. ease of repair
E. short term stock
F. overall program cost

TABLE II: List of Solutions

1. B C A D E F
2. B C E A D F
3. B C F E A D
4. B C E D A F
5. C B A D E F
6. B C F E D A
7. F B D A E C
8. B C F A D E
9. C B D A E F

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VITA

Captain Michaël J. Bonometti was born in Dumont, New Jersey on 26 September 1957. He graduated from high school in Dumont, New Jersey in 1975. He earned a Bachelor of Science in Mathematics from Seton Hall University in 1979. He recieved his commission in the US Army through the ROTC program upon graduation. He served as Platoon Leader, Executive Officer and a Company Commander with the 864th Combat Heavy Engineer Battalion at Fort Lewis, Washington prior to attending the Air Force Institute of Technology, School of Engineering in August of 1983.

Permanent address: 42 Lenape Trail
Bricktown, NJ 08724

VITA

Captain Colt A. Mefford was born on 7 February 1953 in Fresno, California. He graduated from high school in Rancho Cordova, California in 1971. He went on to graduate with a Bachelor of Science in International Affairs from the United States Air Force Academy in 1975. After completing Missile Initial Qualification Training that November, he served four years at Malmstrom AFB, Montana as Minuteman Modernized Missile Combat Crewmember, Combat Crew Commander and Instructor. Until entering the School of Engineering at the Air Force Institute of Technology in August of 1983, he was a Combat Crew Training Squadron Instructor and Courseware Development Section Chief at Vandenberg AFB, California.

Permanent address: 10372 Dolecetto Dr.
Rancho Cordova, CA 95670