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AN ANALYSIS OF SELECTED CHARACTERISTICS OF THE INDIVIDUAL AND HIS INFORMATION PROCESSING BEHAVIOR

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AN ANALYSIS OF SELECTED CHARACTERISTICS OF THE INDIVIDUAL AND HIS INFORMATION PROCESSING BEHAVIOR

APPROVED BY

DISSERTATION COMMITTEE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

Organizational management may be viewed as a system. When it functions without human values it takes on the character of an efficiency expert. However, when it functions around a system of human values, it takes on the character of inspiring leadership. All facets of an organization's daily operations are determined by the ability, motivation and overall efficiency of its human element, and all decisions of any institution are initiated and implemented by the individuals who constitute the human side of organization.

It is my hope that this study will be of interest to all who are involved with the problems in the field of management. I also hope that this dissertation will stimulate students and professional people in business administration who are concerned with information-processing behavior.

Many people have helped with the work incidental to the preparation of this dissertation. I would like to acknowledge my gratitude to my Chairman, Dr. Doyle Bishop, David Ross Boyd Professor of Management, University of Oklahoma, who gave as thorough and constructive critique of the manuscript as any author could ask. His insights and suggestions were of utmost importance in the development of this study.

I would like to express my gratitude to Dr. Thurman White, Vice President for Continuing Education and Public Service at the University of Oklahoma and his staff for allowing me to research and analyze the materials used in the study. Dr. White gave me his encouragement and the opportunity to study continuing education problems as they arose in concrete situations.

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Portions of the manuscript were typed by Mrs. Gloria Boyd and the final drafts were typed by Mrs. Lucy Weaver. To them I wish to express my grateful thanks for their competent assistance, and helpful dialogue.

To all of these who helped I express my thanks, but my particular thanks are extended to my family, my wife Maria M. Spruell, who was ready to do whatever was needed whether it was collecting data, editing, or working with me on this volume, contributing to the insights and interpretations presented, and for her patience and understanding during my endeavor to complete this dissertation. To my daughters, Karen and Susan who gave their special encouragement throughout the study.

I alone am responsible for any errors the reader may find, and I hope he will take the time to draw my attention to them.

C. E. S.

CHAPTER I

INTRODUCTION

The unparalleled growth in the amount of information available in recent years has precipitated extensive research. A large share of this research has centered around information systems which have been developed to cope with the problems associated with the information explosion. As one author notes, "If the phrase 'information technology' is not yet part of our vocabulary; if we are still unconcerned about the new 'information society' into which we are playing - that may well measure the current gap in our knowledge about information."[1] Hence, in the study of organizational decision making the information system is an important variable and the individual user of information is a vital element in any information system, formal or informal.

Since the role of information processing in the decision process is well substantiated, "A possible linkage between explanatory individual and situational variables and information-processing variables appears to be a meaningful

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[1]Charles M. Darling, III, "Confronting the Information Society," CBS Public Affairs Forecasting and Planning, The Conference Board Record (March, 1972), p. 24.

area of investigation."[2] In his review of information-processing research literature, Paisley observes that many studies are mutually duplicative but that no visible effort has been made to replicate research methods. Hence, due to conceptual and methodological variation, it is difficult to compare various research projects in any useful way. The result is that there is an extensive collection of case studies whose findings can be compared only if a ceteris paribus assumption is made to cover the gross differences in procedure.[3]

The main objective of this study was to conduct an investigation of the possible linkage between individual and situational variables, and information-processing variables in solving problems associated with the research and development of continuing education projects and programs. More specifically, by utilizing the specific methodology and system of variables (see Figure 1) used by Cravens in an industrial research and development environment with graduate student research subjects, an attempt was made to reproduce the results of his study in a continuing education environment utilizing professional personnel as research subjects. If

[2]David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 24.

[3]W. J. Paisley, The Flow of (Behavioral) Science Information: A Review of Research Literature (Stanford, California: Stanford University Press, Institute for Communication Research, 1966), p. I-1.

these findings can be reproduced in different environments using different type research subjects, there is a possibility that the complexities of the individual, the task, and his resulting information-processing activities can be abstracted into a conceptual model which would be useful in describing individual information-processing behavior. Various research approaches used to gain insight into these problem areas are delineated and the organization of the research effort is discussed in chapter sequence for the remaining chapters.

Purpose of Study

According to DeCarlo our modern society is based upon information; information is the cornerstone of the world.[4] Machlup indicated that information in this context is closely linked to knowledge: "Linguistically, the difference between knowledge and information lies chiefly in the verb form: to inform is an activity by which knowledge is conveyed; to know may be the result of having been informed. 'Information' as the act of informing is designed to produce a state of knowing in someone's mind; 'information' as that which is being communicated becomes identical with 'knowledge' in the sense of that which is known. Thus, the difference lies not in the

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[4]Charles R. DeCarlo, "Perspectives on Technology," in Technology and Social Change, ed. by Eli Ginzberg (New York: Columbia University Press, 1964), p. 13.

nouns when they refer to what one knows, or is informed about; it lies in the nouns only when they are to refer to the act of informing and the state of knowing, respectively."[5] Information plays a key role in our society, irrespective of whether one defines "information" in a broad sense and maintains that information is only part of knowledge, or whether one defines information in the dynamic sense, as Machlup did.

Since the individual is a vital element in any information system, the goal of an information system should be to effectively link the user with the applicable information base in a manner which matches relevant information with needs. The individual user of information has been the subject of several studies but the body of knowledge that has been developed relative to the task-oriented, information-processing activities of individual problem-solvers in terms of the influences on what information is sought, what the problem-solver does with the information, and the relationship of this information to the results achieved by the individual problem-solver is relatively small.

As noted by Cravens, when a decision is analyzed information processing seems to play a vital role in an individual's decision process, ranging from recognition of a problem to its

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[5]Fritz Machlup, <u>The Production and Distribution of Knowledge in the United States</u> (Princeton, New Jersey: Princeton University Press, 1962), p. 15.

solution.[6] Yet the state of knowledge concerning the decision-maker as a processor of information is limited. To gain a better understanding of this complex relationship answers to a number of questions noted below, as well as other relevant questions, were sought.

1. What is the overall impact of the group of independent variables (Individual, Task, and Individual/Task) on the sets of dependent (Information Processing) variables in each of the information-processing phases?
2. What is the degree and direction of influence of each group of independent variables on the various sets of dependent variables?
3. Are the three groups of independent variables--individual, the task, and individual/task interaction--correlates of individual information processing?
4. What is the relative importance of the variable Risk-Taking Propensity as opposed to the variable Information-Processing Efficiency in describing information search behavior?

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[6] David W. Cravens, "An Exploratory Analysis of Individual Processing," Management Science, Vol. 16, No. 10 (June, 1970), B-657.

Professor Cravens has provided some insight into the above questions through research in an industrial research and development environment.[7] However, as he notes, the results of his research are not operational, in that they cannot be moved intact to some immediate area of application. The thrust of this research is further empirical research in a Continuing Education environment while using Professor Cravens' methods as a base.

This research study is divided into three parts. The three related areas of research reviewed are the individual thinking processes, information processing, and the decision-making process. Part One is a review and evaluation of related research. Part Two is concerned with the conceptual system of variables used and identifying potential relationships of these variables with each other through empirical research. Part Three presents the specific methodology used and the techniques used to analyze the empirical data.

Definition of Terms

Throughout this study certain words and phrases are used often and for continuity of meaning the following definitions are presented:

1. Information Element - The smallest identifiable unit of relevant information processed

[7]Cravens, "An Exploratory Analysis of Individual Processing," B-666.

for a particular task. The element would lose its identity and meaning with respect to the task if segmented further.[8]

2. Structured Diary - A record of information sources in which each research subject records the various sources utilized in a task as well as the amount of time devoted to each source.

3. Individual Problem-Solver - The individual who actually carries out tasks as opposed to those responsible for accomplishment of tasks and other individuals who may have input into the solution of a problem.[9]

4. Tasks - Identifiable jobs or sub-parts of larger projects capable of being completed within the time span and scope of this study.

5. Information-Processing - The total time path taken by an information element from the initial search through the conclusion of a task.[10]

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[8]Auerbach Corporation, DOD User Needs Study, Phase 1, Vol. 1 (AD-615501), May, 1965 (Philadelphia: Auerbach Corporation, 1965), B-13.

[9]Cravens, An Exploratory Study of Information Processing and Decision Making, p. 58.

[10]Ibid.

6. Individual's Image State for a Task - Ammerman defines an "Individual's image state for a task" as being all of the accumulated, organized knowledge that an individual has about himself and his environment.[11]

Hypotheses To Be Tested

In order to provide answers to the above questions and to achieve the objectives of this research study, the following testable hypotheses have been formulated:

1. There is a significant relationship between the set of independent variables from the decision-maker, task, and individual-task interaction domains and the set of dependent variables from the information-processing domain. This hypothesis is designed to ascertain the overall impact of the group of independent variables (individual, task, and individual/task interaction) on the dependent (information-processing) variables; that is, the possible linkage between explanatory individual and situational variables

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[11]Harry L. Ammerman, A Model of Junior Officer Jobs for Use in Developing Task Inventories, Technical Report 65-10 (Alexandria, Va.: George Washington University, Human Resources Office, November, 1965), p. 13.

and information-processing variables in solving problems associated with the research and development of education programs and projects.

2. Years of experience and performance on the present job are idiosyncratic characteristics of the decision-maker which significantly influence an individual's information-processing behavior. Factors such as age, sex, education, experience, job level, and job type are also possible idiosyncratic variables. The Cravens' study findings reflect that for a given population certain idiosyncratic characteristics will vary while others remain relatively constant and suggest years of experience and job performance as relevant dimensions of variation.[12]

3. Characteristics related to the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables.

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[12] Cravens, An Exploratory Study of Information Processing and Decision Making, p. 70.

4. The correlation between the independent (task and individual/task variables) scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task with the dependent (information-processing variables) is not significant. Therefore, these selected independent variables do not significantly influence the individual decision-maker's information-processing behavior.

5. In describing an individual's task-oriented information-processing behavior, those individual problem-solvers identified as risk-takers by Kogan and Wallach's Choice Dilemma Test[13] tend to be relatively inefficient as processors of information as opposed to those individual problem-solvers identified as risk-evaders.

6. Individuals with relatively low task result ratings utilize fewer available internal sources of information where their image states are high at the outset of a task.

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[13] Nathan Kogan and Michael A. Wallach, Risk Taking: A Study in Cognition and Personality (New York: Holt, Rinehart and Winston, 1964), p. 199.

> Individual problem-solving behavior of this type appears to be consistent with Cyert and March's assumption that problemistic search by the individual " . . . proceeds on the basis of a simple model of causality until driven to a more complex one."[14]

<u>The Sample</u>

The University of Oklahoma Center for Continuing Education (OCCE) was selected as the research site for this study. In coordination meetings with top management officials at the Oklahoma Center for Continuing Education these officials agreed to cooperate in the research study. Since the nature of the research methods required close coordination between the researcher and the research subjects, the physical proximity of the Center also made it a desirable location.

Formal recognition was extended to the Center by the National University Extension Association (NUEA) in 1913. In 1958, a grant from the Kellogg Foundation and additional Oklahoma State and bond funds were combined to finance the construction of the Center. At the time of the construction the Center was considered as one of the five outstanding

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[14]Richard M. Cyert and James G. March, <u>A Behavioral Theory of the Firm</u> (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963), p. 121.

residential centers for continuing education in the world. Today, the Continuing Education Center is attentive to the needs of adults who live in all 77 counties of Oklahoma and to the needs of adults in the public services throughout the nation and the world.[15]

The basic goals and functions of the Oklahoma Center for Continuing Education are to assist:

1. Groups (e.g., voluntary associations, communities, governmental agencies, business, and industry) in learning and applying solutions to problems.
2. Individuals and groups in keeping abreast of new knowledge related to the solution of social and economic problems and to the maintenance and advancement of competence in professional, scientific, and technological fields.
3. Adult, part-time students in pre-professional or career development by making available to them the traditional knowledge of the University.
4. Individuals in gaining knowledge related

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[15]"Continuing Education and Public Service," undated, prepared by members of the Office of Assistant Vice President for Continuing Education and Public Service (in the files of the Center).

> to their development tasks, their changing life roles, and personal development.[16]

In order to carry out the goals and functions stated above, the program elements of the Center are grouped into five basic programs: General Administration (or, Office of the Vice President); Delivery Systems; Public Service Programs; Professional Development; and General Education and Personnel Development Programs. There are 145 full-time professional personnel employed by the Center. At the time of this study 22 of these individuals were classified as Program Development Specialists, Supervisors of Instruction, or Field Consultants. One person in the Educator's In-Service Training and Teacher's Corps Program who is based in Oklahoma City and because of the particular type of duties he performs was unable to participate in the study. Four of the persons classified as Supervisors of Instruction are functioning as instructors on a day-to-day basis with no variation in their duties. A decision was made to exclude this group from the study. Hence, seventeen of the 22 individuals classified as Program Development Specialists, Supervisors of Instruction, and Field Consultants were selected as subjects for this study.[17]

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[16]"Program Budgeting - Continuing Education and Public Service," undated, prepared by members of the Office of Assistant Vice President for Education and Public Service (in the files of the Center), p. 1.

[17]*Ibid.*, p. 4.

The professional employees selected as research subjects administer sub-elements of programs which are in turn administered by program managers or project directors. They operate as professionals, making judgements within their assigned areas without the need for day-to-day supervision of the program managers or project directors to whom they report.[18]

Program Development Specialists, Supervisors of Instruction, and Field Consultants serve as reasonable representatives of professional decision-makers in centers for continuing education in that each has an advanced degree, either at the master or doctoral level, and professional experience. Further, their work responsibilities require professional competence and the job commitment is important for both financial and professional reasons.

Scope and Limitations

By utilizing the specific research methodology and system of variables utilized by Cravens[19] in an industrial research and development environment an attempt was made to reproduce the results of his study in a continuing education environment. While it may not be possible to generalize the

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[18]"Continuing Education and Public Service Title and Salary Plan - Professional and Administrative," undated, prepared by members of the Office of the Assistant Vice President for Continuing Education and Public Service (in the files of the Center), p. 1.

[19]Cravens, An Exploratory Study of Information Processing and Decision Making, p. 52.

results obtained from this research effort to the total population of professional employees in all environments, or to all organizational structures, in those instances where the findings of this research effort support the findings of the Cravens study, the possible linkage between individual and situational variables, and the information-processing variables may be established via a conceptual model which would be useful in describing the information-processing behavior of individual decision-makers in other environments.

Certain other limitations of this study must also be noted. First, a breakdown of an individual's information-processing activities into phases involves the risk inherent in characterizing a dynamic, continuous process as a sequence of discrete phases or steps. However, this approach seems necessary to get at the structure and interrelationships of the total process.

Secondly, the information-processing activities of an individual are not necessarily sequential, in that orderly processing of each element may not occur. A given element may wait at a certain stage while the individual problem-solver moves back to a previous stage to assess another element. Therefore, it is important in the analysis of information-processing behavior to identify each information element and record it when it is received by the decision-maker. This procedure permits recycling and doubling back in the problem-solving process.

Thirdly, the choice of variables from the decision-maker domain, the task domain, and the decision-maker/task interaction domain is open to a wide range of possibilities. However, since the stated objective of this research effort is to replicate the specific research methodology used by Cravens[20] to investigate the relationship between explanatory individual and situational variables, and information-processing behavior in solving problems, the choice of variables is the same as those variables used in the Cravens study.

Organization of Study

Chapter I, Introduction, is a review of the purposes of the research, definition of terms used in the study, a brief description of the research methodology, along with the scope and limitations of the study.

Chapter II, Review of Related Research, is a review of research related to, or concerned with the area of decision making, and more specifically, research that is concerned with the information-processing behavior of the individual decision-maker. Of particular interest is the research that has been done by Cravens in developing his conceptual framework for

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[20] Cravens, An Exploratory Study of Information Processing and Decision Making, pp. 85-119.

examining the individual, task-oriented, information-processing behavior as a multi-stage process,[21] and the research done by Ference in developing his general model for the emergence and solution of organizational problems.[22]

Chapter III, Data Collection and Analysis Procedure, describes the methodology used to collect the research data beginning with the initial orientation meeting of the research subjects, review of data collection instruments with each research subject, assistance given to subjects in completion of sample data collection instruments, and conduct of the research project. A description of canonical correlation analysis which was used to analyze the data collected is also included in this chapter.

Chapter IV, Relationship between the Decision-Maker, Task and Individual-Task Interaction Domains Variables and the Set of Information-Processing Variables, is a description of the findings and the procedures used to analyze empirical data collected concerning the decision-maker, task, and individual-task interaction domains and the set of information-processing variables. The primary purpose of this chapter is to test the hypothesis that, "There is a significant relationship between the set of independent variables from the

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[21] Cravens, "An Exploratory Analysis of Individual Processing," B-656-B-650.

[22] Thomas P. Ference, "Organizational Communications Systems and the Decision Process," Management Science, Vol. 17, No. 2 (October, 1970), B-83-B-96.

decision-maker, task, and individual-task interaction domains and the set of dependent variables from the information-processing domain." A summary of the findings and conclusions concerning this hypothesis is reported.

Chapter V, Relationship between Selected Variables Within the Decision-Maker, Task, and Interaction Variables (Independent Group) and the Information-Processing Variables (Dependent Group), describes the procedures used to test three hypotheses: (1) Years of experience and performance on the present job are idiosyncratic characteristics of the decision-maker which significantly influence an individual's information-processing behavior; (2) Characteristics related to the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables; and (3) The correlation between the independent variables (task and individual/task) scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task with the dependent variables (information-processing) is not significant. Therefore, these selected independent variables do not significantly influence the individual decision-maker's information-processing behavior. A summary of the findings and conclusions concerning each of these hypotheses is reported.

Chapter VI, Individual Problem-Solvers and Problemistic Search, contains a description of the procedures used to test two hypotheses: (1) In describing an individual's task-oriented information-processing behavior, those individual problem-solvers identified as risk-takers by Kogan and Wallach's Choice Dilemma Test[23] tend to be relatively inefficient as processors of information as opposed to those individual problem-solvers identified as risk-evaders; and (2) Individuals with relatively low task result ratings utilize fewer available internal sources of information where their image states are high at the outset of a task. Individual problem-solving behavior of this type appears to be consistent with Cyert and March's assumption that problemistic search by the individual " . . . proceeds on the basis of a simple model of causality until driven to a more complex one."[24] A summary of the findings and conclusions concerning each of these hypotheses is reported.

Chapter VII, Summary and Conclusions, contains the summary and conclusions of the study. A statement of the implications of the findings for management in the area of decision making is included. Specifically in the information-search stage of a decision which has traditionally been viewed as a particular stage of decision making rather than reflecting information-search as a multi-stage activity consisting of search, receipt, evaluation, and integration of information into an individual's problem-solving process. The results of the study are presented in a manner designed to make top

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[23]Kogan and Wallach, op. cit.

[24]Cyer and March, op. cit.

management aware of the vital role that information-processing plays in an individual's decision process, ranging from recognition of a problem to its solution. Suggestions for additional research in the information-processing area as it relates to the individual decision-maker are also included.

CHAPTER II

REVIEW OF RELATED RESEARCH

Related research may be classified into three major areas: the decision-making process; the individual thinking processes; and information processes. Information-processing characteristics and those individual information-processing characteristics which influence the processing of information relative to a given task are of primary interest. It should be noted that related research reviewed in this chapter does not fit neatly into an orderly body of knowledge related to individual information-processing and decision making. Nevertheless, a relationship between certain of these studies and this study can be established.

Decision-making Process

Research efforts in the area of decision making are extensive and no attempt was made to offer a comprehensive discussion of this broad base of research. Studies which examine decision-making, or problem-solving, as a multi-stage process are of primary importance. Efforts were directed toward conceptualizing a decision process and to classification of levels, or types, of decisions with special emphasis on variables which are important in the decision process.

Simon notes that decision making, in terms of an analytical concentration on the final outcome, ignores the total, lengthy, complex process of altering, exploring, and analyzing which precedes the final moment of decision. Analyzing a decision in terms of a process permits the decision to be examined via multi-stage elements rather than to consider why the outcome.[1] He further characterizes the decision-making process as searching the environment for conditions calling for decisions and as inventing, developing, and analyzing possible courses of action, then selecting a particular course of action.[2] According to Simon's classification of decisions, programmed decisions are repetitive and routine to the degree that definite procedures are indicated for handling them when they occur. Whereas, non-programmed decisions are those decisions of which the decision "system has no specific procedures to deal with situations like the one at hand but must fall back on whatever general capacity it has for intelligently adaptive, problem-oriented action."[3]

In an exploratory study of the relationships between the decision process, personality, and social structure, Brim, et al. utilized 200 subjects and examined 50 variables

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[1] Herbert Simon, The New Science of Management (New York: Harper and Brothers Publishers, 1960), p. 1.

[2] Ibid., p. 2.

[3] Ibid., p. 6.

which centered on the decision-process phases of evaluation of alternatives and strategy selections. Ten descriptive variables were used at each stage in this study to relate decision-process variables (dependent) to personality and social structure variables (independent). The study was process-oriented; however, observations were made at one point in time. Many potentially useful guidelines concerning the decision-process variables, relationships, and methodology are offered by this study.[4]

Brim, et al. identify the stages of a decision process as consisting of: identification of the problem; obtaining necessary information; production of possible solutions; evaluation of these alternatives; selection of a particular strategy (alternative), actual performance of action, or actions; and subsequent learning and revision.[5]

The process point of view appears to be well established and consistent with respect to various researchers. Katz and Kahn view the decision-making process as: immediate pressures on the decision-maker; analysis of the type of problem and its basic dimensions; the search for solutions and the consideration of the consequences of alternative solutions leading up to the final choice; and post-decisional

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[4]Orville G. Brim, Jr., et al., Personality and Decision Processes (Stanford, California: Stanford University Press, 1962), p. 9.

[5]Ibid.

conflict.[6] Applewhite offers an extensive review of the literature on decision making and cites the work of Litchfield which identifies the decision-process activities as definition of the problem, analysis of the existing situation, calculation and delineation of alternatives, deliberation, and choice.[7]

The viewpoints of the above authors concerning the process viewpoint of decision making, and other process viewpoints, differ in degree rather than in substance. As reflected by Brim, et al., the situation and the point of view taken determines the specific steps or phases of the decision-making process.[8] The following items were mentioned by Brim, et al. relative to formulation of the decision phase:

1. A particular decision may not involve all of the identified phases. For example, certain problems or tasks may not require obtaining new information. (All relevant information may be contained in the knowledge state of the individual or group seeking a solution to a problem.)

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[6]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations (New York: John Wiley and Sons, Inc., 1966), p. 274.

[7]Philip B. Applewhite, Organizational Behavior (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965), p. 56.

[8]Brim, et al., op. cit., p. 10.

2. The conceptualization of decision-process stages applicable to the analysis, in terms of basic phases of the process, points up the similar nature of all decision problems.
3. There seems to be a linkage between decision-process conceptualization and general intellectual functions, such as insight, judgment, and intelligence.
4. Problem-solving and the decision process seem to be much the same and tend to be used interchangeably.[9]

Also noted by Brim, et al. is that "A theoretical classification which exhausts the characteristics of decision processes is a major undertaking--a study in itself."[10] In view of this situation, no attempt to exhaustively identify the possible characteristics or dimensions of variations of a task or decision problems will be made. However, Brim, et al. did classify decisions according to two groupings, "formal properties (theoretical and abstract characteristics of decisions which are independent of content or the substantive nature of the problems), and substantive characteristics (such as economic problems, administrative decisions, career choices, and mate selection)."[11]

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[9] Brim, et al., op. cit., p. 10.

[10] Ibid., p. 14.

[11] Ibid.

Classifications based on formal or abstract properties are numerous. Characteristics utilized by Brim, et al. in their study are the degree of certainty of outcome, state of nature (competitive, cooperative, and neutral); type of cost involved; repetitive play versus nonrepetitive performance; revocable versus irrevocable consequences; method of choice versus single stimuli; and single or multiple significant classes of outcome.[12]

Substantive properties classifications have typically been based on the social context, or role, in which the decision occurs. Brim, et al. maintain that "this is because roles include customs or rules for how one should attempt to solve a problem."[13] Decision-making guides, or decision rules, which provide lists of factors to consider, such as used in finance, advertising, and cost accounting, are in this classification.

Brim, et al. take notice that the particular norms which regulate the decision-making process in different occupational roles are not very well known.[14] However, several other authors who made studies in the fields of education, medicine, business, and public administration offer strong arguments which imply a commonality in form, if not in substance, in the four fields studied.

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[12] Brim, et al., op. cit., pp. 15-17.

[13] Ibid., p. 17.

[14] Ibid., p. 18.

Dimock and Dimock, writing in the field of public administration, discuss the five phases of decision making as: (1) defining the problem; (2) analyzing the problem; (3) identifying alternative solutions; (4) deciding on the best one; and (5) then implementing it. They also note that "A point often overlooked is that, whereas most decision making is primarily problem solving, or asking the right questions, important decision making deals with strategy. It is decisions of this kind that really matter, not the tactical ones that are merely routine. Decisions on strategy deal with questions such as how to meet goals, keep friends, survive, and grow."[15]

In the field of education Campbell, Corbally, and Ramseyer make almost the same statement. They approach the problem by discussing irrational and rational decision making and conclude that as a practical matter we should be concerned with rational decisions. "Whatever the decision is, the issues and problems involved must first be clarified (problem must be defined). Secondly, the existing situation must be analyzed, often requiring the gathering and interpretation of data. Finally, a choice must be made; a course of action must be determined."[16]

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[15]Marshall E. Dimock and Gladys O. Dimock, Public Administration (3d ed.; New York: Rinehart and Co., Inc., 1964), p. 135.

[16]Ronald F. Campbell, John E. Corbally, and John A. Ramseyer, Introduction to Educational Administration (Boston: Allyn and Bacon, 1966), p. 139.

Writing in the field of medicine, Haimann approaches the decision-making problem similar to Campbell, et al. in the education field. He defines the problem-solving process as: (1) defining the problem; (2) analyzing the problem; (3) developing all the alternatives you possibly can, thinking them through as if you had already put them into action, and considering the consequences of each and every one of them; and (4) choosing the one which has the greatest amount of wanted and least amount of unwanted consequences.[17]

In the field of business Newman defines a similar process for the phases of decision making. Based on his research, he notes that decision making involves four basic phases: (1) diagnose the problem properly; (2) conceive of one or more good solutions; (3) project and compare the consequences of such alternatives; and (4) evaluate these different sets of consequences and select a course of action.[18]

The difference between various types of problems has been identified, using many different approaches. The various types of economic decision problems have been classified by Cohn and Cyert, using three dimensions: (1) time; (2) the degree of information (certainty, risk, and uncertainty);

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[17]Theo Haimann, Supervising Management for Hospitals and Related Health Facilities (St. Louis: The Catholic Hospital Association, 1965), p. 31.

[18]William H. Newman, Administrative Action (2d ed.; Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 105.

and (3) the degree of rationality.[19] A distinction between programmed decisions and nonprogrammed decisions is made by Simon, which suggests that these types of decisions are polar types spanning a continuum.[20] Katz and Kahn classify decision making according to the following decision dimensions: (1) level of generality or abstraction; (2) amount of internal and external organizational space affected; and (3) the time span of influence of the decision.[21] Further, they indicate that the stages in the decision process are influenced by the nature of the problem, the organizational context, the basic personality characteristics of the decision-maker, and the cognitive limitation of individuals with respect to situational and personality factors.[22]

A model made up of factors involved in determining total decision success has been formulated and tested by Trual. "His model suggests that decision success can be considered a function of decision quality plus implementation. One of the factors in the model is the 'optimum amount of information' which suggests a way to link information with decision results.[23]

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[19]Kalman J. Cohn and Richard W. Cyert, Theory of the Firm: Resource Allocation in a Market Economy (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965), p. 308.

[20]Simon, op. cit., p. 5.

[21]Katz and Kahn, op. cit., p. 259.

[22]Ibid., p. 274.

[23]David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 24.

Morris conducted a research program on negotiation and decision making in which the effects of task characteristics on the group process were studied. The research effort involved 100 tasks, and observations were accomplished on 108 three-man groups with each group handling four tasks. The objectives of the study were to help clarify the role of task characteristics in group performance; provide detailed information concerning patterns of interaction behavior in task groups; and establish a matrix of baseline data which could be utilized as a normative reference base for studying the effects of task, group structural, and compositional variables. The task characteristics (production problem solving) and the level of task difficulty were the primary concerns of the Morris study.[24]

Individual Thinking Process

The objective of this part of the related research is to identify and review research that provides useful conceptual insights and identification of individual variables which impinge upon the human thinking processes as these relate to problem-solving behavior, and in turn, to information-processing behavior.

It is important to note that there appears to be no generally agreed-upon grouping of areas in the literature with respect to cognitive-judgemental, intellective, and

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[24]Charles G. Morris, Effects of Task Characteristics on Group Process, Technical Report No. 2, AFOSR-65-1519 (Urbana, Ill.: University of Illinois, Department of Psychology, 1965).

personality processes. For example, some researchers group all three under personality characteristics.[25] Kogan and Wallach, in their study of 114 male undergraduates and 103 female undergraduates who attended two similar noncoeducational private colleges, used the cognitive-judgemental, intellective, and personality process groupings. "The research subjects were located in one of four subgroups, on the basis of the moderator variables of test anxiety and defensiveness. Human thinking and problem solving were examined from the viewpoint of the risks, potential costs, and potential gains that may face the individual as he proceeds with his problem-solving efforts."[26]

Verbal comprehension, conceptual foresight, originality, and sensitivity to problems, as these relate to intellectual ability, appear related to problem solving.[27] In the Kogan and Wallach research the relationship between risk-taking and three types of intellective skills is examined. These intellective skills are verbal aptitude, mathematical aptitude, and analytic functioning. Conclusions of the Kogan and Wallach research did indicate the existence of relationships between the intellective correlates and decision-making behavior but suggest that the direction of

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[25]Cravens, op. cit., p. 26.

[26]Kogan and Wallach, Risk Taking: A Study in Cognition and Personality, pp. 21-32.

[27]Applewhite, op. cit., p. 71.

causation may move from risk-taking disposition toward certain of the intellective skills. "The empirical evidence, although indirect, is highly supportive of such an interpretation."[28]

Earlier research, as noted by Brim, et al., indicates that the relationship between intelligence and problem solving is moderate to negligible. "These data suggest that decision-making characteristics probably depend much more on individual differences in training, and on the effects of temperament and personality which regulate the use of various intellective factors, rather than on such factors themselves."[29]

Cognitive processes, as defined by Bruner, Goodnow, and Austin, are the means whereby organisms achieve, retain, and transform information.[30] The concept of attainment as viewed by these authors is a series of decisions. Their objective in studying concept attainment was to "externalize for observation as many of the decisions as could possibly be brought into the open, in the hope that regularities in these decisions might provide the basis for making inferences about the processes involved in learning or attaining a concept. These regularities in decision making we shall call strategies."[31]

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[28]Kogan and Wallach, op. cit., p. 120.

[29]Ibid., p. 121.

[30]Jerome S. Bruner, Jacqueline J. Goodnow, and George A. Austin, A Study of Thinking (New York: John Wiley and Sons, Inc., 1956), p. vii.

[31]Ibid.

Bruner, Goodnow, and Austin see strategy as a "pattern of decisions in the utilization of information that serves to meet certain objectives."[32] Conditions influencing concept attainment may be grouped as indicated below:

1. Definition of task.
2. Nature of the instances encountered.
3. Nature of the validation.
4. Consequences of specific categorizations.
5. Nature of imposed restrictions.[33]

Marquis' research on technical decision making reveals that individuals tend to choose less risky alternatives in a situation of uncertainty as contrasted to comparable risk situations with greater certainty.[34] Marquis cites Sollberg's work on the design of a complex, computer-controlled, problematical environment, which is sufficiently complex and flexible to provide long-term systematic investigations of human thinking processes; identified sufficiently well to permit application of rigorous experimental controls; and lends itself to quantification so as to permit explicit measurement of behavior, as well as permitting direct comparison of alternative strategies of problem solving as being relevant research.[35]

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[32] Bruner, Goodnow, and Austin, *op. cit.*, p. vii.

[33] *Ibid.*

[34] Donald G. Marquis, *Annual Report: Research Program on the Management of Science and Technology, 1964-1965* (Cambridge, Mass.: Massachusetts Institute of Technology, July, 1965), pp. 6-7.

[35] *Ibid.*

Kogan and Wallach's research represents an attempt to exhaustively investigate the risk-taking implications of certain cognitive-judgemental processes. Three measures were utilized in their study. The identification of possible relationships between cognitive processes and risk-taking represents the main importance of this research. Results of the Kogan and Wallach research are reflected by the following statement: "In sum, we have been able to demonstrate that various cognitive-judgemental behaviors--namely, general confidence of judgement, breadth of categorizing, extremity concerning judgements about external events, and extremity concerning self-referent judgements--do possess particular kinds of risk-conservatism implications for particular sub-groups of individuals."[36]

The concept of "Information Overload" is related to an individual's information-processing limits. This concept is discussed by Brown in his article, "Systems, Boundaries, and Information Flow," along with several of the adjustment processes that may occur in an organization when its information system is loaded in excess of capacity.[37] As cited by Brown, responses to information overload include omission, error, queing, filtering, approximation, multiple channels (parallel transmission), and escape.[38]

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[36] Kogan and Wallach, op. cit., p. 199.

[37] Warren B. Brown, "Systems, Boundaries, and Information Flow," Journal of the Academy of Management, IX (December, 1966), 323-24.

[38] Ibid.

Abilities, beliefs, attitudes, and motives are identified by Brim, *et al.* as the individual personality. In their study beliefs were divided into those that were concerned with the characteristics of nature and those involving the relations of means to ends. They concluded that evidence which supports the relationship of beliefs to the decision process is limited.[39]

Structural variations, such as male, female, and grouping by social class were also studied by Brim, *et al.* These variations were used as explanatory variables to explain certain characteristics of social groups. The authors observed that "The theory leading to the use of these structural variations is that they have a probable relation to personality types, which, in turn, may be related to decision making. Nevertheless, it is important to realize that this assumed sequence of causality running from social structure to personality, and then to decision characteristics, may in some instances not appear because of inadequacies of measurements or because of a lack of articulation between the three panels of variables, in spite of our initial theory which led to their selection."[40]

A particular personality variable, according to Kogan and Wallach, may have a different meaning with regard to other

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[39] Brim, *et al.*, *op. cit.*, pp. 46-50.

[40] *Ibid.*, p. 59.

psychological characteristics.[41] Although the results of the Kogan and Wallach research into the relationships between personality and risk-taking are not conclusive, they are certainly complementary to the total research project. The authors' comments on this matter reflect that "The data are quite revealing of some of the personality dimensions /which/ have an impact upon risk-taking. As a valuable by-product we have acquired a deeper knowledge of the kinds of psychological processes tapped by some of the better known scales."[42]

There is a possibility that the risk-taking dimension may serve as a proxy for an individual personality dimension and in this capacity could be viewed as a possible correlate of individual information processing.[43] Kogan and Wallach note that "there are indications in the present work that the risk-conservatism dimension may have implications for a wide variety of behavioral and social phenomenon."[44]

Individual and situation interaction relate to the interaction of individual variables and those pertaining to a situation, such as a task. Brim, et al. describe their research approach as follows: "What we have done in our analysis is to deal first with the direct effects of

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[41]Kogan and Wallach, op. cit., p. 202.

[42]Ibid.

[43]Cravens, op. cit., p. 33.

[44]Kogan and Wallach, op. cit., p. 205.

personality, regardless of the situation; second, to deal with the effects of situations, irrespective of personality; and third, to hypothesize that certain momentary states must have resulted from the interaction of these two sets of variables, and thus to look at the effects of interaction on the decisions."[45] Three situational variables were identified: (1) type of problem (variation with respect to substantive properties); (2) group versus individual problem solving; and (3) order of and familiarity with the problem.[46]

Shannon and Weaver's extension and generalization of information theory presents some possible insights into individual and situation interaction.[47] "There have been many contributions and extensions to the basic theory that was developed in the late 1940's. Information theory grew out of the general philosophy of communication theory. Shannon's work was centered in the area of engineering communication, while Weaver was interested in biological applications."[48]

Information, as the word is used in information theory, is a measure of one's freedom of choice in selecting a message,

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[45]Brim, et al., op. cit., p. 46.

[46]Ibid., pp. 60-62.

[47]Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Urbana, Illinois: The University of Illinois Press, 1964).

[48]Cravens, op. cit., pp. 8-9.

and should not be confused with information in terms of meaning. "In fact, two messages, one which is heavily loaded with meaning and the other which is pure nonsense, can be exactly equivalent, from the present viewpoint, as regards information."[49] The measure of information may be expressed by the same mathematical expression as that utilized for entropy as used in thermodynamics.

The amount of information is measured in terms of the logarithm of the number of available choices:[50] H = measure of information = $-\sum Pi \log Pi$. (The minus sign is necessary to make "H" a positive value.) The higher the probability associated with a given source, the lower the value of H. For example, if a particular source has the probability of one, then the value of H is zero. The key element is the special meaning of information. "Information is, we must steadily remember, a measure of one's freedom of choice in selecting a message. The greater this freedom of choice, and hence, the greater the information, the greater is the uncertainty that the message actually selected is some particular one. Thus, greater freedom of choice, greater uncertainty, greater information go hand-in-hand."[51]

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[49]Shannon and Weaver, _op. cit._, pp. 8-9.

[50]_Ibid._

[51]John C. Hancock, _An Introduction to the Principles of Communication Theory_ (New York: McGraw-Hill Book Company, Inc., 1961), p. 156.

Information Processing

The term "information processing," as used in this research study, concerns the search, evaluation, and use of information in problem solving. Areas of research which are of particular interest are those where information processing is associated with problem solving, or decision making. As noted by Rigby, "A key element in problem solving is securing information on the system and on the environment."[52] The emphasis of the proposed research will be on those studies which relate to individual information processing, rather than on the extensive body of work dealing with formal information systems, such as computerized information systems. Primary concern is with the individual as a processor of information during the problem-solving process and with information during the entire decision-making process rather than just during the "search for information stage."[53]

Individual information-processing research may be classified in terms of total-process studies, specific fragments of the process, and highly specialized efforts.[54] As noted by Cravens, "The bulk of research on information processing has been centered either on the examination of

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[52]Paul H. Rigby, Conceptual Foundations of Business Research (New York: John Wiley and Sons, Inc., 1965), p. 6.

[53]Cravens, *op. cit.*, p. 37.

[54]*Ibid.*

user's information needs, or alternatively, on selected phases of an individual's information-processing activity."[55]

Paisley, in his literature review, notes that with a few exceptions literature on the flow of behavioral science information does not exist, and directs his efforts toward a very comprehensive and careful review of the body of research focusing on the information-gathering and disseminating behavior of physicists, chemists, zoologists, and engineers.[56] "The Paisley review provides a useful evaluation of past research on the information-processing characteristics of scientific and technical people. He covers the literature from the apparent emergence of such studies through 1965. The review offers a valuable guide and cross-check to work related to this study."[57]

As summarized by Cravens, several important and relevant generalizations may be gleaned from Paisley's review of the numerous research studies of information processing:

1. Most of the studies have investigated information use at a point in time rather than over a time span.

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[55] Cravens, _op. cit._, p. 37.

[56] W. J. Paisley, _The Flow of (Behavioral) Science Information: A Review of Research Literature_ (Stanford, California: Stanford University Press, Institute for Communication Research, 1966), p. I-1.

[57] Cravens, _op. cit._, p. 39.

2. The bulk of the work has been highly specialized. Due to conceptual and methodological variation, it is difficult to compare various projects in any useful way.
3. Previous studies have not taken a task-oriented focus with respect to information use.
4. The studies have been concentrated on specific fragments of information processing with a high proportion falling into the area of information search.[58]

Paisley considers the Auerbach Corporation Study conducted in 1964 for the Department of Defense as being unique. The purpose of this study was to collect and analyze a statistically significant data base on how scientists and engineers acquire and utilize technical information in the performance of their duties. The focus of the study was on the searching phase of individual information processing and utilized a simple random sample of 1375 subjects drawn from a population of 36,000 scientists and engineers. A process point of view was used in the Auerbach study; however, data collection was on a one-time basis, and there was a significant

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[58]Cravens, op. cit., pp. 39-40.

variation with respect to the tasks included in the study. In spite of these limitations, we may view this study as providing important insights concerning individual information-processing variables and methodology. In addition, the use of the information chunk, or element of information, suggests a meaningful unit of analysis for the present study.[59]

"Process-fragments refer to specific phases or aspects of information processing. The most extensive body of research relating to individual information processing deals with information use patterns."[60] A bibliography of information user need studies with nearly 700 listings was included in the Auerbach study. However, the many questions surrounding individual information-searching has apparently not been answered by the previous user need studies. As reflected by the Auerbach study, user needs are neither broadly known nor understood.[61]

In his review of research literature, Paisley observes that many of these use studies are mutually duplicative but that no visible effort has been made to replicate methods. The result is that there is an extensive collection of case studies whose findings can be compared only if a _ceteris paribus_ assumption is made to cover the gross differences in procedure.[62]

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[59] Cravens, _op. cit._, pp. 44-45.

[60] Auerbach Corporation, _DOD User Needs Study_, C-1.

[61] _Ibid._, I-2.

[62] Paisley, _op. cit._, p. II-1.

McLaughlin, Rosenbloom, and Wolek collected data on more than 1200 instances of information acquisition via self-administered questions from 430 respondents. The purpose of this study was to examine the acquisition of useful technical information by scientists and engineers in five divisions of a large industrial corporation. Their approach to the problem was the cross-tabulation of dependent variables (characterizing the means of acquisition) against a series of situational and personal independent variables; that is, independent variables, such as corporate organization, field of science, education, and experience were examined with respect to the dependent variable, information source. The authors concluded that the transfer of technical information involves a complex social process in which technology, personal characteristics, organizational values and structures, and the beliefs of professional subcultures interact to influence information acquisition behavior.[63]

The concept of "local search" for information for choice and definition of problems is supported by research which was done by using 157 National Aerospace Administration (NASA) professional research personnel. Results of this study indicate that the researcher's supervisor is the most

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[63]Curtis P. McLaughlin, Richard S. Rosenbloom, and Francis W. Wolek, Technology Transfer and the Flow of Technical Information in a Large Industrial Corporation PB-173457 (Cambridge, Mass.: Harvard University, Graduate School of Business Administration, March, 1965).

frequent source of ideas, with work experience and literature ranking second.[64]

The manner in which engineers and scientists allocate their time and the effect of this allocation on the outcome of four government research and development projects was analyzed by Allen and Andrien. They concluded that the percentage of total time spent in three categories of information-gathering (outside consultation, staff consultation, and literature search) varies significantly over the life of a project. A higher percentage of information-gathering time is spent on those subsystems reflecting greater uncertainty than on those reflecting less uncertainty.[65] "Allen and Andrien found that higher rated research teams are relatively stable in all phases of information-gathering, while lower rated teams initially spend far more time gathering information than they do in later stages and [the time spent on gathering information] fluctuates more [than the favorable teams] throughout the project. These findings suggest that: (1) uncertainty relative to a task outcome and search investment (time) are positively associated, and

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[64]Marquis, op. cit., pp. 17-18.

[65]Thomas J. Allen and Maurice P. Andrien, Jr., Time Allocation among Three Technical Information Channels by R and D Engineers (Cambridge, Mass.: Massachusetts Institute of Technology, Alfred P. Sloan School of Management, August, 1965).

(2) group job performance and search investment are associated."[66]

Rosenberg conducted a study of the correlation between preference ranking and the ease of use of eight information-gathering methods which involved 94 industrial and governmental professional research and nonresearch personnel. He used a structured questionnaire with subjects indicating a preference for information-gathering methods with respect to given hypothetical situations. The results of the study reflect no significant correlation between preference ranking and amount of information ratings; however, the study indicates that ease of use is an important variable in determining information-gathering methods.

In his article, "An Exploratory Analysis of Individual Information Processing," Cravens analyzes the information-processing behavior of the individual decision-maker. His primary interest was the identification, measurement, and analysis of a set of 21 variables pertaining to the multi-stage information-processing activities of individual decision-makers. The specific objective of this study was to identify relationships between selected characteristics of both the decision-maker and his task and his information-processing behavior.[67]

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[66]Cravens, op. cit., p. 47.

[67]Ibid., B-656-B-657.

The Cravens study, which was supported in part by National Aeronautics and Space Administration Contract No. NSR-15-003-055 to the Aerospace Research Applications Center, Indiana University, utilized an industrial research and development environment as the research site. Eighteen male staff engineers and scientists employed by the Aerospace Research Applications Center were used as research subjects. These subjects were each pursuing graduate degrees and each had a work commitment of 24 hours a week. The author believed that these subjects provided a somewhat abstract representation of technical decision-makers in industrial firms and that this group could serve as reasonable proxies for problem-solvers in industrial organizations, since they each possessed technical education and professional experience, and the job commitment was important for both financial and professional reasons.[68]

Cravens concluded that while this study did provide insight into the information-processing behavior of the individual decision-maker, the need for further research is apparent. He notes that additional research in the following areas appears promising:

1. The refinement and extension of certain of the measures of key variables in the system.

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[68]Cravens, _op. cit._, B-656-B-657.

2. Investigation of relationships among key variables in a controlled laboratory environment.
3. Investigation of the system of variables in other environments.
4. Decision process implications.[69]

Ference examined the emergence and solution of organizational problems from the communications framework perspective. He developed a general model based on the information-processing activities of the individual members of a communications network. The Ference model describes the problem-solving process as a sequence of five stages: problem recognition, identification procedures, information acquisition and integration, definition of constraint set, and comparison and adaption. The author explains that, "These propositions (the 16 propositions contained in the general model), while supported in part by existing theory and evidence, are admittedly speculative; they are presented as possibilities for operationalizing the model. The propositions are intended, therefore, to stimulate the research needed to add precision to --- the model."[70]

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[69]Cravens, op. cit., B-666.

[70]Ference, "Organizational Communications Systems and the Decision Process," B-83.

Major conclusions drawn by Ference in his study are noted below:

1. The role of communication positions is seen to be that of integration and transmittal. In particular, this integrative behavior is seen to be a critical factor in determining the subsequent nature of the decision process.
2. The patterns of communication and interaction within organizations are complex and affected by many diverse variables. A theory of decision making in organizations must take these variables into account.[71]

Current Research Study and Related Research

An attempt to establish a causal linkage between variables pertaining to the individual and the situation on one hand and decision making on the other hand has been the goal of much of the related research. The approach most often used has been to select a limited number of independent and dependent variables, develop an appropriate group of measuring instruments, and then investigate the existence of relationships via multivariate

[71]Ference, op. cit., B-95.

analysis. The Brim, <u>et al.</u>,[72] Kogan and Wallach,[73] and Cravens[74] studies used this approach. Hence, a similar approach for this research effort seems appropriate.

Other studies have separated variables into groups, or sets, so as to provide an analytical framework within which various relationships of interest can be studied. An example of this approach is the Kogan and Wallach research, where the independent sets consist of cognitive-judgemental, personality, and intellective plus a set of dependent decision-making variables.[75]

The concept of viewing decision making as a process (set of interrelated stages) has not been utilized as an analytical approach except in the Brim, <u>et al.</u>[76] and Cravens[77] studies. In the Brim, <u>et al.</u> research a simplified decision-process viewpoint provides the analytical focus and the Cravens study takes an information-processing viewpoint of decision making. "An important orientation of this (Cravens) study is to consider information processing during the entire decision process, rather than to arbitrarily

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[72] Brim, <u>et. al.</u>, <u>op</u>. <u>cit</u>., pp. 9-59.

[73] Kogan and Wallach, <u>op</u>. <u>cit</u>., p. 205.

[74] Cravens, <u>op</u>. <u>cit</u>., B-666.

[75] Kogan and Wallach, <u>op</u>. <u>cit</u>., p. 205.

[76] Brim, <u>et al.</u>, <u>op</u>. <u>cit</u>., pp. 9-59.

[77] Cravens, <u>op</u>. <u>cit</u>., B-666.

identify the information collection phase as the total process."[78] Cravens concludes that since the role of information processing in the decision process is well substantiated, "A possible linkage between explanatory individual and situational variables and information-processing variables appears to be a meaningful area of investigation."[79]

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[78] Cravens, *op. cit.*, 52.

[79] *Ibid.*, 54.

CHAPTER III

DATA COLLECTION AND ANALYSIS PROCEDURES

The task of Chapter III is to describe the conceptual framework which provides a structure within which relationships of interest to this study were investigated. The selected research site, along with research subjects, are discussed. Further, the scheme for measurement of each independent and dependent variable is described in detail. The information-processing variable system used in this study is outlined in Figure 1.

As noted by the Auerbach Corporation Interview Guide Handbook in technical problem solving, the problem-solver receives information inputs and transforms these inputs into new information. The individual problem-solver viewed in this context may be considered an information processor.[1] Since the primary interest of this study is to analyze selected characteristics of the individual and his information-processing behavior in a continuing education environment, the information-processing variables and their possible correlates are examined in detail.

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[1]Auerbach Corporation, Interview Guide Handbook (Philadelphia: Auerbach Corporation, July 2, 1964), preface.

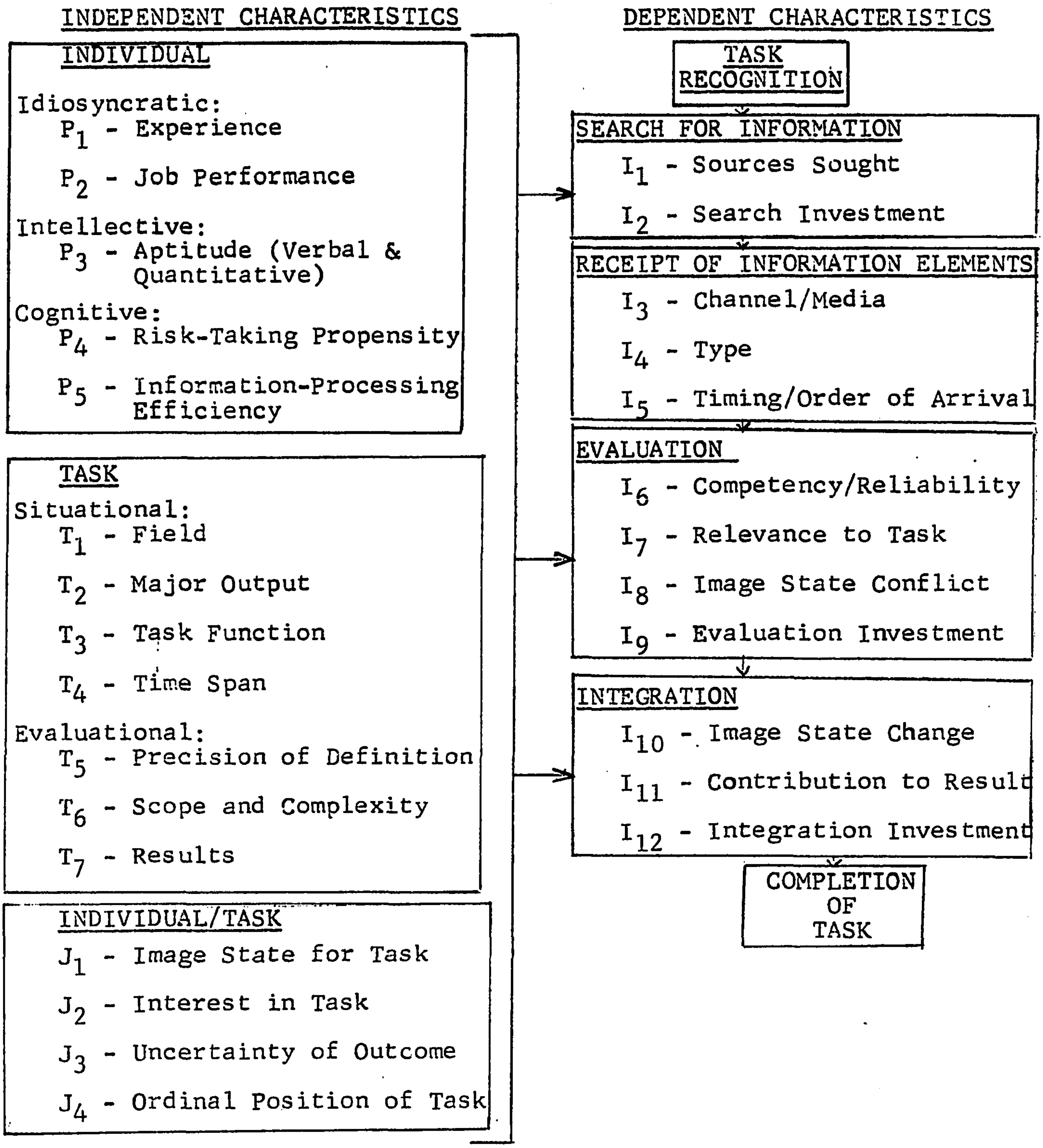

Figure 1 -- Information-Processing Variable System

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 80.

As concluded by Cravens, depth of investigation is of primary interest because of the exploratory nature of this type of research. Therefore, there are numerous reasons for limiting the scope of this research to a single organization. These factors are noted below:

1. The on-going, dynamic aspects of individual information processing are central to the research effort. Interest is in the intricacies of task-oriented information processing from the recognition of a task through to its completion--an in-depth study of variables.
2. In view of the dimensions of the study, as well as its process orientation, it was important for the researcher to maintain a close and continuing relationship with the subjects by utilizing multiple interviews, structured diaries, questionnaires, observations, and monitoring of tasks, including related records and paper work associated with each subject and task.
3. Full cooperation on the part of the research participants, as an understanding of the nature and depth of information required for the study, was critical in achieving the objectives of the research. The success of

the effort was highly dependent upon the researcher being able to obtain, in effect, a play-by-play description of the information-processing activities.

4. It was necessary that the various environmental influences surrounding the research site be held fairly constant. This would be extremely difficult if more than one organization had been utilized.[2]

The objectives and methodology of the research effort were discussed with the management group of the Oklahoma Center for Continuing Education in an attempt to identify potential measurement problems. Measurement instruments were explained to each research subject before the total measurement process began using tasks which are representative of tasks included in the research sample. This explanation was considered necessary so as to afford the researcher a realistic look at the intricacies of information processing in the Oklahoma Center for Continuing Education (OCCE) environment which was utilized as the research site.

All measurements of independent and dependent variables were obtained from the research subjects, except those variables

[2]David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 54.

related to job performance ranking and job performance rating.

The details of each dependent variable measurement was explained to each research subject and the measuring instruments to be used were discussed and questions answered. Care was taken to direct these discussions to what each measurement involves in terms of the subject supplying the required data. Questions concerning why a particular measurement was included were delayed until the completion of the study, at which time each subject was given access to the results.

Communication channels were established which encouraged regular interaction between the subjects and the investigator. To minimize the "Hawthorne Effect," that is, changes in the decision-maker's behavior as a result of his knowing that he is participating in the research study, the fact that the important thing, insofar as this research effort is concerned, is what is actually done by each research subject in his information-processing activities and that there are no right or wrong answers in the context of this study was stressed.

Since the proposed research is process-oriented, it is important to identify where in the decision process each variable was measured. This is indicated in Figure 2.

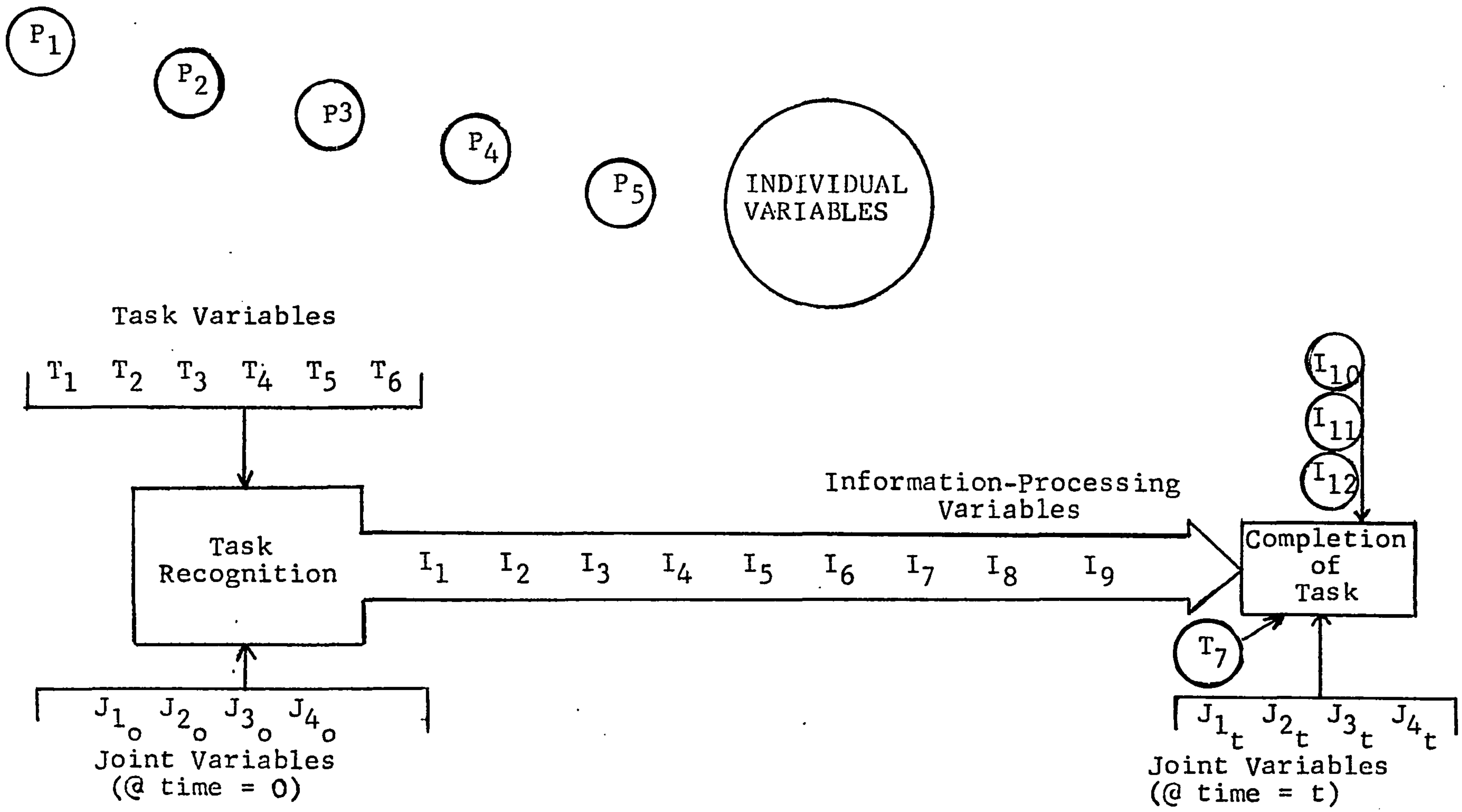

Figure 2 -- Time Span of Variable Measurement

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 98.

Measurement of Variables

Rigby noted that measurement is a technique to superimpose a concept on an environment and to identify changes in the concept. Further, he identified three problems associated with measurement: (1) the identification of a satisfactory scaling device; (2) the success of the researcher measuring what he thinks he is measuring; and (3) the knowledge of the degree of accuracy of the measurement device.[3]

Siegal classifies measurements according to levels: nominal, ordinal, interval, and ratio. Using Siegal's work as a base, nominal, ordinal, interval, and ratio scales are described below:

1. Nominal Scale. This is measurement at its weakest; that is, a very primitive level. Numbers, or other symbols, are used to classify an object, person, or characteristic. The scaling operation involves partitioning of a given class into a set of mutually exclusive subclasses.

2. Ordinal or Ranking Scale. Measurement at this level allows objects to be ranked on a basis of comparison. In other words, *X* is greater than *Y*. It is not known how much greater. If the relation "greater than" (>)

[3]Paul H. Rigby, Conceptual Foundations of Business Research (New York: John Wiley and Sons, Inc., 1965), pp. 156-58.

holds for all pairs of classes, then an ordinal scale exists. Variable measurements in the behavioral sciences are typically no stronger than ordinal.

3. Interval Scale. Measurement according to this scale provides all of the characteristics of ordinal measurement with the additional characteristic that the distance between any two numbers on the scale is of known size. Thus, the measurement achieved is considerably stronger than via an ordinal scale.

4. Ratio Scale. A ratio scale has all the characteristics of an interval scale plus a true zero point of origin. Here, the ratio of any two scale points is independent of the unit of measurement. Any statistical test can be utilized, provided that ratio-measurement has been accomplished.[4]

Cravens suggests that the "Appropriate sequence (of actions in conducting a research study) is to formulate a conceptual framework. Then given this body of concepts, the next task is to select measuring instruments."[5] The suggested

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[4]Sidney Siegal, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company, Inc., 1956), pp. 22-29.

[5]Cravens, op. cit., p. 99.

sequence was followed in conducting the current research program.

The majority of the measuring instruments that were used in this study are either on the ordinal or interval scales. Measuring instruments that were used in the Cravens study were utilized where possible to ascertain if these instruments are suitable for measuring the selected variables in a continuing education environment. Each variable included in the variable system (independent and dependent) is discussed in terms of the particular measuring instrument utilized, source of measurement, unit of measurement, level of measurement, and time and frequency of measurement.[6]

Independent Characteristics

Individual Domain

There are three groups of variables in the individual domain. These are Idiosyncratic, Intellective, and Cognitive (see Figure 1).

1. Idiosyncratic Variables. There are two variables associated with this group: Experience (P_1) and Job Performance (P_2). Experience was measured in two ways: (1) An aggregate measure was obtained in terms of the years of experience for each

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[6] Cravens, op. cit., p. 99.

subject. This aggregate measure included Oklahoma Center for Continuing Education experience; and (2) Job experience was used in an attempt to allow for possible job learning curve influences. Data was obtained from personnel records and supplemented where necessary by personal interviews. Job Performance (P_2) was measured via a Job Performance Ranking Guide (see Appendix A) and a Job Performance Rating form (see Appendix B).

2. Intellective Variables. Aptitude (Verbal and Quantitative) P_3 is the only variable in this group. The Wonderlic Personnel Test was utilized as an intellective measure.[7] "This instrument was developed by E. F. Wonderlic to aid in examining and measuring mental abilities of adults in business and industrial situations. The test has been standardized in a business situation on adults with age ranges from 20-65 and with various work backgrounds."[8]

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[7]E. F. Wonderlic, Wonderlic Personnel Test Manual (Northfield, Ill.: E. F. Wonderlic and Associates, Inc., 1966).

[8]Cravens, op. cit., p. 102.

3. Cognitive Variables. This group consists of two variables: Information-processing Efficiency (P_5) and Risk-taking Propensity (P_4). Risk-taking Propensity (P_4) was measured via an instrument called the "Choice Dilemmas Procedure." Each item on this twelve-item instrument represents a choice dilemma between a risky and a safe course of action. Each research subject is asked to select the probability level for the risky alternative success that would make it sufficiently attractive to be chosen, thus reflecting the deterrence or failure for the subject in a particular decision area.[9]

As noted by Kogan and Wallach the Choice Dilemmas Procedure instrument is of a semiprojective nature in that the subject is being asked how he would advise others in each of the twelve situations described. Further, an assumption is made that an individual's advice to others reflects his own regard for the desirability of success relative to the disutility of failure.[10]

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[9]Nathan Kogan and Michael A. Wallach, Risk Taking: A Study in Cognition and Personality (New York: Holt, Rinehart and Winston, 1964), pp. 256-61.

[10]Ibid.

Cravens observes that this assumption may be questionable, since Professors Cummings and Harnett of the Indiana University Graduate School of Business believe there are certain ambiguities present on at least eight of the twelve questions.[11] In an attempt to overcome these ambiguities, Cummings and Harnett have modified the Kogan and Wallach instrument. However, because there is an extensive base of results available for comparison purposes, the original instrument was used, rather than the modified version. An Information-Processing Efficiency Index (P_5) was obtained for each subject by utilizing a modified version of the approach utilized by Hayes.[12] Using this approach, each subject was provided with 32 decision situations, each containing eight alternatives and eight characteristics describing each of the alternatives. The object was to measure decision quality and

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[11] Cravens, _op_. _cit_., p. 102.

[12] John R. Hayes, _Human Data Processing Limits in Decision Making, Report No. ESD-TDR-62-48_ (Bedford, Mass.: Air Force Systems Command, Electronic Systems Division, July, 1962), pp. 24-27.

decision time. A weighted-decision, time/quality index was calculated to serve as a measure of each subject's information-processing efficiency (see Appendix D).

Task Domain

There are two groups of variables in the Task Domain: Situational and Evaluational. An instrument called a Task Record was used to record task variables measurements (see Appendix E). The variables within the Task Domain were obtained from each subject for a given task. Cravens obtained the measurements for these variables from the ARAC Retrospective Search Service supervisor who made all task assignments at the Indiana University Aerospace Research Applications Center. However, tasks assignments at the Oklahoma Center for Continuing Education are not made from a central office; that is, assignments may come from any of the five basic program division offices or any of the program managers, or project directors to whom the subjects report. Hence, the decision was made to obtain these measurements from the subjects rather than from a central location, as in the Cravens study.[13]

1. Situational Variables. This group of variables consists of Field (T_1), Major Output (T_2), Task Function (T_3), and

[13]Cravens, op. cit., p. 104.

Time Span (T_4).

a. Classification of Field (T_1) was accomplished by using the categories established by the Oklahoma Center for Continuing Education for identifying the field of each task. The Task Field Classification System is shown in Appendix F. Major Output (T_2) which refers to whether the output is a finding, a recommendation, a decision, or other, was measured by using the categories provided in the Auerbach Study.[14] The Task Function (T_3) refers to the kind or level of output with respect to the use of the task result. This information was secured from output classification codes used by the Oklahoma Center for Continuing Education. In terms of the homogeneity of tasks included in Cravens study variables T_1, T_2, and T_3 did not vary to the degree that their possible influence could be investigated and in addition the sample

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[14] Auerbach Corporation, op. cit., B-13.

was too small to obtain sufficient observations of these variables in the categories available. The homogeneity of tasks included in this study did vary to the degree that their influence could be investigated and the sample was considered large enough to obtain sufficient observation of these variables in the categories available.[15]

b. "The Time Span (T_4) of each task was measured in terms of the elapsed time (in working days) from receipt of a task to its completion."[16]

2. Evaluational Variables. This group consists of the Precision of Definition (T_5), Scope and Complexity (T_6) and Results (T_7) of each task. An index of precision of definition, ranging from poorly defined to well defined was assigned to each task via a rating scale. Precision of definition was measured at the time that a task was received and was measured in terms of the information provided (task objectives and restraints). Scope and

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[15] Cravens, *op. cit.*, p. 104.

[16] *Ibid.*, p. 105.

Complexity (T_6) was measured by obtaining a rating from the appropriate research subject for each task. Each subject was asked to rate each task on a one to seven scale based on the anticipated difficulty in gaining a solution. Another measure of this variable is the man-hours invested on each task to reflect scope and complexity. (It is assumed that the amount of effort to complete a given task is a reflection of the scope and complexity of the task). The scope and complexity of each task was measured via two instruments to guard against task situations where a single measure may not accurately represent the scope and complexity of a given task.[17]

Interaction Domain

The interaction domain consists of the four variables pertaining to the interaction of the individual and the task. These variables are: Image State for Task (J_1); Interest in Task (J_2); Certainty of Outcome (J_3), and Ordinal Position of Task (J_4). Empirical data was obtained with respect to each task assigned to a particular subject via the Search

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[17] Cravens, op. cit., p. 106.

Record (see Appendix G). A Search Record was given to each subject upon receipt of each task to be included in this study and the Search Record was completed for each task.

1. Image State for Task (J_1). Shannon and Weaver's entropy concept of information theory was used to gain a measure, or index, of each subject's image state for a particular task.[18] This concept was discussed on page 37 in Chapter II (Related Research). The three measurements in Appendix G: Alternatives (J_1) and probability estimate that a particular information source contained relevant information (q_i) and the conditional probability estimate that if the source contained relevant information, then how good (quality) was it espected to be (r_i) were utilized to obtain the measurement of each subject's image state for a task:

$$\text{Image State } (J_1) = -\sum_i P_i \log e \; P_i$$

Where i is the number of alternative sources listed and $Pi = q_i \, r_i$.[19]

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[18]Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communications (Urbana, Ill.: The University of Illinois Press, 1964.

[19]Cravens, op. cit., pp. 107-108.

Each subject was asked to list the alternative sources of information which he believed may contain information relevant to the task; indicate the probability that a particular information source would contain relevant information; and specify for each alternative source of information the conditional probability that if the source contained relevant information, how good (quality) it was expected to be.

2. Interest in Task (J_2). A subject's interest in a task was measured by utilizing an approach developed by Morris.[20] Morris used a rating scale ranging from one through seven, with one reflecting low interest and seven relatively high interest. To obtain an average measure of interest in the task over the time span of the task, a rating was obtained at the beginning of each task and at the conclusion of each task. The average measurement seems most appropriate since a basic assumption is made that a subject's interest in a task may vary during the course of the task.

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[20] Charles G. Morris, Effects of Task Characteristics on Group Process. Technical Report No. 2, AFOSR 65-1519 (Urbana, Ill.: University of Illinois, Department of Psychology, July, 1965), p. 100.

3. Uncertainty of Outcome (J_3). Each subject was asked to make a subjective estimate concerning the outcome of each task at the beginning of each task. This information was used as a measure of the subject's opinion of the uncertainty of the outcome of the task. The base of reference for assessing uncertainty of outcome was provided by the objectives and constraints specified for each task at its outset.

4. Ordinal Position of Task (J_4). The ordinal position of each task with respect to all other tasks being handled by a particular subject was obtained by a simple ranking. Each subject was asked to indicate how many tasks he was currently working on at the beginning of each task. If, for example, he had three in process, then the ordinal position for the task at hand was four. The measurement was obtained only at the outset of each task, recognizing that the ordinal position of a task could change over the elapsed time of any given task.

Dependent Characteristics

Information-Processing Domain

The information-processing domain consists of four groups of variables. These are: Search for information; receipt of information elements; evaluation; and integration. These groups of variables are the dependent variables of this study and measurements were obtained from the subjects with respect to each task from the Diary of Information Sources and Diary of Information Elements shown in Appendices H and I.

These Appendices (Diary of Information Sources and Diary of Information Elements) were maintained by each subject for the duration of each task. During the course of completion of each task regular contact was made by the researcher with the research subject to answer any questions and to insure the dynamic recording of data during the time span of each task. The Diary of Information Sources and Diary of Information Elements were used in an attempt to secure a play-by-play record of each subject's information-processing activities.

Cravens observes that the use of these two diaries involves a possible problem with respect to whether the investigator is actually measuring what he thinks he is measuring.[21] Further, he notes that Banks[22] has identified

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[21]Cravens, op. cit., p. 109.

[22]Seymour Banks, "Designing Marketing Research To Increase Validity," Journal of Marketing, XXVIII (October, 1964), 33-34.

two sources of internal validity which are related to this problem: testing and instrument decay. The testing concerns the possible structuring influence of the diary on the problem-solving behavior of the subject; instrument decay involves the consistency of the subject in recording data over the time span of a task.

Based upon the observations of this researcher and in accord with observations made by Cravens, the major influence of the diaries has been to increase the time required to complete a task rather than to change a subject's problem-solving behavior. In addition, consistency of response did not vary significantly and personal observations of the subjects during the research study and review of the data collected appears to substantiate these conclusions:

1. Search for Information. This phase includes Sources Sought (I_1) and Search Investment (I_2). Three measures of sources were obtained: total number of sources sought; the number of external sources; and the number of internal sources. The measures were obtained by a simple counting of all sources in these categories from the Diary of Information Sources. Two measures of Search Investment (I_2) were obtained: total search time (in hours) and the average search time (in hours) per source.

2. Receipt of Information Elements. This phase includes Channel/Media (I_3), Type (I_4), and Timing/Order of Arrival (I_5). The variables in this phase are included only as an aid in identifying information elements during the remainder of the task process and were not included as part of the study. (See Figure 1 for task process from task recognition to completion of task). Channel/Media (I_3), Element Type (I_4), and Timing/Order of Arrival (I_5) were recorded in columns D, E, and A, respectively, of the Diary of Information Elements (Appendix I).

3. Evaluation. This phase includes Competency and Reliability (I_6), Relevance to Task (I_7), Image State Conflict (I_8), and Evaluation Time Investment (I_9). Beginning with this phase throughout the remainder of the decision process the information element is the basic unit of analysis. For control purposes all elements received by the decision-maker on a given task, irrespective of whether or not they were ultimately rejected or accepted, were recorded. This information was obtained from the Diary of Information Elements (Appendix I). Ratings of each subject for Competency/Reliability (I_6),

Relevance to Task (I_7), and Image State Conflict (I_8) variables were made at the time that the particular element was evaluated. Recognizing the dynamic nature of the problem-solving process, it is quite possible that a subject's ratings for a given element would not be the same if the evaluation had occurred earlier or later in the time span of a task. Also, it should be noted that these measures are subjective in that two subjects might rate the same element for the same task differently. These measurements are directed toward describing information processing with respect to the individual, rather than to attempt to determine how well (in a normative sense) information processing is being accomplished.

a. A rating scale ranging from <u>one</u> through <u>nine</u> was used to obtain a measure of the competency and reliability of the information source of each element. The subject was asked to indicate a rating for each element received. In order to obtain an overall measure of Competency/Reliability (I_6) for a given subject/task situation, the mean rating for all elements was used. This procedure provided the advantage of an aggregate measure for convenience of analysis and at the same time allowed a build-up of the aggregate measure through individual information elements. The aggregate measures of Competency/Reliability included a mean for all elements as well as means for both the accepted and rejected element groups.

b. Similar scales were used to measure Task Relevance (I_7) and Image State Conflict (I_8). For each of these variables a mean rating for the total number of task elements was obtained, along with means for the accepted and rejected element groups.

c. Evaluation Investment (I_9) was measured in terms of the total time for evaluation of all elements, and each of the mean times per element, for the accepted and rejected element groups.

4. Integration. Three variables were measured during the integration of each accepted information element into the task. The Integration Phase variables are Image Change (I_{10}), Contribution to Result (I_{11}), and Integration Investment (I_{12}). Measurements for Contribution

to Result (I_{11}) and Integration Investment (I_{12}) were recorded in columns L and M, respectively, of the Diary of Information Elements (Appendix I) for each task.

a. Image State Change (I_{10}) was obtained by subtracting zero from the Image State Index (J_1) at the outset of a task. On this basis Image State Change (I_{10}) = (J_{10} - J_{1t}) where J_{1t} = 0. An assumption is made that at the completion of a task, a subject's image state for that task will be equal to zero. In other words, his information at this point is perfect. The information searched for, evaluated, and integrated aided the subject in moving from his initial image state to a perfect state of zero.[23]

b. A rating scale of one through seven was used to measure the contribution of each information element to the task result. This rating was accomplished at the

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[23]Harry L. Ammerman, A Model of Junior Officer Jobs for Use in Developing Task Inventories, Technical Report 65-10 (Alexandria, Va.: George Washington University, Human Resources Research Office, November, 1965), p. 13.

completion of integration of each information element into the task result. A mean rating of accepted elements serves as a measure of Contribution to Result (I_{11}).

c. Integration Investment (I_{12}) was measured in terms of the total man-hours expended on element integration and the average time per information element. In some instances it may be possible that no further time was invested in an element beyond the "accept" decision. In these instances the "total man-hours expended" on element integration and the average time per information element have values of zero.

Method of Analysis

The relationships of interest in the current research study "involve an assessment of the total impact of the set of independent variables on the set of dependent variables as well as the impact on certain subsets of the [In]dependent group [on the set of dependent variables.] A multivariate statistical technique is appropriate for this task."[24] As

[24] Cravens, op. cit., p. 114.

Cravens points out, canonical correlation analysis is a statistical technique which is well suited to investigating the relationships of interest in this study. Further, he points out that canonical analysis is a more general statistical model of which multiple correlation is a special case and that the canonical model seeks to relate two sets of variables in as many independent ways as possible.[25] Veldman notes that "The goal of canonical analysis is to define the primary independent dimensions which relate one set of variables to another set of variables. The technique is primarily descriptive, although the method used involves finding sets of weights which will yield two composite variables (one for each set of original variables) which will correlate maximally."[26] Further, these correlations may be viewed as factor loadings in that large correlation coefficients for certain variables indicate that these variables contribute more to the set than do those with smaller coefficients.[27] (See Appendix J for a discussion of the canonical model.)

Since the calculations associated with canonical analysis are extremely involved and time-consuming, a computer

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[25]Cravens, _op_. _cit_., p. 114.

[26]Donald J. Veldman, "Chapter II, Regression Analysis" (parenthesis added), _FORTRAN Programming for the Behavioral Sciences_ (New York: Holt, Rinehart and Winston, 1967), p. 2.

[27]_Ibid_., p. 10.

program available for this task was used to analyze data collected. The program utilized was developed by Professor Donald J. Veldman, University of Texas, and is entitled the CANONA Program.[28]

Program CANONA can accommodate up to 50 variables on each side of the program and this limit can be extended by using more temporary storage tape units. A description of the CANONA procedure as outlined by Veldman is indicated below:

1. First, a correlation matrix RAA is computed by the CORS Subroutine (a subroutine to compute means, sigmas, and intercorrelations from raw data on cards, with optional data-tape output) and then a second data-card format is read, replacing the one that followed the Parameter Control Card. Subroutine CORS is again called to compute correlation matrix RBB. The raw data are then read back into memory one subject at a time to compute the cross-correlation matrix RAB.
2. The basic relationships matrix $RBB^{-1}\ R^{1}BA$ RAA^{-1} RAB is computed next and submitted to

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[28] Veldman, _op_. _cit_., pp. 32-39.

Subroutine AEVS (a subroutine to extract roots and vectors from a square asymmetric matrix) for extraction of roots and vectors, since it is an asymmetric matrix. The vectors returned from Subroutine AEVS are normalized to form the B-side weights, and are then used with RAA^{-1} RAB to obtain the A-side weights, which are subsequently normalized also. Correlations between the canonical functions and the original variables on each side are computed next.

3. Chi-square tests are computed next for each of the B canonical roots. All roots (squared canonical correlations), chi-square values, degrees of freedom, and chance-probability values are printed. A test is made of each successive probability value against a minimum value designated on the Parameter Control Card to determine the number of significant canonical functions. The number of functions which exceed this value will be used subsequently in output of weights and the computation of canonical scores for individual subjects. (Since all functions are desired in this study regardless of their probability values, the cut-off field on the Parameter Control Card was set at 1.0(10000).[29]

[29]Veldman, _op_. _cit_., p. 286.

CHAPTER IV

RELATIONSHIP BETWEEN THE DECISION-MAKER, TASK AND INDIVIDUAL-TASK INTERACTION DOMAINS VARIABLES AND THE SET OF INFORMATION-PROCESSING VARIABLES

The procedures used to analyze the empirical data collected concerning the variables included in the decision-maker, task, and individual-task interaction domains are discussed, along with their relationships to the variables in the information-processing domain, specifically as these variables concern the hypothesis that "There is a significant relationship between the set of variables from the decision-maker, task, and individual-task interaction domains and the set of dependent variables from the information-processing domain." A summary of the findings and conclusions concerning the hypothesis is presented.

Independent Variables

Data was collected for nineteen variables in the independent group. The specific variables included in the independent set and the data collection procedures are discussed in detail in Chapter III. Selected variable measurements were used which by definition are not independent of each other. In other instances more than one instrument was used to measure a specific variable. The reason for including these non-independent and overlapping measures was to obtain the most promising data for analysis.

Inclusion of the data from the non-independent and overlapping measurements in the canonical analysis would tend to reflect canonical correlation coefficients much higher than might actually be present. Hence, an effort was made to eliminate selected variables from analysis beyond the simple correlation stage. (See Appendices N, O, and P).

A total of four independent variables were selected for elimination from canonical analysis. These were total professional experience (P_1), performance rank (P_2), technical man-hours invested (T_6) and probability estimate (Outcome)(J_3). Specific reasons for excluding these measurements from the canonical analysis are as follows: (1) OCCE experience and total experience seeks to measure the same variable and since OCCE experience is a part of total professional experience, inclusion of both measurements would tend to indicate higher canonical correlation coefficients than would actually be present; (2) Performance rank and performance index both measure job performance (P_2). Hence, based on the nature of the measurements and the simple correlations with each of the dependent measures, the performance index was chosen for canonical analysis; (3) Technical man-hours invested and the scope and complexity rating for each task both measure the same variable (T_6). Therefore, technical man-hours was eliminated from canonical analysis; (4) Probability of outcome was eliminated because by definition the measure was not independent of other measures that were retained in the study.

Dependent Variables

The information-processing domain consists of four groups of variables. These are: search for information, receipt of information elements; evaluation, and integration. The variables within these groups are the dependent variables of this study. Specific variables included in the dependent set and the data collection procedures used are discussed in detail in Chapter III.

Selected measurements were excluded from canonical analysis because they are by definition not independent of other measures retained in the canonical analysis. Total sources sought seek to measure the same variable (I_1) as the measures sources sought (internal) and sources sought (external). Total search hours is not independent of search investment (hours/source). Competency reliability (mean rating total elements) is not independent of competency reliability (mean rating-rejected elements) and competency reliability (mean rating-accepted elements) which were retained in the study. Relevance to task (mean rating-total elements) is not independent of relevance to task (mean rating-rejected elements) and relevance to task (mean rating-accepted elements) which were retained in the study. Image state (mean rating-total elements) is not independent of image state (mean rating-rejected elements and image state (mean rating-accepted elements) which were retained in the study. Evaluation investment (average hours/rejected elements) and evaluation investment (average hours/accepted elements) are not independent of evaluation investment (total evaluation hours) which was retained in the study.

The change in image state index is by definition the difference between the image state of the research subject at the beginning of the task and his image state at the completion of the task; that is, if the image state is assumed to be zero (perfect) at the completion of the task (this concept was discussed in Chapter III) then the image state change is equal to the value of the image state at the beginning of the task. Since this fact caused both the independent variable, image state index, and the dependent variable, image state change, to be the same, the dependent variable was excluded from the canonical analysis.

Measures of contribution to result and relevance to task were designed to measure different items. The contribution to result measure was designed to rate the contribution of a given information element to the final result of the problem. Each research subject was instructed to attempt to make this rating at the time of his accept/reject decision.

The relevance to task measure was designed to indicate the degree of relevancy that a specific information element has with respect to the task at hand. However, the correlation between relevance of accepted elements and contribution to results of accepted elements was .4872 (See Appendix O). Therefore, the contribution to result measure was not included in canonical analysis.

Correlation of Independent Variables with Dependent Variables

The set of variables from the decision-maker, task, and individual-task interaction domains were found to be highly correlated with the set of dependent variables from the information-processing domain. The canonical correlation coefficient between the independent set of variables and the dependent set of variables was 0.8718 and was significant at an alpha level of 0.000. Cravens also found the set of independent variables drawn from the individual, task, and individual-task interaction domains to be highly correlated with the dependent set of information-processing variables. The canonical correlation coefficient between the independent and dependent set in his study was 0.940 and was significant at an alpha level of 0.001.[1]

A high canonical correlation between the set of independent variables and the set of dependent variables suggests

[1]David W. Cravens, "An Exploratory Study of Individual Information Processing and Decision Making" (unpublished dissertation, Indiana University, 1967), p. 120.

that there is a significant relationship between the two sets of variables. Since Cravens[2] found the two sets of variables to be highly correlated also and since the variables selected as potential correlates in the Cravens[3] study and in this study have been found in previous research studies to impinge upon information-processing behavior as reflected in Chapter II, this is not an unexpected finding.

As indicated by Veldman, "The goal of canonical analysis is to define the primary independent dimensions which relate one set of variables to another set of variables. The technique is primarily descriptive, although the method used involves finding sets of weights which will yield two composite variables (one for each set of original variables) which will correlate maximally. The output of a canonical analysis should suggest answers to questions concerning the number of ways in which the two sets of measures are related, the strengths of the relationships, and the nature of the relationships so defined."[4] The nature of associations of the independent variables and dependent variables in the system are discussed in the following paragraphs.

Task result rating had the highest correlation (-0.5138) with the independent composite variable of any of the measures within the independent set. Task result rating is an attempt

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[2]Cravens, _op. cit._, p. 120.

[3]_Ibid._, pp. 100-114.

[4]Donald J. Veldman, _FORTRAN Programming for the Behavioral Sciences_ (New York: Holt, Rinehart and Winston, 1967), p. 282.

to evaluate the results of each task in terms of the task objectives and constraints. Very good results would be reflected in terms of the degree to which positive statements can be made regarding the solution, using the objectives and constraints as a base of reference. Thus, successful task results appear to be positively associated with the independent canonical composite variable which in turn is positively related to the dependent canonical composite variable.

In the Cravens[5] study information-processing efficiency (IPE) index had the highest correlation (0.801) with the independent composite variable of any of the measures within the independent set. Since the IPE index was measured in terms of decision time divided by decision quality (see Appendix D), the higher the IPE index the lower the information-processing efficiency. Hence, a high value of the IPE index reflects a relatively low information-processing efficiency.

Precision of definition had the second highest correlation (-0.4465) with the independent composite variable. A well-defined task is one where the objectives and constraints of the task are completely specified. Further contact with the task originator is unnecessary. A poorly-defined task is one where the problem-solver does not know what is required

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[5] Cravens, op. cit., pp. 128-32.

in terms of task objectives and constraints. This result suggests that the precision of definition, how well the objectives and constraints of a task are defined, is a key contributor to the independent set.

The individual's image state index had the second highest correlation (0.397) with the independent composite variable in the Cravens[6] study. In the current study the individual's image state index had the seventh highest correlation (0.3039) with the independent composite variable. The image state index of an individual for a given task refers to the combined state of knowledge concerning a task at its outset. The lower the value of the index, the higher is the individual's state of knowledge with an index of zero reflecting a state of perfect knowledge.

Risk-taking propensity index had the third highest correlation (-0.3991) with the independent canonical composite variable. A relatively high value of the risk-taking propensity index is intended to identify a risk-evader. Hence, individuals with conservative tendencies (as measured by the RTP index) are associated with high values of the independent canonical composite and are key contributors to the independent set.

Intellective aptitude had the fourth highest correlation (-0.3727) with the independent composite variable. The

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[6] Cravens, op. cit., p. 132.

Wonderlic Personnel Test was utilized as an intellective measure. Hence, a high correlation between intellective aptitude and the independent canonical composite variable suggests an important role for intellective aptitude in the canonical system. Therefore, a linkage is provided between the intellective aptitude variable and variable measures in the dependent set. In the Cravens[7] study, intellective aptitude made a relatively modest contribution to the independent set.

The strength of the relationship of each of the remaining eleven independent variable measures is reflected by the composite correlation coefficient shown in Table I. A comparison of the composite correlations for independent variables found in this study with those found in the Cravens study is presented in Table III.

Competency reliability (accepted elements) had the highest correlation (-0.7623) with the dependent composite variable of any of the measures within the dependent set. Competency reliability is the result of the decision-maker's evaluation of the source of the information element. If a source was considered to be highly reliable, then this rating was relatively high. Alternatively, if the reliability of the source of the information element was considered to be low, the competency reliability rating was low.

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[7]Cravens, op. cit., p. 130.

TABLE I

COMPOSITE CORRELATIONS FOR INDEPENDENT MEASURES IN DECREASING ORDER OF MAGNITUDE

	Variable Measure	Correlation: Variable and Composite ($r_{xi\ x*}$)
1.	Task Result Rating	-0.5138
2.	Precision of Definition	-0.4465
3.	Risk-Taking Propensity	-0.3991
4.	Intellective Aptitude (Wonderlic Score)	-0.3727
5.	Ordinal Position of Task	0.3405
6.	Job Performance Index	0.3339
7.	Image State Index	0.3039
8.	Time Span (Days)	0.1950
9.	Major Output Code	-0.1612
10.	Scope and Complexity Rating	0.1333
11.	Information Processing Efficiency Index	-0.1219
12.	Task Function	0.1175
13.	OCCE Experience	0.0760
14.	Interest in Task Rating	-0.0622
15.	OCCE Field Code	0.0413

Cravens[8] found sources sought (internal) to have the highest correlation (0.6342) with the dependent composite variable. Thus, the strength of the relationship of sources sought (internal) with the independent correlation composite variable is greater in his study than in the current study.

Relevance to task (accepted elements) had the second highest correlation (-0.5882) with the dependent composite variable. For each information element the decision-maker rated the element as to the degree of relevancy that this particular information element had with respect to a given task. In the Cravens[9] study relevance to task (accepted elements) had the fourth highest correlation (-0.3336) with the dependent composite variable. Hence, the strength of relationship of relevance to task (accepted elements) with the dependent canonical composite variable was not as strong in the Cravens study as is the relationship in the current study.

Image state conflict (accepted elements) had the third highest correlation (0.5716) with the dependent composite variable. Image state conflict is a measure of the influence of a particular information element on the decision-maker's state of knowledge concerning a task. A relatively high rating indicates high conflict; whereas, a relatively low rating indicates low conflict between an information element

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[8] Cravens, _op. cit._, p. 131.

[9] _Ibid._

and the decision-maker's image state. Cravens[10] found image state conflict (accepted elements) to have the seventh highest correlation (0.2110) with the dependent composite variable; thereby, indicating a less significant relationship for this variable in his study as opposed to this study.

Search investment (hours/source) had the fourth highest correlation (0.3260) with the dependent composite variable. Search investment is defined as that portion of the decision-maker's effort up to the point that he had received one or more elements of information. At the time that he began to evaluate information received, the time was entered in the Diary of Information Elements (Appendix I). Search investment (hours/source) had the very lowest correlation (0.0352) in the Cravens[11] study. Search investment (hours/source) is a key contributor to the dependent set in the current study; whereas in the Cravens[12] study this variable made a relatively modest contribution to the dependent set.

The association and strength of the relationships of each of the remaining nine dependent variable measures are reflected by the composite correlation coefficient shown in Table II. A comparison of the composite correlations for dependent variables found in this study with those found in the Cravens' study is presented in Table IV.

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[10] Cravens, op. cit., p. 131.

[11] Ibid.

[12] Ibid.

TABLE II

COMPOSITE CORRELATIONS FOR DEPENDENT MEASURES IN DECREASING ORDER OF MAGNITUDE

	Variable Measure	Correlation: Variable and Composite (r_{yi} y^*)
1.	Competency Reliability (Accepted Elements)	-0.7623
2.	Relevance to Task (Accepted Elements)	-0.5882
3.	Image State Conflict (Accepted Elements)	0.5716
4.	Search Investment (Hours/Source)	0.3260
5.	Rejected Elements Processed	0.2807
6.	Evaluation Investment (Hours)	0.2095
7.	Sources Sought (Internal)	0.1941
8.	Competency Reliability (Rejected Elements)	0.1181
9.	Relevance to Task (Rejected Elements)	0.1092
10.	Image State Conflict (Rejected Elements)	0.0981
11.	Accepted Elements Processed	0.0962
12.	Sources Sought (External)	0.0222
13.	Integration Investment (Hours)	-0.0108

TABLE III

COMPARISON OF COMPOSITE CORRELATIONS FOR INDEPENDENT MEASURES WITH THE CRAVENS STUDY

	Variable Measure	Current Study Correlation: Variable and Composite ($r_{xi\ x*}$)	Cravens Study Correlation: Variable and Composite ($r_{xi\ x*}$)[1]
1.	Task Result Rating	-0.5138	0.3638
2.	Precision of Definition	-0.4465	-0.1002
3.	Risk-Taking Propensity	-0.3991	-0.2732
4.	Intellective Aptitude	-0.3727	0.1162
5.	Ordinal Position of Task	0.3405	-0.0090
6.	Job Performance Index	0.3339	0.1642
7.	Image State Index	0.3039	0.3966
8.	Time Span (Days)	0.1950	0.0750
9.	Major Output Code	-0.1612	(not included in this study)
10.	Scope and Complexity Rating Index	0.1333	-0.0960
11.	Information-Processing Efficiency	-0.1219	-0.7005
12.	Task Function	0.1175	(not included in this study)
13.	OCCE Experience	0.0760	*-0.0384
14.	Interest in Task Rating	-0.0622	-0.1500
15.	OCCE Field Code	0.0413	(not included in this study)

*ARAC Experience included in the Cravens study.

[1] Cravens, *op. cit.*, 131.

TABLE IV

COMPARISON OF COMPOSITE CORRELATIONS FOR DEPENDENT MEASURES WITH THE CRAVENS STUDY

	Variable Measure	Current Study Correlation: Variable and Composite ($r_{yi\ y^*}$)	Cravens Study Correlation: Variable and Composite ($r_{yi\ y^*}$)[1]
1.	Competency Reliability (Accepted Elements)	-0.7623	-0.0568
2.	Relevance to Task (Accepted Elements)	-0.5882	-0.3360
3.	Image State Conflict (Accepted Elements)	0.5716	0.2110
4.	Search Investment (hours/source)	0.3260	0.0352
5.	Rejected Elements Processed	0.2807	0.0720
6.	Evaluation Investment (Hours)	0.2095	0.3352
7.	Sources Sought (Internal)	0.1941	0.6342
8.	Competency Reliability (Rejected Elements)	0.1181	0.4249
9.	Relevance to Task (Rejected Elements)	0.1092	0.2734
10.	Image State Conflict (Rejected Elements)	0.0981	0.0983
11.	Accepted Elements Processed	0.0962	-0.2793
12.	Sources Sought (External)	0.0222	0.1482
13.	Integration Investment(Hours)	-0.0108	0.2109

[1] Cravens, *op. cit.*, p. 131.

Summary of Results

The set of variables from the decision-maker, task, and individual-task interaction domains were found to be highly correlated with the set of dependent variables from the information-processing domain. The canonical correlation coefficient between the independent and dependent set of variables was 0.8718 and was significant at the alpha level of 0.000. Findings of this study are consistent with the findings of the Cravens study. He found the canonical correlation coefficient between the independent and dependent set to be 0.940 and was significant at an alpha level of 0.001.

Task result rating, precision of definition, risk-taking propensity, and intellective aptitude were the key contributors to the independent set composite correlation variable and competency reliability (accepted elements), image state conflicts (accepted elements), and search investment (hours/source) were the key contributors to the dependent set composite correlation variable.

Based on the relatively high canonical correlation between the independent and dependent sets of variables, one can accept the hypothesis that there is a significant relationship between the set of independent variables from the decision, task, and individual-task interaction domains and the set of dependent variables from the information-processing domain.

The results of this study suggest the following description of an individual research subject's information-processing behavior. Individuals who tend to be risk-takers and possess a relatively high intellective aptitude, on tasks where the results are rated relatively high and the precision of definition is well-defined, tend to place a high value on the competency and reliability of accepted information elements; tend to place a relatively high value on the relevancy to the task of accepted information elements; and spend relatively large amounts of time searching for information.

CHAPTER V

RELATIONSHIP BETWEEN SELECTED VARIABLES WITHIN THE DECISION-MAKER, TASK, AND INTERACTION VARIABLES (INDEPENDENT GROUP) AND THE INFORMATION-PROCESSING VARIABLES (DEPENDENT GROUP)

Chapter V describes the procedures used to analyze the empirical data collected concerning the test of three hypotheses. These hypotheses are: (1) Years of experience and performance on the present job are idiosyncratic characteristics of the decision-maker which significantly influence an individual's information-processing behavior; (2) Characteristics of the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables; and (3) The correlation between the independent variables (task and individual/task, scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task with the dependent variables (information-processing) is not significant. Therefore, these selected independent variables do not significantly influence the individual decision-maker's information-processing behavior.

Data for the specific variables involved with the above hypotheses were collected and measured as described in Chapter II.

Selected Groups of Independent Variables As Correlates of Information-Processing Behavior

Veldman observes that correlations between the original variables and the canonical composite variable can be viewed as factor loadings in that large correlation coefficients for particular variables indicate that these variables contribute more to the variable set than those variables with smaller coefficients.[1] Hence, a high correlation between a selected variable and the canonical composite variable suggests an important role for the variable in the canonical system. Further, the square of the canonical correlation coefficient divided by one can be used as a measure of the proportion of variation explained by the variables included in the system.

Professional Experience and Job Performance Variables

Total professional experience and Oklahoma Center for Continuing Education (OCCE) experience seek to measure the same variable as discussed in Chapter IV. Hence, total professional experience was excluded from canonical analysis because the OCCE professional experience appeared more relevant to the current research effort. OCCE experience was found to play a rather negligible role in contributing to the correlation of the independent set of variables with the dependent set of variables. This variable had a canonical

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[1]Donald J. Veldman, "Chapter II, Regression Analysis," FORTRAN Programming for the Behavioral Sciences (New York: Holt, Rinehart and Winston, 1967), p. 10.

correlation coefficient of 0.0760, which indicates that OCCE experience explains only .58 percent of the variation explained by the independent variables in the system.

ARAC experience, experience in the Aerospace Research Applications Center at Indiana University was also found to play a negligible role in contributing to the correlation of the independent and dependent set of variables in the Cravens[2] study. ARAC experience had a correlation coefficient of -0.0384[3] and explained only .15 percent of the variation explained by the independent variables in the system.

Job performance rank and job performance index both are designed to measure how well an individual performs his job. The job performance index was chosen for canonical analysis for reasons noted in Chapter IV. Job performance index made a modest contribution to the correlation of the independent set of variables with the dependent set of variables. With a canonical correlation coefficient of 0.3339 job performance explained 11.15 percent of the total variation explained by the independent variables in the system.

In the Aerospace Research Applications Center[4] study, job performance was found to have made a relatively negligible

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[2]David W. Cravens, "An Exploratory Study of Individual Information-Processing and Decision Making" (unpublished dissertation, Indiana University, 1967), p. 131.

[3]_Ibid_.

[4]_Ibid_., p. 121.

contribution to the correlation of the independent and dependent sets of variables. In the ARAC study job performance had the sixth highest correlation (0.1642) with the independent canonical composite variable and explained only 2.70 percent of the total variation explained by the independent variables in the system.

Based on the above findings the hypothesis that "years of experience and performance on the present job are idiosyncratic characteristics of the decision-maker which significantly influence an individual's information-processing behavior" must be rejected.

Individual and Individual/Task Interaction Variables Vs Task Variables As Correlates of Information-Processing Behavior

Five of the variable measures from the individual domain were included in the canonical analysis. These were: OCCE experience, job performance index, intellective aptitude, risk-taking propensity index, and information-processing index. Three of the individual/task interaction domain variables were included in the canonical analysis. The remaining individual domain and individual/task interaction measures were excluded from canonical analysis for the reasons discussed in Chapter IV.

Seven of the variable measures from the task domain were included in the canonical analysis. These were: OCCE field code, major output code, OCCE task field code, time span (days), precision of definition, scope and complexity rating, and task result rating.

The contribution of each variable within each of the three subgroups is reflected by the correlation between each original variable and the composite variable for the independent set. Based on an examination of the correlation coefficients of each of the variables, the findings reveal that the individual and individual/task interaction domains variables explain 53.36 percent of the total variation explained by the independent variables in the system. Whereas, the task domain variables explain 46.72 percent of the total variation.

Cravens notes that an inspection of the key contributors to the independent set in his study suggests that characteristics related to the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables.[5] Here, the two studies are consistent as they relate to these particular groups of variables.

In view of the findings at the Oklahoma Center for Continuing Education and the findings at the Aerospace Research Applications Center,[6] the hypothesis that "characteristics of the decision-maker and his interaction with the task are

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[5]David W. Cravens, "An Exploratory Analysis of Individual Processing," Management Science, Vol. 16, No. 10 (June, 1970), p. B-664.

[6]Ibid.

better correlates of information-processing behavior than are task variables" can be accepted. However, the magnitude of the difference between the percent of the total variation explained by the individual and individual/task interaction variables as opposed to the task variables is not of a large magnitude in that the former groups explain 53.36 percent and the latter group explains 46.72 percent, or a difference of only 6.64 percent.

Selected Independent Variables As Correlates of Information-Processing Behavior

Scope and complexity was measured via a one through seven rating scale and via the total technical manhours invested in a given task. However, only the rating scale was used in the canonical analysis as discussed in Chapter IV. Uncertainty-of-outcome was measured via a probability estimate made by the research subject for each task. Time span was measured in days, lapse time from beginning to completion of a task. The ordinal position of the task was the position of each task with respect to all other tasks being handled by a particular subject. It was obtained by a simple ranking.

The four independent variables: scope and complexity, uncertainty-of-outcome, time span (days), and ordinal position-of-task, made a modest to negligible contribution to the correlation of the independent set of variables with the information-processing variables. A review of the relative contributions of each variable via the correlation coefficients of each variable with the canonical composite variable for the independent set reveals that the variables combined explained only 17.79 of the total variation explained by the independent set.

The results of the Cravens[7] study reveal that the scope and complexity, uncertainty-of-outcome, time span, and ordinal position of task played negligible roles in the correlation of the independent set of variables with the information-processing variables. The combined effects of these variables in this study explained only 1.58[8] percent of the total variation explained by the independent set, which is considerably less than the combined effect of these variables in the current study.

In view of the findings of the current study and the findings of the Cravens[9] study, the hypothesis that, "the correlation between the independent variables (task and individual/task), scope and complexity, time span, uncertainty-of-outcome, and ordinal position of task with the dependent variables (information-processing) is not significant" may be accepted. Further, an assumption can be made, at least in the two types of environments studied, that these selected

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[7]Cravens, op. cit., p. 121.

[8]Ibid., p. 130.

[9]Ibid., p. 121.

independent variables do not significantly influence the individual decision-maker's information-processing behavior.

Summary of Results

The data collected concerning three hypotheses considered in this chapter were analyzed using the correlations between the original variables and the canonical composite variable as factor loadings since large correlation coefficients for particular variables indicate that these variables contribute more to the variable set than those variables with smaller coefficients.

Individual variables of job experience and job performance were found not to significantly influence an individual's information-processing behavior. Therefore, the hypothesis that "years of experience and performance on the present job are idiosyncratic characteristics which significantly influence an individual's information-processing behavior" must be rejected.

Characteristics of the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables. Based on an examination of the correlation coefficients of each of the variables, the findings reveal that the individual and individual/task interaction domains variables explain 53.36 percent of the total variation explained by the independent variables in the system. Whereas, the task domain variables explain 46.72 percent of the variation. Hence, the hypothesis that "characteristics of the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables" can be accepted.

Task scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task were found to have made relatively negligible contributions to the correlation of the independent and dependent sets of variables. In view of the findings, the hypothesis that "the correlation between the independent variables (task and individual/task), scope and complexity, time span, uncertainty-of-outcome, and ordinal position of task with the dependent variables is not significant" may be accepted. Therefore, these selected variables were found to have not significantly influenced the individual decision-maker's information-processing behavior.

CHAPTER VI

INDIVIDUAL PROBLEM-SOLVERS AND PROBLEMISTIC SEARCH

The purpose of this chapter is to analyze the empirical data collected and report the results of the investigation concerning two hypotheses. These hypotheses are: (1) In describing an individual's task-oriented information-processing behavior, those individual problem-solvers identified as risk-takers by Kogan and Wallach's Choice Dilemma Test[1] tend to be relatively inefficient as processors of information as opposed to those individual problem-solvers identified as risk-evaders; and (2) Individuals with relatively low task result ratings utilize fewer available internal sources of information when image states are high at the outset of a task.

"In canonical correlation the relationship between an independent and a dependent variable can be seen indirectly by first considering the correlation of the independent variable with its composite; next the correlation between the two composites; and finally, the correlation of the

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[1]Nathan Kogan and Michael A. Wallach, Risk-Taking: A Study in Cognition and Personality (New York: Holt, Rinehart and Winston, 1964), p. 179.

dependent variable with its composite."[2] This technique was used to ascertain the relationship of selected independent variables and selected dependent variables from the information-processing domain.

Risk-Taking Propensity As a Correlate of Information Sources Sought

Risk-taking propensity had the third highest correlation (-0.3991) with the independent canonical composite variable. A relatively high value on the risk-taking propensity index is intended to identify a risk-evader. Hence, individuals with conservative tendencies (as measured by the RTP index) are associated with high values of the independent canonical composite variable and are key contributors to correlation of the independent and dependent sets of variables.

As discussed in Chapter IV the set of variables from the decision-maker, task, and individual-task interaction domains (independent set) were found to be highly correlated with the set of dependent variables from the information-processing domain. The canonical correlation coefficient between the independent and dependent sets of variables was 0.8718 and was significant at an alpha level of 0.000. In other words, the independent variables seek to explain 76.00 percent of the variation in the dependent group.

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[2]David W. Cravens, "An Exploratory Analysis of Individual Information-Processing," Management Science, Vol. 16, No. 10 (June, 1970), p. B-664.

Information-processing efficiency has a relatively low correlation (-0.1219) with the independent canonical composite variable. A relatively small correlation coefficient for a particular variable indicates that this variable contributes less to the canonical composite variable and to the correlation of the independent and dependent sets of variables. In this context information-processing efficiency played an almost negligible role.

Interpretation of the above findings suggests that risk-evaders are associated with a high value on the risk-taking propensity-index which was highly correlated with the canonical composite variable. Information-processing efficiency was measured in terms of decision time divided by decision quality (see Appendix D). Hence, a high value on the information-processing-index reflects relatively low information-processing efficiency. Individuals with relatively low information-processing efficiency appear to be positively associated with the independent canonical composite which in turn is positively related to the dependent canonical composite variable. Thus, the results of this study suggest that risk-takers are relatively inefficient as processors of information. Thus, the hypothesis that, "in describing an individual's task-oriented, information-processing behavior, those individual problem-solvers identified as risk-takers by Kogan and Wallach's[3] Choice Dilemma

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[3]Kogan and Wallach, op. cit., p. 179.

test tend to be relatively inefficient as processors of information as opposed to those individual problem-solvers identified as risk-evaders" can be accepted. Further, the negative correlation between the two variables (information-processing efficiency and risk-taking propensity) suggests that risk-evaders are more efficient information processors.

Task result rating had the highest correlation (-0.5138) with the independent canonical composite variable of any of the measures within the independent set. Task result rating seeks to evaluate the results of each task in terms of the task objectives and constraints. Successful task results appear to be positively associated with the independent canonical composite variable which in turn is positively correlated with the dependent canonical composite variable.

Image state for a task was used to gain a measure, or index, of each subject's image state, combined knowledge concerning a particular task. This concept was discussed in Chapter II (Related Research). The lower the value of the image state index, the higher is the decision-maker's state of knowledge with an index of zero reflecting a state of perfect knowledge. The image state index had a correlation of (0.3039) with the independent canonical composite variable. Since the lower the value on the image state index, the higher is the decision-maker's state of knowledge concerning the task at hand, the subjects in this study had relatively high image states at the outset of the task.

Sources sought (internal) had the seventh highest correlation (0.1941) with the dependent canonical composite variable. The correlation coefficient for this variable indicates that it made only a modest contribution to the dependent canonical composite variable.

The findings of this study suggest that individuals with high task results ratings utilized relatively few internal information sources. Task result rating had the highest correlation with the independent canonical composite variable and explained 26.40 percent of the total variation explained by the independent variables. Image state ranked seventh among the fifteen independent variables in correlation with the independent composite variable. Recalling that the lower the value on the image state index, the higher is the individual's state of knowledge, subjects in this study had relatively high image states. Whereas, internal sources sought was only moderately correlated with the dependent composite variable.

As a result of the findings the hypothesis that, "individuals with relatively low task result ratings utilize fewer available internal sources of information when image states are high at the outset of a task," can be accepted.

Summary of Results

The purpose of this chapter was to analyze the empirical data collected and to report the findings concerning two hypotheses. The technique of establishing relationships between independent and dependent variables by first considering the correlation of the independent variable with the composite, then the correlation between the two composites, and finally, the correlation of the dependent variable with its composite was used.

The findings of the study suggest that risk-evaders are associated with a high value on the risk-taking propensity index which was highly correlated with the composite variable. A high value on the information-processing efficiency index reflects relatively low information-processing efficiency. Thus, the negative correlation between the two variables (information-processing efficiency and risk-taking propensity suggests that risk-evaders are more efficient information processors than are risk-takers.

The findings of this study suggest that individuals with low task results ratings utilized relatively few internal information sources. Hence, the hypothesis that, "individuals with relatively low task result ratings utilize fewer available internal sources of information when their image states are high at the outset of a task, can be accepted. This finding is consistent with the Cravens[4] study and with the

[4]Cravens, op. cit., p. 70.

observations of Cyert and March concerning individual problem-solving behavior that, "problemistic search by the individual . . . proceeds on the basis of a simple model of causality until driven to a more complex one."[5]

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[5]Richard M. Cyert and March, James G., A Behavioral Theory of the Firm (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963), p. 121.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Since the individual is a vital element in any information system, the goal of an information system should be to effectively link the user with the applicable information base in a manner which matches relevant information with needs. The individual user of information has been the subject of several studies but the body of knowledge that has been developed relative to the task-oriented, information-processing activities of individual problem-solvers in terms of the influences on what information is sought, what the problem-solver does with the information, and the relationship of this information to the results achieved by the individual problem-solver is relatively small.

The primary objective of this study was to conduct an investigation of the possible linkage between individual and situational variables and information-processing variables in solving problems associated with the research and development of continuing education projects and programs. By utilizing the specific methodology used in previous research in an industrial research and development environment with graduate student research subjects, an attempt was made to replicate the research methodology in a continuing education environment utilizing professional personnel as research subjects.

This research study is divided into three separate parts. Part I is a review and evaluation of research in three related areas, individual-thinking processes, information-processing, and the decision-making process. Part II is concerned with the conceptual system of variables and in identifying potential relationships of these variables with each other through empirical research. Part III presents the specific methodology and techniques used to analyze the empirical data.

Results of the Study

As noted in Chapter I, in order to achieve the objectives of this research study, six testable hypotheses were formulated. In the following paragraphs a summary of the findings and conclusions concerning each hypothesis is presented.

The first hypothesis was, "There is a significant relationship between the set of independent variables from the decision-maker, task, and individual-task interaction domains and the set of dependent variables from the information-processing domain." This hypothesis is designed to identify the possible linkage between explanatory individual and situational variables and information-processing variables.

Independent variables from the decision-maker, task, and individual-task interaction domains were found to be highly correlated with the set of dependent variables from the information-processing domain. The canonical correlation coefficient between the independent and dependent sets of variables was 0.8718 and was significant at an alpha level of 0.000. A high canonical correlation between the set of independent variables and the set of dependent variables suggests that there is a significant relationship between these two sets of variables. These findings are consistent with the findings of the Cravens study. He found the canonical correlation coefficient between the independent and dependent sets of variables to be 0.940 and significant at an alpha level of 0.001.

The second hypothesis was, "Years of experience and performance on the present job are idiosyncratic characteristics of the decision-maker which significantly influence an individual's information-processing behavior." Individual variables of job experience and job performance were found not to significantly influence an individual's information-processing behavior. Therefore, this hypothesis was rejected. This finding is consistent with the Cravens study in that he also found job experience and job performance to have played negligible roles in contributing to the correlation of the independent set of variables with the dependent set of variables.

The third hypothesis was, "Characteristics related to the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables." Characteristics of the decision-maker and his interaction with the task were found to be better correlates of information-processing behavior than task variables. Cravens also notes that an inspection of key contributors to the independent set in his study reveals that characteristics related to the decision-maker and his interaction with the task are better correlates of information-processing behavior than are task variables. The two studies are consistent as they relate to these particular groups of variables.

The fourth hypothesis was, "The correlation between task scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task with the information-processing variables is not significant." Task scope and complexity, time span, uncertainty-of-outcome, and ordinal position of the task were found to have made relatively negligible contributions to the correlation of the independent and dependent sets of variables. Therefore, these selected independent variables were found not to have significantly influenced the individual decision-maker's information-processing behavior. The results of the Cravens study reveal that these selected independent variables also played negligible roles in correlation of the independent set of variables with the information-processing variables.

The fifth hypothesis was, "In describing an individual's task-oriented information-processing behavior, those individual problem-solvers identified as risk-takers by Kogan and Wallach's Choice Dilemma Test tend to be relatively inefficient as processors of information as opposed to those individual problem-solvers identified as risk-evaders." The results of this study suggest that risk-evaders are more efficient information-processors than are risk-takers. Cravens also concludes that individuals who process information relatively inefficiently tend to be risk-takers.

The sixth hypothesis was, "Individuals with relatively low task-result ratings utilize fewer available internal sources of information where their image states are high at the outset of the task." Individuals in this study who had low task-result ratings were found to have utilized relatively few internal information sources. This finding is also consistent with the Cravens study finding.

While each of the findings concerning the above hypotheses are consistent with the findings of the Cravens study, it should be noted that the strength of relationship of the various independent and dependent variables with each other is not the same as in the current study. A comparison of the composite correlations variable measures of this study with the Cravens study is reflected in Table III and Table IV.

The objectives of this study appear to have been accomplished in that each of the six hypotheses was tested in a continuing education environment, the results were reported, and specific areas in which this study supported the findings of the Cravens study are identified. Further, a strong linkage was established between individual and situational variables and information-processing variables in solving problems associated with the research and development of continuing education projects and programs.

Implications for Management

The primary objective of this study was to conduct an investigation into the possible linkage between individual and situational variables and information-processing variables in solving problems associated with the research and development of continuing education programs. Task-result rating, precision-of-definition rating, risk-taking propensity index, and intellective aptitude were the key contributors to the independent set composite correlation variable and were associated with the four highest-ranked dependent variables in the following manner:

1. High competency/reliability ratings for accepted information elements.
2. High relevance to task for accepted information elements.

3. Relatively high image-state conflict for accepted information elements.

4. High search (hours/source) investment.

The above noted results suggest the following description of individual research subjects' information-processing behavior. Individuals, who tend to be risk-takers and possess a relatively high intellective aptitude, on tasks where the results are rated high and the precision of definition is well defined, tend to:

1. Place a high value on the competency and reliability of accepted information elements.

2. Place a high value on the relevance of accepted information elements to the task.

3. Spend relatively large amounts of time searching for information.

In those instances where the findings of this study are consistent with previous research efforts, there is a possibility of abstracting these findings into a conceptual model which may be useful in describing the information-processing behavior of individual decision-makers. This conceptual model is of necessity primarily associated with an organizational information system since this study was primarily concerned with the individual as an information-processor. Based on research findings to date, a conceptual model may take the form of the model discussed in the following paragraphs.

An examination of Table III (Comparison of Composite Correlations for Independent Measures with the Cravens Study) reveals that the values of the composite correlations for selected variables are very close to the values of composite correlations found in previous research. The independent variable measurements are task-result rating, risk-taking propensity index, and image-state index. Task-result ratings are the result of the research subjects' attempts to evaluate the results of each task in terms of the task objectives and constraints. The risk-taking propensity index is the result of the research subjects' scores on the Choice Dilemmas Procedure Test described in Chapter III. The image-state index is a measure of an individual's state-of-knowledge for a particular task at its outset; that is, his evaluation of potential sources of information as to the probable accuracy and reliability of information that will be received.

It has been found in previous research efforts that in many instances formal information systems are not widely used by individual decision-makers. Two primary reasons for this have been found to be a lack of awareness of the existence of the services provided by the formal information system, and in other instances the formal information system did not provide the features desired by the user, particularly convenience, responsiveness, and the ability to conduct a dialogue with the system.

To improve an existing management information system, or establish a new system, management must observe user habits and accumulate detailed data on such items as traffic volume, response time, vocabulary, type and complexity of questions, need for information and data, and types of tasks on which information is required. Task-result rating and the image-state index could be used by management to identify solution-paths for problem-solving which would be helpful in integrating the formal and informal information system so that the user actually becomes an integral part of the information system.

The image-state index of an individual problem-solver is the result of his state of knowledge for a particular task; that is, his evaluation of potential sources of information and the probable accuracy and reliability of information that will be received. There are two main paths through which a particular individual is included in a problem-solving process. The first is for substantive reasons and the second is for organizational reasons. In the first instance certain sources are included because they are seen by the decision-maker as possessing information required to solve the problem. In the second instance inclusion of certain sources is required by the organizational structure. Information from sources included for substantive reasons (in many instances these represent the informal system) will be given more weight than information from sources included for procedural reasons. Hence, the individual decision-maker's image-state for a given task, that is, his evaluation of the reliability and accuracy concerning the various positions in a management information system, could be very useful to management in identifying the elements of the informal information system and in modifying the formal information system to more adequately meet user needs.

Task-result ratings and image-state index measures could also be used by management as a basis for training programs which, if properly implemented, could strengthen both the informal and formal information systems. As an example of such a program, improvements to the local environment could be made through a local skills inventory; that is, develop a directory which is organized by skill area and would list such items as a source, individual's name, telephone number, and experience in a subject area. Also, a training course, or guide, may be developed to bring to the attention of decision-makers techniques currently available to assist them in better organizing their personal files, thereby enhancing their image states for tasks within their decision areas.

Risk-taking propensity was measured via an instrument called the Choice Dilemmas Procedures. Each item on this twelve-item instrument represents a choice dilemma between a risky and a safe course of action. If the proposition is accepted that, "selection is the process through which we determine whether or not a person has a certain ability and on the basis of that determination decide the degree to which he possesses that ability," the risk-taking propensity index could be valuable in the personnel selection process for certain occupations.

Individuals with conservative tendencies, as measured by the risk-taking propensity index, are more efficient information-processors than are those individuals identified as risk-takers. Hence, persons identified as risk-evaders would have a greater chance for success as, for instance, air traffic controllers. Aside from the safety factors associated with risk-takers, air traffic controllers are required to process large amounts of information, on a continuing basis, on which to base their decisions concerning the control of aircraft movements. Another area which involves extensive information-processing would be in the weather forecasting service. Here again the risk-conservatism index would be a valuable tool in the selection process.

In addition to the two examples noted above, the risk-conservatism index would be a valuable tool in the selection process in any area of management where a decision-maker (administrator) would be able to commit an organization to an irrevocable course of action; that is, his decision would be the final decision for the organization. Examples of occupations of this nature are Commercial Bank Loan Officers, Contracting Officers (Public and Private) and highly placed Public Administration Officers.

Persons identified as risk-takers may be desirable for certain occupations such as scientific researchers, certain types of salesmen positions, and in some instances division managers of aggressive commercial firms. In these instances the ability of the manager to make a decision and take decisive action would be more important than his ability to process large amounts of information. This is not to infer that information-processing is not required, or is not important to the success of these occupations. The risk-taker may be an efficient information-processor in his own right but in general, his information-processing efficiency will not be as great as that of risk-evaders. Hence, there is a trade-off between the individual decision-maker's ability to take risks and his ability to process information.

Suggestions for Additional Research

Further research into the complexities of the individual, the task and his resulting information-processing behavior seems desirable. Additional research appears promising in the following areas:

> Investigation of the variable system used in this study in other continuing education environments and in selected business and industrial environments.

> Since the individual is a vital element in any information system, an investigation to link the results of this study with an applicable information base in a manner which matches relevant information with needs appears desirable.

Study of the relationships among key variables under laboratory conditions. As reflected in Chapter IV, task-result rating, precision of definition, and risk-taking propensity explained .8062 squared, or 65 percent of the variation in the dependent group while the entire 15 variable group explained .8718 squared or 76 percent. Hence, these three measures explained almost as much as the entire set of 15 independent variables. A laboratory study of these selected key variables would be promising as a source of information concerning individual information-processing behavior.

Investigation into other decision-making areas such as finance, marketing, etc. For example, information-processing and decision-making as it concerns customer decision-making could provide a valuable point of reference for product promotional strategy.

Investigation into group information-processing and decision-making as opposed to individual information-processing and decision-making. Since the current effort has been directed toward individual information-processing and decision making, a study of the same variable system from the point of view of group problem-solving activity would be interesting.

Refinement of selected measures of variables used in the system. Of particular interest would be measures used to gauge the time problem-solvers spend on search for information and evaluation of information elements received. From a data collection and conceptual standpoint the concept of a search phase appears relatively straightforward. However, research subjects did experience some difficulty in segregating search time and evaluation time.

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APPENDIX A

JOB PERFORMANCE RANKING GUIDE

OBJECTIVE

Will you please rank the individuals listed in the left hand column from high to low, using the following job performance factors as a basis of comparison of individuals. The factors are not listed in any particular order of importance.

1. Depth of problem-solving capability. Number of approaches generated--imagination, ingenuity, generation of feasible alternatives. Ability to select "best" alternative.
2. Degree of success in producing results.
3. Consistency with respect to quality and timeliness.
4. Tenacity and perseverance--attention to details.
5. Communication of results.

PROCEDURE

After carefully considering the above five factors, use them as a basis for selecting the individual who ranks at the top of the group. Place his name at the top of the right hand column. Next, select the individual who ranks at the bottom of the group. Write his name at the bottom of the right hand column. Continue, to alternate from next highest to next lowest until all names have been placed in the right column in ranked order from high to low.

Name of Individual	Rank from High to Low
1.____________	1.____________
2.____________	2.____________
3.____________	3.____________
4.____________	4.____________
5.____________	5.____________
6.____________	6.____________
7.____________	7.____________
8.____________	8.____________
9.____________	9.____________

APPENDIX A (Continued)

Name of Individual	Rank from High to Low
10.__________	10.__________
11.__________	11.__________
12.__________	12.__________
13.__________	13.__________
14.__________	14.__________
15.__________	15.__________
16.__________	16.__________
17.__________	17.__________

Source: David W. Cravens, _An Exploratory Study of Individual Information Processing and Decision Making_ (unpublished dissertation, Indiana University, 1967), p. 146.

APPENDIX B

JOB PERFORMANCE RATING

NAME________________________ PERSON RATING________________

DATE________________________

OBJECTIVE

Will you please rate the above individual on the scale below using the following job performance factors as a basis of comparison of individuals. The factors are not listed in any particular order of importance.

1. Depth of problem-solving capability. Number of approaches generated--imagination, ingenuity, generation of feasible alternatives. Ability to select "best" alternative.

2. Degree of success in producing results.

3. Consistency with respect to quality and timeliness.

4. Tenacity and perseverance--attention to details.

5. Communication of results.

PERFORMANCE RATING

Very Low Performance	1	2	3	4	5	6	7	Extremely High Performance

REMARKS

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), p. 147.

APPENDIX C

CHOICE DILEMMAS PROCEDURE

O P I N I O N Q U E S T I O N N A I R E I I

Instructions. On the following pages, you will find a series of situations that are likely to occur in everyday life. The central person in each situation is faced with a choice between two alternative courses of action, which we might call X and Y. Alternative X is more desirable and attractive than alternative Y, but the probability of attaining or achieving X is less than that of attaining or achieving Y.

For each situation on the following pages, you will be asked to indicate the minimum odds of success you would demand before recommending that the more attractive or desirable alternative, X, be chosen.

Reach each situation carefully before giving your judgement. Try to place yourself in the position of the central person in each of the situations. There are twelve situations in all. Please do not omit any of them.

1. Mr. A, an electrical engineer, who is married and has one child, has been working for a large electronics corporation since graduating from college five years ago. He is assured of a lifetime job with a modest, though adequate, salary, and liberal pension benefits upon retirement. On the other hand, it is very unlikely that his salary will increase much before he retires. While attending a convention, Mr. A is offered a job with a small, newly founded company which has a highly uncertain future. The new job would pay more to start and would offer the possibility of a share in the ownership if the company survived the competition of the larger firms.

Imagine that you are advising Mr. A. Listed below are several probabilities or odds of the new company's proving financially sound.

Please check the lowest probability that you would consider acceptable to make it worthwhile for Mr. A. to take the new job.

___ The chances are 1 in 10 that the company will prove financially sound.
___ The chances are 3 in 10 that the company will prove financially sound.
___ The chances are 5 in 10 that the company will prove financially sound.

APPENDIX C (Continued)

___ The chances are 7 in 10 that the company will prove financially sound.
___ The chances are 9 in 10 that the company will prove financially sound.
___ Place a check here if you think Mr. A. should <u>not</u> take the new job no matter what the probabilities.

Source: Nathan Kogan and Michael A. Wallach, Risk Taking: A Study in Cognition and Personality (New York: Holt, Rinehart and Winston, 1964), p. 258.

APPENDIX D

INFORMATION-PROCESSING EFFICIENCY INDEX

Approach

The basic approach in measuring an individual's Information-Processing Efficiency (P_5) for this study will be that utilized by Hayes.[1] The primary modifications to Hayes' procedure will be as follows:

1. A fixed task was utilized in that decision alternatives were held at eight and the characteristics describing each task were held to eight. Hayes varied both from four, six, and eight alternatives and characteristics.

2. The range of values for each characteristic was modified slightly to arrive at task sets A, B, C, and D.

Decision Matrix

A typical data matrix is shown below:

	1	2	3	4	5	6	7	8
Speed	327	387	267	207	267	297	327	297
Pilot	PF	VP	GE	GE	FG	GE	PF	FG
Delay	3	3	3	5	9	3	9	7
Radar	F	F	G	FG	GE	GE	GE	GE
Armament	50%	30%	80%	100%	50%	100%	80%	50%
Distance	150	110	170	250	150	190	210	130

---

[1] John R. Hayes, Human Data Processing Limits in Decision Making, Report No. ESD-TDR-62-48 (Bedford, Mass.: Air Force Systems Command, Electronic Systems Division, July, 1962).

APPENDIX D (Continued)

	1	2	3	4	5	6	7	8
Search	31	36	26	41	26	46	26	26
Contact	F	PF	GE	P	FG	F	FG	G

The numbers one through eight refer to eight alternative aircraft. The task is to decide which of the alternative planes to send to investigate a reported submarine sighting. The characteristics in the left-hand column describe the alternatives. As Hayes indicates:

> The eight characteristics do not share a common unit of measurement nor does an increasing numerical value necessarily indicate an increase in desirability. For example, high numbers are more desirable for 'speed,' but less desirable for 'delay.' These properties of the set of characteristics make it unlikely that the subject will adopt a simple arithmetic rule for arriving at decisions and, hence, will help to insure that decisions will involve genuinely multidimensional judgements.[2]

Thirty-two data matrices will be constructed using the random technique described by Hayes in Appendix A.[3] Four sets (A, B, C, and D) of eight different matrices will be developed. The basic data to be used to randomly construct each matrix are shown on the next page.[4]

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[2]Hayes, _op. cit._, p. 3.

[3]_Ibid._, pp. 24-27.

[4]_Ibid._, p. 41.

APPENDIX D (Continued)

Characteristic	"Best" Value	Rank of Values						"Worst" Value	Unit of Measurement
	1	2	3	4	5	6	7	8	
1. Speed	375	345	315	285	255	225	195	165	Miles per hour
2. Pilot	E	GE	G	FG	F	PF	P	VP	Adjective
3. Delay	0	2	4	6	8	10	12	14	Minutes
4. Radar	E	GE	G	FG	F	PF	P	VP	Adjective
5. Armament	100%	90%	80%	70%	60%	50%	40%	30%	Percent
6. Distance	100	120	140	160	180	200	220	240	Miles
7. Search	55	49	43	37	31	25	19	13	Minutes
8. Contact	E	GE	G	FG	F	FP	P	VP	Adjective

APPENDIX D (Continued)

This basic set of data will be used to generate the eight decision matrices for set A. Sets B, C, and D will be generated by modifying the basic set of data as follows:

1. The values for characteristics 2, 4, 5, and 8 will be the same for task sets A, B, C, and D.

2. On task sets B, C, and D the best "speed" value will begin at 387, 383, and 386, respectively, and decrease in increments of 30.

3. On task set B the best "delay" value will begin at 1 and increase in increments of 2. On set C the best "delay" value will begin at 0 and increase in increments of 2. On set D the best "delay" value will begin at 2 and increase in increments of 1.

4. Distance will begin on sets B, C, and D at 110, 115, and 95, respectively, and increase in increments of 20.

5. Search will begin on set B at 46 and decrease in increments of 5. Search will begin on sets C and D at 53 and 56, respectively, and decrease in increments of 6.

Administration Procedure

Four batteries of eight tasks each will be administered individually to each subject. The make-up of each battery is shown below:

Battery No.	Matrices Included
1.	A_1 B_2 C_3 D_4 A_2 B_3 C_4 D_5
2.	A_3 B_4 C_5 D_6 A_4 B_5 C_6 D_7
3.	A_5 B_6 C_7 D_8 A_6 B_7 C_8 D_1
4.	A_7 B_8 C_1 D_2 A_8 B_1 C_2 D_3

APPENDIX D (Continued)

The instructions given to each subject will be essentially the same as those utilized by Hayes and are shown below:[5]

Before testing each subject will be instructed as follows:

"This is an experiment in decision making. You are based at a shore station and you receive reports of radar sightings of submarines. It is your job to dispatch a single plane to search the area where the sighting occurred. To do this you have to decide which one of the available planes is best for the assignment."

"In each problem, you will have eight planes from which you must choose. In making your decision you will have to consider several factors which describe the planes."

At this point the subject will be shown a data matrix listing the eight characteristics. Each will be explained to him in detail. The subject will then be asked to paraphrase the explanations. If the subject's paraphrasing is judged unsatisfactory, the explanation will be repeated.

The instructions will then continue as follows:

"The problem will be presented to you on these sheets, and will be placed face down in front of you. When I give the signal turn the problem over and start work. When you

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[5]Hayes, _op_. _cit_., pp. 9-10.

have finished, tell me which plane you have chosen.

"Each test will consist of 8 problems. In each problem, you should try to make the best decision possible; accuracy is the most important thing."

Scoring

The construction of each matrix (using Hayes' procedures) will be such that there will be one best, one second best, one third best, and four fourth best alternatives. Scores of 1.00, 0.875, 0.750, and 0.625 will be given for first, second, third, and fourth best alternatives, respectively. These scores correspond to decision quality measures.

The time required by the subject to make a decision on each task will be recorded, along with the particular alternative selected by him.

An information-processing efficiency (IPE) index will be constructed for each subject as follows:

$$\text{IPE Index} = \frac{1}{n} \sum_i \frac{t_i}{q_i}$$

where i goes from 1 to 32,

t_i = time for decision i in minutes,

q_i = quality of decision i,

q_i has alternative values of 1.000, 0.875, 0.750, and 0.625,

and $n = 32$.

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), pp. 150-54.

APPENDIX E

TASK RECORD

(See instructions on back before completing this form)

TASK NO.____________ DATE RECEIVED (T_4)__________

ASSIGNED TO____________ DATE CLOSED OUT (T_4)__________

A. FIELD CODE (T_1)______________

B. MAJOR OUTPUT CODE (T_2)______________

C. KIND OF OUTPUT CODE (T_3)______________

D. PRECISION OF DEFINITION (T_5):
(Place an X above the number selected)

Well Defined	7	6	5	4	3	2	1	Poorly Defined

E. SCOPE AND COMPLEXITY (T_6):
(Place an X above the number selected)

Low Difficulty	1	2	3	4	5	6	7	High Difficulty

TECHNICAL MAN-HOURS EXPENDED (Estimated)________

F. RESULTS (T_7):
(Place an X above the number selected)

Results Very Good	7	6	5	4	3	2	1	Negative Results

G. REMARKS

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), pp. 155-56. (The Kind of Output Code will be provided by the Oklahoma Center for Continuing Education, Norman, Oklahoma.)

APPENDIX E (Continued)

INSTRUCTIONS FOR COMPLETING TASK RECORD

A. Field Code. Indicate the code number in the appropriate field for the task, using the Oklahoma Center for Continuing Education classification codes.

B. Major Output Code

1. Finding	3. Decision
2. Recommendation	4. Other

C. Kind of Output Code. The Four Central, interrelated goals and functions of Continuing Education and Public Service are:[1]

01 To assist individuals and groups in keeping abreast of new knowledge related to the solution of social and economic problems and to the maintenance and advancement of competence in professional, scientific, and technological fields.

02 To assist adult part-time students in pre-professional or career development by making available to them the traditional knowledge of the University.

03 To assist groups (e.g., voluntary associations, communities, governmental agencies, business and industry) in learning and/or applying solutions to problems.

04 To assist individuals in gaining knowledge related to their developmental tasks, their changing life roles, and to their personal development.

D. Precision of Definition. A well-defined task is one where the objectives and constraints are completely specified. Further contact with the originator of the task is unnecessary. A poorly-defined task is one where the problem-solver does not know what is required in terms of objectives and constraints.

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[1]"Program Budgeting - Continuing Education and Public Service," undated, prepared by members of the Office of Assistant Vice President for Education and Public Service (in the files of the Center), p. 1.

APPENDIX E (Continued)

E. Scope and Complexity. A task reflecting high difficulty is one on which the problem-solver has no basis for knowing where to start in it. It is so complex that it requires custom-tailored treatment. In contrast, a low-difficulty task is one where a clear-cut procedure for gaining a solution is known.

F. Results. Results should be evaluated in terms of the task objectives and constraints. Very good results would be reflected in terms of the degree to which positive statements can be made regarding the solution, using the objectives and constraints as a base of reference.

G. Remarks. Indicate any additional comments that may be helpful in characterizing the task and distinguishing it with respect to other tasks. Note unusual characteristics of the task.

APPENDIX F

TASK FIELD CLASSIFICATION SYSTEM

01 Accountant
02 Architects
03 Clergymen
04 Computer Specialists
05 Engineers
- a. Aeronautical and Astronautical Engineers
- b. Chemical Engineers
- c. Civil Engineers
- d. Electrical and Electronic Engineers
- e. Industrial Engineers
- f. Mechanical Engineers
- g. Metallurgical and Materials Engineers
- h. Mining Engineers
- i. Petroleum Engineers
- j. Sales Engineers

06 Lawyers and Judges
07 Librarians
08 Life and Physical Sciences
- a. Agricultural Scientists
- b. Biological Scientists
- c. Chemists
- d. Geologists
- e. Physicists and Astronomers

09 Mathematical Specialists
- a. Actuaries and Statisticians
- b. Mathematicians

10 Operations and Systems Researchers and Analysts
11 Physicians, Dentists, and related Practitioners
- a. Dentists
- b. Physicians, Medical and Osteopathic

12 Registered Nurses, Dietitians, and Therapists
13 Health Technologists and Technicians
- a. Technicians
- b. Clinical Laboratory Technologists and Technicians
- c. Dental Hygienists
- d. Radiologic Technologists and Technicians

14 Social Scientists
- a. Economists
- b. Psychologists
- c. Sociologists

15 Social and Recreation Workers
16 Teachers, except College and University
- a. Elementary School Teachers
- b. Secondary School Teachers

17 Teachers, College and University

APPENDIX F (Continued)

18 Engineering and Science Technicians
   a. Draftsmen
   b. Electrical and Electronic Engineering Technicians
   c. Industrial Engineering Technicians
   d. Mathematical Technicians
19 Technicians, except Health and
   a. Engineering and Science
   b. Airplane Pilots
   c. Air Traffic Controllers
   d. Radio Operators
20 Writers, Artists, and Entertainers
   a. Editors and Reporters
   b. Designers
   c. Musicians and Composers
   d. Radio and Television Announcers
21 All Other Professional, Technical and Kindred Workers
22 Managers and Administrators, except Farm
   a. Bank Officers and Financial Managers
   b. Buyers, Wholesale and Retail Trade
   c. Inspectors, except Construction; Public Administration
   d. Officials and Administrators, Public Administration, n.e.c.
   e. Purchasing Agents and Buyers, n.e.c.
   f. Restaurant and Cafeteria Managers
   g. Sales Managers and Department Heads, Retail Trade
   h. Sales Managers and Department Heads, Retail Trade excepted
   i. School Administrators, College
   j. School Administrators, Elementary and Secondary
   k. Managers and Administrators, n.e.c.
   l. All Other Managers and Administrators, except Farm

Source: Herbert R. Hengst and Robert S. Morrissey, The Oklahoma Continuing Education Opportunities Audit, 1971-72, Norman, Oklahoma (The Center for Studies in Higher Education, University of Oklahoma, June, 1973), pp. 83-84.

APPENDIX G

SEARCH RECORD

(See instructions on back before completing this form)

TASK NO.____________________ DATE RECEIVED_____________

NAME________________________ DATE COMPLETED____________

A. <u>SOURCE ALTERNATIVES</u> (J_1)

Alternative sources from which you anticipate obtaining information relevant to this task. (List as they occur to you)	Probability Estimates. (The sum of each column can exceed 1.0) Does the source contain some relevant information? (q_i)	If there, how helpful will it be? (r_i)
__________	________	______
__________	________	______
__________	________	______
__________	________	______
__________	________	______
__________	________	______
__________	________	______
__________	________	______
__________	________	______

B. <u>INTEREST IN TASK</u> (J_2)

Considering the various tasks that you have worked on, how does your interest in this task compare with them?

(Place an X above the number selected)

Very Low Interest	___ 1	___ 2	___ 3	___ 4	___ 5	___ 6	___ 7	Extremely High Interest

C. <u>CERTAINTY OF OUTCOME</u> (J_3)

What is your probability estimate concerning the likelihood that you will come up with a solution to the task in terms of the objectives and constraints given for the task?

___ 0	___ .1	___ .2	___ .3	___ .4	___ .5	___ .6	___ .7	___ .8	___ .9	___ 1.0

D. <u>TASK LOAD</u> (J_4)

How many other tasks are you currently working on?
Indicate No. ___

APPENDIX G (Continued)

INSTRUCTIONS FOR COMPLETING SEARCH RECORD

A. SOURCE ALTERNATIVES

Please list all possible sources that you believe may contain information relevant to this task. Include such sources as your associates, other individuals (including the person submitting the request), reference books, information systems, etc. These sources are in effect alternatives that you see as avenues through which you can gain a solution to the task.

Probability Estimates. Under column q_i indicate the probability (between 0.0 and 1.0) that each source contains some relevant information--not how much or how good it may be. Under column r_i indicate the probability (between 0.0 and 1.0) that if the source does contain some information, then how helpful will it be. This is your probability estimate of the degree of help.

B. INTEREST IN TASK

Be frank in your indication of interest on this task. If it is of marginal interest to you, then indicate this on the form. If it is of high interest check the form accordingly. Consider other problems you have worked on and try to view your interest in this problem in terms of the others you have worked on.

C. CERTAINTY OF OUTCOME

On some problems you are relatively sure that you will locate relevant information. On others the existence of such information is highly doubtful. Try to objectively estimate the probability of success concerning the outcome of the task that you have been assigned. In other words, how certain are you concerning the outcome of the task in terms of the specified objectives and constraints?

D. TASK LOAD

Indicate here how many other tasks you are working on at the time of receipt of this task.

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), pp. 158-59.

APPENDIX H

DIARY OF INFORMATION SOURCES*
(See instructions on back before completing this form)

NAME____________________ TASK NO.__________

(A) LIST IN ORDER SOURCE IS SEARCHED	(B) SOURCE CODE NO. (I_1)	(C) IDENTIFY (I_1)	(D) ESTIMATED TIME SPENT (I_2)	(E) DATE
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

*Information resulting from your existing knowledge (that contained in your head) is not to be considered in terms of a source. Rather it is characterized by your "image state" for the task at the outset of the task.

APPENDIX H (Continued)

INSTRUCTIONS FOR DIARY OF INFORMATION SOURCES

A. List each source in the order that you begin searching. If you refer more than once to the same source, list it each time in the order it is utilized. People are sources the same as books, computer systems, etc.

B. and C. Identify each source classification in column B by using the following code numbers. Also identify the specific name of the source (i.e., NASA, John Smith, DOD, AEC, Science Information Exchange, etc.) in column C.

SOURCES SOUGHT:

Code No.	Internal	Code No.	External
1.	Supervisor	9.	Library
2.	Colleague	10.	Organized Information System
3.	Other Individual		
4.	Organizational Files		
5.	Personal Files	11.	Consultant
6.	Library	12.	Manufacturer or Supplier
7.	Organized Information System (Manual or Computerized)	13.	Trade or Professional Association
8.	Other (Identify)	14.	Other (Identify)

D. Estimate the time (in hours and fractions thereof) spent in searching each source.

"Search" is defined as that portion of your effort up to the point that you have received one or more "elements" of information. For example, the time spent in writing a computer search strategy should be considered as search time. When you begin to evaluate information received the time should be entered in the "Diary of Information Elements." (Appendix I)

E. Indicate the date search was initiated for each source (if search of a particular source is extended over one day provide a new listing each day). Also enter any sources that are contacted after initial contact. Try to record a play-by-play listing of the sources you contact on the task.

Source: David W. Cravens, An Exploratory Study of Individual Information Processing and Decision Making (unpublished dissertation, Indiana University, 1967), pp. 160-61.

APPENDIX I

TASK NUMBER____________________ NAME________________________

DIARY OF INFORMATION ELEMENTS (Received and Evaluated)
(See Instructions for Columns A-M)

I_5			I_3	I_4	I_6						
(A)	(B)	(C)	(D)	(E)	(F)						
Element Number	Date	Source Number	Channel/ Media Code	Element Type Code	COMPETENCY/ RELIABILITY Low						High
					1	2	3	4	5	6	7
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											
17.											
18.											
19.											
20.											

APPENDIX I (Continued)

TASK NUMBER____________________ NAME________________________

	I_7 (G) RELEVANCE TO TASK							I_8 (H) IMAGE STATE CONFLICT							I_9 (I) Evaluation Time (Estimated)	(J) Accept/ Reject (A or R)
	High						Low	Low						High		
	7	6	5	4	3	2	1	1	2	3	4	5	6	7		
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																

APPENDIX I (Continued)

TASK NUMBER________________ NAME________________

	I_{11}							I_{12}
(K) Prescriptive (Yes or No)	(L) CONTRIBUTION TO RESULT High … Low							(M) Time Spent After Accept-Reject Decision
	7	6	5	4	3	2	1	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

APPENDIX I (Continued)

INSTRUCTIONS FOR DIARY OF INFORMATION ELEMENTS (Received and Evaluated)

An information element is defined such that if you receive 25 accession numbers on a computer print-out, each of the 25 is considered an information element. Information resulting from a discussion with an associate is defined as an element of information.

A. and B. ELEMENT NUMBER AND DATE

List each information element in the order it is received by you. Indicate the date of receipt. Typically an element will be received as a result of search action initiated by you. However, if it comes to your attention not as a result of search, then it should be noted as random.

C. SOURCE NUMBER

Obtain the source number from the left-hand column number on the Diary of Information Sources (Appendix H). This links the source with the information clement received.

D. CHANNEL/MEDIA CODE NUMBER

The channel or media is the means by which the information element is transmitted to you. Use the code number on the next page to identify the appropriate channel/media.

Code	CHANNEL/MEDIA (I_3)	Code	ELEMENT TYPE (I_4)
1	Brochures, catalogs, standards and codes, drawings, schematics, and parts lists.	1	Concepts.
		2	Cost and funding.
		3	Design techniques.
2.	Oral contact.	4	Experimental processes.
3.	Live demonstration, physical measurement of experiment.	5	Mathematical aids and formulae.
4.	Directives, handbooks, and manuals.	6	Performance and characteristics.

APPENDIX I (Continued)

Code	CHANNEL/MEDIA (I_3)	Code	ELEMENT TYPE (I_4)
5	Correspondence, memos, TWX, personal notes, personal logs, and personal files.	7	Production processes and procedures.
		8	Raw data.
		9	Specifications.
6	Newsletters and other mass media.	10	Technical status.
		11	Test processes and procedures.
7	Reports and proposals.		
8	Texts.	12	Utilization.
9	Photographs, maps, and films.	13	Other.
10	Pre-prints, reprints, and journals.		
11	Previous knowledge.		
12	Computer printout.		
13	Other		

E. ELEMENT TYPE CODE NUMBER

Use the code number above to identify the element type.

F. COMPETENCY/RELIABILITY

Your evaluation of the competency/reliability of a particular information element should be based on the source of the information element. For example, if you consider the source highly reliable, then this rating should be relatively high. Alternatively, mark it low if your evaluation indicates this.

G. RELEVANCE TO TASK

Indicate the degree of relevancy the information element has with respect to the task according to the rating scale on the form.

H. IMAGE STATE CONFLICT

Consider the information element's influence on your present state of knowledge concerning the task. If the element has a high conflict with your current "image state," then you should indicate this via the rating scale.

APPENDIX I (Continued)

I. <u>EVALUATION TIME</u>

At this point you will have accepted or rejected the information element. Estimate the amount of time spent in evaluating the element.

J. <u>ACCEPT/REJECT</u>

Indicate your decision to accept or reject this information element.

The following columns should be completed only for "accepted" elements. No further information is required on "rejected" elements.

K. <u>PRESCRIPTIVE</u>

Indicate if the element is prescriptive (yes or no). Prescriptive information has a mandatory effect on the task with respect to objectives and/or constraints. The bulk of information received is of a nonprescriptive nature.

L. <u>CONTRIBUTION TO RESULT</u>

Use the rating scale in column L to rate the contribution of the information element to the final result of the problem. Attempt to make this rating at the time of your accept/reject decision. Additionally, go back over your ratings at the completion of the task.

M. <u>TIME SPENT AFTER EVALUATION</u>

Estimate the amount of time spent on each information element <u>after</u> your decision to accept/reject the element up to completion of the task.

Source: David W. Cravens, <u>An Exploratory Study of Individual Information Processing and Decision Making</u> (unpublished dissertation, Indiana University, 1967), pp. 162-67.

APPENDIX J

THE CANONICAL MODEL

Canonical analysis is a general statistical model of which multiple correlation is a special case. The canonical model seeks to relate two sets of variables in as many independent ways as possible.

Canonical analysis provides three main outputs:

1. The number of ways in which two sets of variables are related.
2. The indicated strengths of these relationships.
3. The nature of the relationships which are defined.

As with any statistical model, canonical analysis rests upon certain assumptions. The two main assumptions of canonical analysis (for testing statistical significance) are:

1. Both sets of variables (dependent and independent) are measured according to an interval scale of measurement.
2. Data observed are a random sample of observation vectors drawn from the same multinormal universe.

While the multinormality assumption can be limiting, indications exist that the test of statistical significance used in canonical analysis is rather robust for samples of moderate size.

Testing the significance of the canonical roots can be accomplished using a distribution which is approximately Chi-squared (X^2). The theory underlying the test is discussed by Bartlett.[1] The calculations associated with canonical analysis are extremely involved and time-consuming, but computer programs are available for this task.

The individual variables in each set contribute as a group to the canonical correlation between sets. However, the individual roles of the original variables in the canonical correlation are also of interest since certain variables make more important contributions than others. A helpful way to think of the variables in each set is to represent them by two

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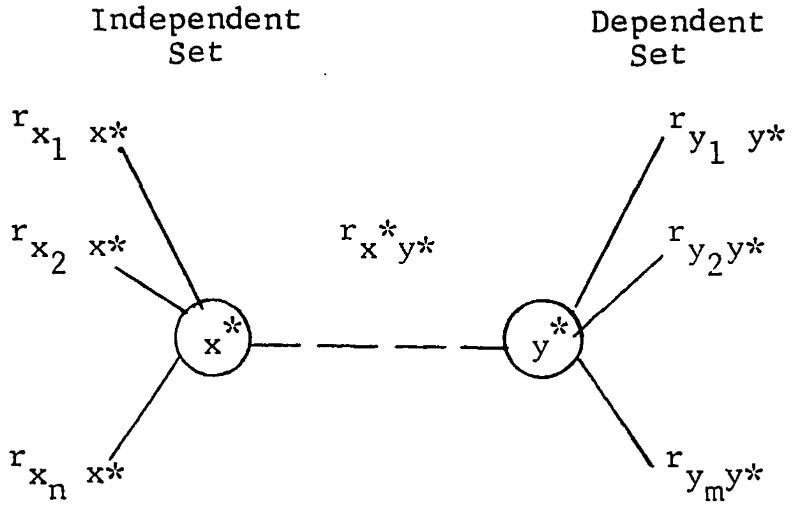
[1]M. S. Bartlett, "The Statistical Significance of Canonical Correlation," *Biometrica*, Vol. 32 (1941).

APPENDIX J (Continued)



$x_1, x_2, \ldots\ldots, x_n$ = Independent variables

$y_1, y_2, \ldots\ldots, y_m$ = Dependent variables

x^* or y^* = Composite variable

$r_{x_i}\ x^*$ or $r_{y_1}\ y^*$ = Correlation coefficient between an original variable and the composite (or proxy) variable

$r_{x^*y^*}$ = Canonical correlation coefficient between the two sets of variables

Figure 1. Linkage of Original and Composite Variables

---

composite or proxy variables, x^* and y^*. A composite canonical variable is, in effect, a proxy variable for a group of single observations of each variable in a set of variables. The correlation between these two composite variables is the canonical correlation coefficient, $r_{x^*y^*}$. An indication of the importance of the role of each variable in the canonical system is reflected by the correlation between each original variable in a given set and the composite variable for that set. Veldman[2] indicates that these correlations can be viewed

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[2]Donald J. Veldman, "Chapter II, Regression Analysis," FORTRAN Programming for the Behavioral Sciences (New York: Holt, Rinehart and Winston, 1967), p. 10.

APPENDIX J (Continued)

as factor loadings in that large correlation coefficients for particular variables indicate that these variables contribute more to the set than do those with smaller coefficients.

Thus, via a sequence of steps, the structure of the entire system of variables can be established. Figure 1 provides a frame of reference for tracing the linkage of the original independent and dependent variables and the composite variables.

In terms of Figure 1, the correlation coefficients, $r_{x_i x*}$ and $r_{y_i y*}$ indicate the importance of each variable in the system. These are the correlations between the original variables and their composite or proxy variable. The correlation coefficient $r_{x_i x*}$ links the original variable to the composite variable. The r_{x*y*} is the canonical correlation coefficient between the two sets. The variables in the dependent set are linked to their corresponding canonical variable, y*, by $r_{y_i y*}$. While the individual linkages between independent and dependent variables are indirect, the correlations obtained from canonical analysis provide a basis for discussing the direction and magnitude of influence of each independent variable.

Source: David W. Cravens, "An Exploratory Analysis of Individual Information Processing," Management Science, vol. 16, No. 10, June, 1970, pp. B-668-B-670.

APPENDIX K

Data Obtained on Subjects
for the Seven Individual Measures

Subject Number	Individual Measures						
	1	2	3	4	5	6	7
1	1.	27.	12.	6.	38.	73.	1.328
2	6.	23.	17.	2.	34.	67.	1.033
3	4.	21.	2.	7.	34.	42.	.754
4	6.	24.	1.	7.	28.	76.	1.099
5	2.	5.	13.	5.	9.	75.	1.244
6	5.	17.	4.	6.	21.	70.	1.452
7	2.	8.	15.	4.	19.	54.	1.170
8	3.	25.	7.	6.	20.	29.	1.523
9	1.	12.	11.	7.	22.	63.	1.216
10	12.	15.	16.	5.	37.	66.	.449
11	2.	8.	14.	5.	33.	83.	.895
12	4.	32.	6.	6.	31.	98.	2.031
13	3.	22.	9.	4.	28.	77.	1.315
14	3.	24.	10.	2.	28.	46.	.965
15	3.	17.	8.	5.	39.	85.	.667
16	3.	11.	5.	7.	37.	81.	1.108
17	3.	10.	3.	6.	36.	72.	1.294

APPENDIX L

Measurements Obtained for Independent Variables

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT								
	8	9	10	11	12	13	14	15	16
1	22.	3.	1.	12.	6.	3.	10.	6.	1.219
2	22.	2.	1.	8.	6.	3.	44.	6.	.325
3	22.	2.	1.	12.	6.	3.	20.	5.	.699
4	22.	2.	1.	7.	6.	5.	23.	7.	.693
5	22.	2.	1.	11.	5.	5.	12.	6.	0.
6	22.	4.	1.	3.	5.	6.	8.	4.	0.
7	22.	3.	1.	1.	6.	3.	2.	6.	0.
8	22.	4.	1.	2.	5.	6.	6.	7.	.589
9	17.	4.	1.	7.	4.	4.	16.	5.	.943
10	22.	2.	1.	4.	2.	6.	8.	4.	.693
11	22.	4.	1.	12.	7.	3.	8.	7.	0.
12	22.	1.	1.	5.	6.	6.	2.	7.	1.254
13	22.	1.	1.	2.	5.	6.	8.	6.	1.171
14	22.	1.	1.	1.	5.	5.	8.	5.	.349
15	22.	1.	1.	3.	6.	6.	24.	6.	.171
16	17.	1.	4.	15.	7.	2.	25.	5.	.273
17	22.	3.	3.	5.	7.	1.	5.	6.	0.
18	22.	2.	1.	10.	4.	5.	24.	6.	1.555
19	21.	4.	1.	4.	3.	5.	6.	6.	1.040
20	22.	4.	1.	1.	6.	3.	2.	6.	0.
21	22.	4.	1.	3.	7.	5.	16.	6.	.941
22	22.	2.	1.	9.	4.	4.	10.	6.	0.
23	22.	4.	1.	2.	6.	3.	3.	6.	0.
24	22.	4.	1.	3.	7.	6.	16.	7.	1.536
25	22	2.	1.	1.	5.	6.	4.	5.	1.867

APPENDIX L (Continued)

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT		
	17	18	19
1	6.	.90	5.
2	6.	.90	6.
3	6.	.90	7.
4	6.	.70	8.
5	6.	.90	9.
6	6.	.9	10.
7	7.	1.	10.
8	6.51	1.	10.
9	5.51	1.	10.
10	5.	.80	10.
11	7.	1.	10.
12	7.	1.	3.
13	7.	.90	3.
14	5.	.60	3.
15	7.	1.	3.
16	6.	.80	3.
17	6.	1.	2.
18	3.	.80	2.
19	3.50	.60	2.
20	6.	.90	2.
21	6.	.90	3.
22	3.50	.70	2.
23	6.50	.90	4.
24	6.50	.90	2.
25	5.50	.80	1.

APPENDIX L (Continued)

Measurements Obtained for Independent Variables

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT								
	8	9	10	11	12	13	14	15	16
26	16.	1.	3.	5.	5.	4.	25.	6.	.179
27	16.	3.	3.	12.	5.	6.	15.	7.	1.761
28	16.	3.	3.	6.	5.	6.	20.	7.	1.190
29	16.	3.	3.	12.	5.	6.	20.	7.	1.311
30	11.	2.	3.	1.	6.	4.	8.	5.	.923
31	22.	3.	3.	1.	2.	5.	4.	4.	1.127
32	11.	3.	3.	1.	5.	5.	4.	6.	.753
33	22.	2.	3.	1.	3.	5.	8.	6.	1.987
34	22.	2.	3.	5.	3.	6.	22.	4.	.887
35	11.	2.	3.	3.	6.	4.	8.	5.	.971
36	11.	4.	3.	2.	6.	3.	12.	6.	1.758
37	12.	3.	3.	2.	3.	6.	10.	4.	1.531
38	22.	2.	3.	1.	2.	6.	8.	4.	.250
39	13.	4.	1.	1.	7.	6.	2.	6.	0.
40	13.	4.	1.	1.	7.	6.	1.	6.	0.
41	13.	4.	1.	2.	6.	6.	3.	7.	.094
42	13.	1.	1.	1.	6.	6.	1.50	7.	0.
43	13.	4.	1.	1.	3.	5.	8.	4.	2.087
44	22.	3.	3.	14.	6.	7.	25.	6.	1.774
45	16.	3.	3.	14.	5.	7.	20.	6.	2.398
46	16.	3.	3.	8.	7.	7.	15.	5.	1.016
47	16.	3.	3.	5.	5.	5.	7.	5.	.341
48	16.	3.	3.	5.	6.	5.	6.	6.	.512
49	16.	3.	3.	7.	6.	6.	4.	6.	1.335
50	16.	3.	3.	6.	7.	7.	5.	6.	0.

APPENDIX L (Continued)

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT		
	17	18	19
26	5.	1.	3.
27	5.	1.	3.
28	5.	1.	3.
29	7.	.80	4.
30	4.	.80	2.
31	5.	.70	3.
32	4.	.90	2.
33	5.	.50	2.
34	4.	.40	3.
35	3.	.70	2.
36	3.	.80	1.
37	5.	.40	2.
38	6.	.40	2.
39	4.50	.90	8.
40	1.	1.	8.
41	3.	1.	7.
42	2.41	1.	6.
43	1.	.60	3.
44	7.	.90	6.
45	6.	.90	6.
46	4.	.90	6.
47	5.	.70	6.
48	5.	.90	6.
49	7.	.90	6.
50	7.	.80	6.

APPENDIX L (Continued)

Measurements Obtained for Independent Variables

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT								
	8	9	10	11	12	13	14	15	16
51	21.	2.	2.	5.	4.	4.	4.	7.	0.
52	21.	4.	2.	1.	5.	5.	4.50	7.	0.
53	21.	3.	2.	5.	5.	3.	1.50	7.	0.
54	21.	4.	2.	5.	7.	6.	.50	7.	0.
55	21.	3.	2.	4.	5.	4.	.80	7.	0.
56	21.	4.	2.	5.	6.	4.	15.	5.50	0.
57	21.	4.	2.	1.	4.	4.	4.	7.	0.
58	21.	4.	2.	2.	4.	5.	13.	7.	0.
59	21.	4.	2.	2.	3.	3.	6.	11.	.306
60	22.	4.	3.	2.	7.	4.	8.	7.	0.
61	21.	4.	3.	1.	3.	5.	1.	5.	.719
62	10.	4.	3.	3.	7.	5.	1.50	4.	.346
63	22.	4.	3.	1.	7.	1.	4.	7.	.368
64	22.	3.	3.	10.	4.	6.	15.	6.	.706
65	14.	3.	3.	1.	6.	2.	4.	5.	.464
66	22.	4.	3.	9.	4.	4.	3.	5.	1.533
67	22.	2.	3.	15.	6.	6.	10.	6.	1.827
68	22.	3.	3.	16.	2.	6.	5.	3.	.996
69	22.	3.	3.	16.	7.	1.	2.	$.	.714
70	22.	4.	1.	5.	6.	6.	8.	7.	.933
71	22.	4.	1.	5.	6.	6.	36.	6.	.347
72	22.	2.	1.	2.	6.	3.	14.	6.	0.
73	22.	3.	1.	1.	6.	2.	5.	6.	0.
74	22.	2.	1.	2.	3.	5.	17.	6.	0.
75	13.	3.	1.	1.	6.	2.	6.	6.	0.

APPENDIX L (Continued)

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT		
	17	18	19
51	5.	1.	1.
52	4.	1.	2.
53	5.	1.	3.
54	4.	1.	4.
55	4.	1.	4.
56	5.	.70	5.
57	6.	1.	6.
58	6.	.90	5.
59	6.	.90	4.
60	5.50	.80	10.
61	3.50	.70	10.
62	5.50	.50	10.
63	4.	.90	10.
64	6.	.50	10.
65	5.50	.80	10.
66	1.50	.70	10.
67	6.50	.90	10.
68	4.50	.80	10.
69	3.	.70	10.
70	6.	1.	5.
71	5.	.80	5.
72	7.	1.	3.
73	7.	.80	3.
74	7.	.50	1.
75	5.	1.	1.

APPENDIX L (Continued)

Measurements Obtained for Independent Variables

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT								
	8	9	10	11	12	13	14	15	16
76	22.	3.	1.	1.	6.	4.	3.	7.	.347
77	22.	4.	1.	1.	7.	1.	6.	6.	0.
78	22.	3.	1.	4.	5.	5.	24.	4.	0.
79	22.	1.	1.	1.	2.	4.	4.	4.	0.
80	22.	1.	3.	3.	3.	6.	25.	3.	0.
81	22.	1.	3.	2.	6.	5.	13.	5.	.693
82	22.	1.	3.	4.	6.	6.	36.	4.	0.
83	22.	2.	3.	5.	3.	5.	13.	4.	0.
84	22.	1.	3.	6.	6.	6.	10.	6.	.347
85	22.	1.	4.	12.	6.	5.	5.	7.	.347
86	22.	4.	4.	13.	7.	5.	6.	7.	.347
87	16.	4.	3.	1.	7.	1.	1.5	4.	0.
88	16.	4.	3.	2.	6.	5.	8.	5.	1.406
89	22.	4.	3.	5.	5.	3.	48.	5.	0.
90	16.	4.	3.	7.	6.	4.	22.	3.	.368
91	22.	1.	3.	3.	7.	4.	16.	7.	.095
92	22.	1.	3.	1.	7.	5.	5.	6.	.311
93	22.	2.	3.	2.	6.	7.	6.	6.	1.124
94	22.	1.	3.	1.	7.	5.	4.	6.	0.
95	21.	1.	3.	1.	7.	3.	1.	7.	0.
96	22.	3.	3.	3.	7.	7.	32.	7.	0.
97	22.	1.	3.	4.	7.	5.	4.	7.	0.
98	22.	1.	3.	5.	7.	6.	6.	7.	.895
99	22.	1.	3.	2.	6.	5.	5.	6.	.653
100	22.	2.	3.	3.	7.	4.	10.	7.	.557

APPENDIX L (Continued)

TASK NUMBER	INDEPENDENT VARIABLE MEASUREMENT		
	17	18	19
76	7.	1.	1.
77	4.	1.	1.
78	4.	1.	1.
79	7.	1.	1.
80	5.50	.80	5.
81	4.50	.60	4.
82	5.	.90	4.
83	6.50	.80	3.
84	5.50	1.	2.
85	6.50	1.	2.
86	6.	.90	1.
87	1.50	.70	4.
88	6.	.50	3.
89	5.50	1.	3.
90	5.	.90	4.
91	6.	1.	1.
92	4.50	1.	1.
93	7.	.80	2.
94	5.50	1.	1.
95	3.	1.	1.
96	7.	1.	1.
97	6.50	1.	1.
98	6.	1.	1.
99	6.	.90	1.
100	3,50	1.	1.

APPENDIX M

Measurements Obtained for Dependent Variables

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	1	2	3	4	5	6	7	8
1	3.	2.	1.	30.	10.	3.	0.	3.
2	1.	1.	0.	20.	20.	1.	0.	1.
3	3.	2.	1.	20.	6.67	3.	0.	3.
4	2.	2.	0.	12.	6.	2.	0.	2.
5	2.	2.	0.	12.	6.	2.	0.	2.
6	3.	3.	0.	8.	2.75	3.	0.	3.
7	4.	0.	4.	2.	.50	4.	0.	4.
8	5.	1.	4.	15.50	3.10	5.	0.	5.
9	4.	4.	0.	16.	4.	5.	0.	5.
10	4.	4.	0.	4.33	1.08	4.	0.	4.
11	4.	4.	0.	8.	2.	6.	0.	6.
12	6.	6.	0.	10.25	1.71	6.	0.	6.
13	2.	0.	2.	8.	4.	2.	0.	2.
14	1.	1.	0.	.14	.14	1.	0.	1.
15	3.	2.	1.	12.	4.	3.	0.	3.
16	4.	4.	0.	3.25	.81	4.	0.	4.
17	3.	1.	2.	3.	1.	3.	0.	3.
18	10.	10.	0.	2.13	.21	13.	0.	13.
19	3.	3.	0.	1.	.33	4.	0.	4.
20	1.	1.	0.	.13	.13	1.	0.	1.
21	1.	1.	0.	.25	.25	1.	0.	1.
22	4.	4.	0.	.75	.19	5.	0.	5.
23	1.	1.	0.	.13	.13	1.	0.	1.
24	1.	1.	0.	.13	.13	1.	0.	1.
25	4.	4.	0.	.75	.19	4.	0.	4.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	9	10	11	12	13	14	15	16
1	6.	0.	6.	6.30	0.	6.30	2.	0.
2	5.	0.	5.	6.	0.	6.	2.	0.
3	5.	0.	5.	6.30	0.	6.30	2.30	0.
4	8.	0.	8.	2.50	0.	2.50	2.	0.
5	6.	0.	6.	6.50	0.	6.50	1.50	0.
6	6.	0.	6.	6.	0.	6.	2.	0.
7	6.	0.	6.	7.	0.	7.	1.	0.
8	6.	0.	6.	7.	0.	7.	1.	0.
9	6.	0.	6.	7.	0.	7.	1.60	0.
10	5.	0.	5.	5.30	0.	5.20	3.80	0.
11	7.	0.	7.	7.	0.	7.	1.	0.
12	5.80	0.	5.80	6.20	0.	6.20	2.	0.
13	6.	0.	6.	6.	0.	6.	1.	0.
14	5.	0.	5.	5.	0.	5.	3.	0.
15	6.	0.	6.	7.	0.	7.	2.	0.
16	7.	0.	7.	7.	0.	7.	1.	0.
17	7.	0.	7.	7.	0.	7.	1.	0.
18	5.50	0.	5.50	6.30	0.	6.30	1.50	0.
19	7.30	0.	7.30	5.80	0.	5.80	1.	0.
20	7.	0.	7.	7.	0.	7.	1.	0.
21	7.	0.	7.	7.	0.	7.	1.	0.
22	5.20	0.	5.20	6.60	0.	6.60	2.3	0.
23	7.	0.	7.	7.	0.	7.	1.	0.
24	7.	0.	7.	7.	0.	7.	1.	0.
25	6.	0.	6.	6.50	0.	6.50	1.	0.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	17	18	19	20	21	22	23	24
1	2.	22.30	0.	7.40	1.219	7.	30.50	10.18
2	2.	20.	0.	20.	.325	6.	1.	1.
3	2.30	0.	0.	0.	.699	6.	2.50	.83
4	2.	5.	0.	2.50	.693	5.50	10.	5.50
5	1.50	5.50	0.	2.80	0.	6.50	8.	4.
6	2.	10.	0.	6.70	0.	6.50	0.	0.
7	1.	2.	0.	.80	0.	4.50	0.	0.
8	1.	.60	0.	.20	.589	5.20	.50	.50
9	1.60	1.83	0.	.40	.943	6.	1.	.20
10	3.80	3.81	0.	3.80	.693	4.50	1.50	1.50
11	1.	.50	0.	.50	0.	6.33	2.	.33
12	2.	7.	0.	1.60	1.254	6.	6.	1.
13	1.	2.	0.	1.	.171	6.50	1.	.50
14	3.	1.	0.	1.	.349	5.	1.	1.
15	2.	3.	0.	1.	.171	7.	3.	1.
16	1.	.33	0.	.10	.273	6.50	18.16	4.54
17	1.	2.83	0.	.70	0.	7.	6.	2.
18	1.50	1.63	0.	.10	1.555	6.	13.50	1.04
19	1.	1.	0.	.30	1.040	6.	4.	1.
20	1.	.13	0.	.10	0.	7.	2.	2.
21	1.	.13	0.	.10	.941	7.	16.	16.
22	2.30	1.	0.	.20	0.	6.	6.50	1.30
23	1.	.13	0.	.10	0.	7.	2.	2.
24	1.	.13	0.	.13	1.536	7.	16.	16.
25	1.	.10	0.	.25	1.867	6.25	3.50	.88

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	1	2	3	4	5	6	7	8
26	10.	8.	2.	6.50	.65	10.	2.	8.
27	3.	1.	2.	9.	3.	3.	0.	3.
28	7.	3.	4.	11.50	1.64	7.	1.	6.
29	8.	8.	0.	15.	1.87	8.	0.	8.
30	5.	4.	1.	3.50	1.70	5.	0.	5.
31	3.	3.	0.	1.16	.39	3.	0.	3.
32	5.	5.	0.	1.58	.32	5.	0.	5.
33	3.	3.	0.	3.	1.	3.	0.	3.
34	6.	6.	0.	13.	2.16	6.	0.	6.
35	3.	2.	1.	4.50	1.50	3.	0.	3.
36	3.	0.	3.	4.	1.33	3.	0.	3.
37	5.	3.	2.	6.	1.20	5.	0.	5.
38	5.	5.	0.	5.50	1.10	5.	0.	5.
39	2.	2.	0.	.06	.03	2.	0.	2.
40	1.	1.	0.	.03	.03	1.	0.	1.
41	2.	2.	0.	.07	.03	2.	0.	2.
42	2.	1.	1.	.53	.27	2.	0.	2.
43	1.	1.	0.	.16	.16	1.	0.	1.
44	17.	10.	7.	19.25	1.13	21.	1.	20.
45	14.	6.	8.	13.35	.95	14.	0.	14.
46	10.	3.	7.	11.50	1.15	1.	0.	11.
47	6.	1.	6.	3.50	.58	8.	0.	8.
48	5.	0.	5.	5.	1.	5.	0.	5.
49	5.	3.	2.	3.50	.70	5.	0.	5.
50	4.	4.	0.	1.50	.38	4.	0.	4.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	9	10	11	12	13	14	15	16
26	4.90	3.50	5.25	7.	7.	7.	4.40	5.
27	5.75	0.	5.75	7.	0.	7.	3.	0.
28	5.85	3.	6.33	7.	7.	7.	2.28	4.
29	5.	0.	5.	7.	0.	7.	3.25	0.
30	5.60	0.	5.60	5.60	0.	5.60	2.	0.
31	5.	0.	5.	5.33	0.	5.33	2.	0.
32	5.	0.	5.	5.	0.	5.	2.	0.
33	5.66	0.	5.66	6.	0.	6.	2.30	0.
34	5.33	0.	5.33	5.83	0.	5.83	1.40	0.
35	5.66	0.	5.66	6.	0.	6.	2.50	0.
36	5.66	0.	5.66	5.66	0.	5.66	2.33	0.
37	5.40	0.	5.40	5.60	0.	5.60	2.40	0.
38	5.40	0.	5.40	5.60	0.	5.60	2.50	0.
39	7.	0.	7.	6.50	0.	6.50	1.50	0.
40	7.	0.	7.	7.	0.	7.	1.	0.
41	7.	0.	7.	7.	0.	7.	1.	0.
42	7.	0.	7.	7.	0.	7.	1.	0.
43	7.	0.	7.	7.	0.	7.	1.	0.
44	5.80	5.	5.81	5.85	4.	5.95	1.95	3.
45	5.65	0.	5.65	5.43	0.	5.43	2.21	0.
46	6.	0.	6.	5.64	0.	5.64	1.36	0.
47	5.50	0.	5.50	5.88	0.	5.88	2.	0.
48	6.	0.	6.	6.20	0.	6.20	1.80	0.
49	6.	0.	6.	6.	0.	6.	2.50	0.
50	7.	0.	7.	7.	0.	7.	2.25	0.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	17	18	19	20	21	22	23	24
26	3.40	4.37	.63	.39	.179	4.875	67.	7.50
27	3.	20.	0.	5.	1.761	6.750	4.	1.
28	2.	13.	.50	2.08	1.190	6.333	17.	2.33
29	3.25	17.	0.	2.13	1.311	5.500	7.	.88
30	2.	1.33	0.	1.33	.923	6.	1.50	1.50
31	2.	.92	0.	.31	1.127	5.333	.75	.25
32	2.	1.58	0.	.32	.753	5.600	.58	.12
33	2.30	1.25	0.	.42	1.987	6.	1.25	.42
34	1.40	5.50	0.	.92	.887	5.833	3.25	.54
35	2.50	1.	0.	.33	.971	6.	.75	.25
36	2.33	2.	0.	.67	1.758	5.666	1.25	.42
37	2.40	2.25	0.	.45	1.531	6.	1.50	.30
38	2.50	2.25	0.	.45	.250	5.400	1.25	.25
39	1.50	3.	0.	1.50	0.	7.	1.	.50
40	1.	1.	0.	1.	0.	7.	0.	0.
41	1.	1.25	0.	.63	.946	0.	0.	0.
42	1.	1.08	0.	.54	0.	6.50	0.	0.
43	1.	5.	0.	5.	2.087	7.	0.	0.
44	1.90	3.33	.08	.16	1.774	5.380	20.	1.
45	2.21	1.67	0.	.12	2.398	5.500	10.75	1.77
46	1.36	1.08	0.	.10	1.016	6.	11.66	1.06
47	2.	.83	0.	.83	.341	6.	4.75	.59
48	1.80	.50	0.	.50	.512	6.60	4.50	.90
49	2.50	.53	0.	.53	1.335	5.80	4.25	.85
50	2.25	.58	0.	.58	0.	5.75	4.50	1.13

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	1	2	3	4	5	6	7	8
51	5.	5.	0.	1.50	.30	5.	0.	5.
52	4.	4.	0.	3.50	.88	1.	0.	1.
53	1.	0.	1.	.50	.50	1.	0.	1.
54	2.	1.	1.	2.	1.	2.	0.	2.
55	2.	2.	0.	2.50	1.25	1.	0.	1.
56	2.	2.	0.	1.	1.	2.	0.	2.
57	5.	0.	5.	1.50	.30	8.	0.	8.
58	5.	0.	5.	2.60	.52	5.	0.	5.
59	20.	0.	20.	2.20	.11	20.	0.	20.
60	1.	1.	0.	4.	4.	1.	0.	1.
61	3.	2.	1.	2.50	.83	3.	0.	3.
62	2.	2.	0.	2.83	.42	0.	0.	2.
63	2.	2.	0.	3.	1.50	2.	0.	2.
64	3.	0.	2.	2.50	.85	3.	0.	3.
65	3.	3.	0.	2.	.67	3.	0.	3.
66	6.	4.	2.	2.75	.55	6.	0.	6.
67	6.	4.	2.	7.33	1.22	6.	0.	6.
68	3.	2.	1.	4.	1.33	3.	0.	3.
69	3.	2.	1.	.90	.30	3.	0.	3.
70	12.	6.	6.	13.	1.08	12.	3.	9.
71	1.	0.	1.	10.	10.	5.	0.	5.
72	4.	2.	2.	9.50	2.37	4.	0.	7.
73	3.	3.	0.	1.50	.50	8.	0.	8.
74	3.	1.	2.	8.	2.67	12.	0.	12.
75	2.	2.	0.	.50	.25	2.	0.	2.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	9	10	11	12	13	14	15	16
51	7.	0.	7.	7.	0.	7.	1.	0.
52	7.	0.	7.	7.	0.	7.	1.	0.
53	6.	0.	6.	7.	0.	7.	2.	0.
54	7.	0.	7.	7.	0.	7.	1.	0.
55	7.	0.	7.	7.	0.	7.	1.	0.
56	7.	0.	7.	7.	0.	7.	1.	0.
57	6.	0.	6.	7.	0.	7.	1.	0.
58	5.60	0.	5.60	7.	0.	7.	2.	0.
59	5.50	0.	5.50	7.	0.	7.	1.50	0.
60	6.	0.	6.	6.	0.	6.	3.	0.
61	5.67	0.	5.67	4.67	0.	4.67	1.67	0.
62	5.	0.	5.	6.50	0.	6.50	1.50	0.
63	6.	0.	6.	6.	0.	6.	1.50	0.
64	6.	0.	6.	4.67	0.	4.67	2.	0.
65	5.33	0.	5.33	6.	0.	6.	1.	0.
66	5.83	0.	5.83	5.	0.	5.	1.67	0.
67	6.	0.	6.	4.50	0.	4.50	2.	0.
68	4.	0.	4.	6.33	0.	6.33	3.67	0.
69	4.33	0.	4.33	6.	0.	6.	3.67	0.
70	5.91	3.33	6.77	6.	3.67	6.77	1.50	3.
71	5.	0.	5.	5.	0.	5.	3.	0.
72	6.25	0.	6.25	7.	0.	7.	2.	0.
73	6.	0.	6.00	7.	0.	7.	1.	0.
74	5.33	0.	5.33	7.	0.	7.	2.	0.
75	7.	0.	7.	7.	0.	7.	1.	0.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	17	18	19	20	21	22	23	24
51	1.	.83	0.	.16	0.	7.	.83	.16
52	1.	1.	0.	1.	0.	7.	0.	0.
53	2.	1.	0.	1.	0.	7.	0.	0.
54	1.	2.	0.	1.	0.	7.	0.	0.
55	1.	1.50	0.	1.50	0.	7.	0.	0.
56	1.	.50	0.	.25	0.	7.	12.	6.
57	1.	.25	0.	.03	0.	7.	.75	.09
58	2.	3.90	0.	.78	0.	6.60	6.50	1.30
59	1.50	3.30	0.	.17	.306	7.	5.50	.28
60	3.	1.	0.	1.	0.	7.	.08	.08
61	1.67	.50	0.	.17	.719	5.67	.15	.05
62	1.50	1.	0.	.50	.346	5.50	1.58	.79
63	1.50	1.17	0.	.84	.368	7.	1.08	.54
64	2.	6.50	0.	2.17	.706	4.67	6.	2.
65	1.	.50	0.	.17	.464	7.	1.08	.36
66	1.67	.35	0.	.35	1.533	5.50	2.07	.35
67	2.	3.50	0.	.58	1.827	4.167	1.38	.25
68	3.67	.50	0.	.17	.996	6.333	.05	.02
69	3.67	.28	0.	.28	.714	5.333	.05	.02
70	1.	13.50	.83	1.22	.933	5.077	12.	1.
71	3.	3.	0.	.60	.347	4.	3.	.60
72	2.	5.75	0.	1.44	0.	5.750	5.	1.25
73	1.	8.80	0.	1.10	0.	6.375	.65	.81
74	2.	8.25	0.	.69	0.	5.41	1.30	.11
75	1.	.20	0.	.10	0.	7.	.20	.10

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	1	2	3	4	5	6	7	8
76	3.	3.	0.	2.	.67	3.	1.	2.
77	1.	1.	0.	4.	4.	1.	0.	1.
78	2.	2.	0.	10.	5.	6.	0.	6.
79	2.	2.	0.	4.	2.	3.	0.	3.
80	6.	6.	0.	6.	1.	6.	3.	3.
81	7.	2.	5.	5.50	.78	7.	1.	6.
82	4.	2.	2.	4.	1.	4.	0.	4.
83	2.	2.	0.	12.50	6.25	2.	0.	2.
84	4.	3.	1.	3.	.75	4.	0.	4.
85	1.	1.	0.	2.	2.	1.	0.	1.
86	4.	2.	2.	1.58	.40	4.	0.	4.
87	2.	2.	0.	.52	.26	2.	0.	2.
88	6.	5.	1.	5.58	.93	6.	0.	6.
89	3.	0.	3.	24.	8.	3.	0.	3.
90	3.	3.	0.	6.50	2.17	3.	0.	3.
91	2.	2.	0.	0.	0.	2.	0.	2.
92	3.	3.	0.	.75	.25	3.	0.	3.
93	5.	5.	0.	1.40	.28	10.	1.	9.
94	2.	2.	0.	.06	.03	2.	0.	2.
95	1.	1.	0.	0.	0.	1.	0.	1.
96	2.	2.	0.	0.	0.	2.	0.	2.
97	1.	1.	0.	0.	0.	2.	0.	2.
98	5.	4.	1.	.78	.16	8.	1.	7.
99	4.	4.	0.	1.25	.31	5.	0.	5.
100	4.	4.	0.	.20	.05	4.	0.	4.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	9	10	11	12	13	14	15	16
76	5.	1.	7.	7.	7.	7.	3.	7.
77	7.	0.	7.	7.	0.	7.	1.	0.
78	5.83	0.	5.83	6.	0.	6.	1.	0.
79	5.	0.	5.	7.	0.	7.	3.	0.
80	5.33	4.67	6.	5.50	3.67	8.33	3.	3.33
81	5.	5.	3.33	5.43	5.	5.50	3.14	3.
82	4.50	0.	4.50	5.25	0.	5.25	3.25	0.
83	6.	0.	6.	6.50	0.	6.50	2.	0.
84	6.25	0.	6.25	6.	0.	6.	2.	0.
85	6.	0.	6.	7.	0.	7.	2.	0.
86	6.	0.	6.	6.50	0.	6.50	1.75	0.
87	7.	0.	7.	7.	0.	7.	1.	0.
88	5.83	0.	5.83	5.33	0.	5.33	2.67	0.
89	7.	0.	7.	6.	0.	6.	1.	0.
90	6.33	0.	6.33	6.	0.	6.	2.33	0.
91	6.55	0.	6.55	7.	0.	7.	1.	0.
92	6.67	0.	6.67	6.33	0.	6.33	2.	0.
93	6.88	7.	6.88	6.40	6.	6.40	1.55	4.
94	7.	0.	7.	7.	0.	7.	1.	0.
95	7.	0.	7.	7.	0.	7.	1.	0.
96	7.	0.	7.	7.	0.	7.	2.	0.
97	7.	0.	7.	7.	0.	7.	1.	0.
98	6.75	6.	6.85	5.88	3.	6.28	1.75	3.
99	6.40	0.	6.40	6.40	0.	6.40	2.	0.
100	6.50	0.	6.50	6.75	0.	6.75	1.25	0.

APPENDIX M (Continued)

TASK NUMBER	DEPENDENT VARIABLE MEASUREMENT							
	17	18	19	20	21	22	23	24
76	1.	.20	0.	.07	.347	4.333	0.	0.
77	1.	1.	0.	1.	0.	7.	2.	2.
78	1.	1.80	0.	.30	0.	6.	3.85	.64
79	3.	.75	0.	.75	0.	7.	.75	.25
80	3.33	5.50	.67	1.11	0.	4.833	19.90	3.67
81	3.17	2.78	1.	.30	.693	5.	7.	1.03
82	3.25	3.	0.	.75	0.	5.500	23.	5.75
83	2.	12.50	0.	6.25	0.	6.	2.	1.
84	2.	5.	0.	1.25	.347	6.	2.75	.69
85	2.	.50	0.	.50	.347	6.	2.	2.
86	1.75	2.42	0.	.61	.347	7.	2.40	.60
87	1.	.08	0.	.04	0.	7.	1.25	.63
88	2.67	8.	0.	1.33	1.406	3.833	1.17	.03
89	1.	1.	0.	.33	0.	5.667	.17	0.
90	2.33	.17	0.	.06	.368	5.	0.	0.
91	1.	1.75	0.	.88	.095	7.	15.	7.50
92	2.	1.50	0.	.50	.311	5.67	1.75	.58
93	1.11	3.41	.50	2.02	1.124	6.20	3.03	2.60
94	1.	.75	0.	.38	0.	7.	3.75	1.88
95	1.	0.	0.	0.	0.	7.	1.50	1.50
96	2.	6.00	0.	8.	0.	7.	26.	13.
97	1.	0.	0.	0.	0.	7.	4.50	2.25
98	1.57	2.61	.50	.30	.895	5.50	4.75	.68
99	2.	3.25	0.	.65	.653	6.	3.25	.65
100	1.25	.58	0.	.15	.557	6.50	8.50	2.13

APPENDIX N

Correlation Matrix of Independent Variables

Independent Variable Measurement	1	2	3	4	5	6
1. Occe Experience	1.0000	0.1704	-0.1419	-01410	0.0099	0.0845
2. Total Experience		1.0000	-0.1453	-0.0552	0.1426	0.1013
3. Performance Rank			1.0000	-0.6363	-0.0339	0.0870
4. Performance Index				1.0000	0.0724	0.0865
5. Wonderlic Score					1.0000	0.1511
6. Risk Taking Propensity Index						1.0000
7. Information-Processing Efficiency Index						
8. OCCE Field Code						
9. Major Output Code						
10. Kinds of Output Code						
11. Task Time Span (days)						
12. Precision of Definition Rating						
13. Scope and Complexity Rating						
14. Technical Man-hours Invested						
15. Result Rating						
16. Image State Index						
17. Interest in Task Rating						
18. Probability Estimate						
19. Ordinal Position of Task						

APPENDIX N (continued)

	Independent Variable Measurement	7	8	9	10	11	12
1.	OCCE Experience	-0.1190	-0.2510	-0.1426	-0.0371	0.1401	0.0777
2.	Total Experience	0.4621	-0.0456	0.2862	-0.4773	-0.0768	-0.2764
3.	Performance Rank	-0.2090	0.0275	-0.1436	0.0731	-0.0747	0.2857
4.	Performance Index	-0.1673	0.0511	0.0587	0.3997	0.1276	-0.1276
5.	Wonderlic Score	-0.3483	-0.0217	-0.0223	-0.4009	-0.2228	-0.0143
6.	Risk Taking Propensity Index	0.4944	0.3145	0.1041	-0.2783	0.2299	0.2293
7.	Information-Processing Efficiency Index	1.0000	0.1479	0.3215	-0.2369	0.0364	-0.1142
8.	OCCE Field Code		1.0000	-0.2151	-0.1783	0.1260	-0.1105
9.	Major Output Code			1.0000	-0.1645	0.0372	0.0312
10.	Kinds of Output Code				1.0000	0.2278	0.0885
11.	Task Time Span (days)					1.0000	0.0384
12.	Precision of Definition Rating						1.0000
13.	Scope and Complexity Rating						
14.	Technical Man-hours Invested						
15.	Result Rating						
16.	Image State Index						
17.	Interest in Task Rating						
18.	Probability Estimate						
19.	Ordinal Position of Task						

APPENDIX N (continued)

	Independent Variable Measurement	13	14	15	16	17	18	19
1.	OCCE Experience	-0.1848	-0.0637	-0.0983	0.1645	-0.1836	-0.1806	0.2354
2.	Total Experience	0.0852	-0.0769	0.1484	0.1416	-0.1679	-0.0769	0.1115
3.	Performance Rank	0.0314	-0.0198	0.1869	-0.3155	-0.1032	0.3492	-0.1342
4.	Performance Index	0.0033	0.0586	-0.1321	0.1849	0.0916	-0.2349	-0.1311
5.	Wonderlic Score	-0.0001	-0.0801	0.1518	-0.1011	0.0335	0.1152	-0.1984
6.	Risk Taking Propensity Index	0.0188	-0.0171	0.3533	-0.0483	0.1728	0.3413	0.0777
7.	Information-Processing Efficiency Index	-0.0163	-0.1042	0.0958	0.0579	-0.0292	0.0302	0.0805
8.	OCCE Field Code	-0.0323	0.1541	0.1327	-0.2000	0.3853	0.1343	-0.0584
9.	Major Output Code	-0.1314	-0.1496	0.0233	0.0685	-0.1907	-0.0518	0.3635
10.	Kinds of Output Code	0.0569	0.0086	-0.1341	0.1689	-0.0557	-0.1864	-0.0918
11.	Task Time Span (days)	0.0706	0.2880	-0.0101	0.3135	0.1400	0.0351	0.2903
12.	Precision of Definition Rating	-0.2377	-0.0327	0.4463	-0.2046	0.0561	0.4291	-0.0289
13.	Scope and Complexity Rating	1.0000	0.1513	0.0130	0.3211	0.1669	-0.0979	0.0187
14.	Technical Man-hours Invested		1.0000	-0.1234	0.0792	0.2132	0.0080	-0.0913
15.	Result Rating			1.0000	-0.0880	0.1970	0.5006	-0.1484
16.	Image State Index				1.0000	-0.0976	-0.3167	0.0233
17.	Interest in Task Rating					1.0000	0.1671	-0.0356
18.	Probability Estimate						1.0000	-0.0856
19.	Ordinal Position of Task							1.0000

APPENDIX O

Correlation Matrix of Dependent Variables

Dependent Variable Measurement	1	2	3	4	5	6
1. Total Sources	1.0000	0.5651	0.7657	0.2713	-0.1736	0.9189
2. Internal Sources		1.0000	-0.0925	0.1791	-0.1764	0.5367
3. External Sources			1.0000	0.1887	-0.0693	0.6927
4. Total Search Hours				1.0000	0.7229	0.2632
5. Average Hours/Source					1.0000	-0.1274
6. Number of Elements						1.0000
7. Number "Rejected"						
8. Number "Accepted"						
9. Competency/Reliability-Total						
10. Competency/Reliability-Rejected						
11. Competency/Reliability-Accepted						
12. Relevance-Total						
13. Relevance-Rejected						
14. Relevance-Accepted						
15. Image State-Conflict-Total						
16. Image State-Conflict-Rejected						
17. Image State-Conflict-Accepted						
18. Total Evaluation Hours						
19. Average Hours/Rejected Elements						
20. Average Hours/Accepted Elements						
21. Change in Image State Index						
22. Contribution to Result						
23. Total Integration Hours						
24. Average/Accepted Elements						

APPENDIX O (continued)

Dependent Variable Measurement	7	8	9	10	11	12
1. Total Sources	0.3869	0.9003	0.0431	0.3802	-0.2565	-0.1364
2. Internal Sources	0.4032	0.4993	-0.0300	0.3898	-0.1118	-0.1338
3. External Sources	0.1520	0.6998	0.0756	0.1546	-0.2093	-0.0433
4. Total Search Hours	0.1262	0.2594	-0.3270	0.0887	-0.2042	-0.1904
5. Average Hours/Source	-0.0836	-0.1200	-0.3265	-0.1023	-0.1562	-0.1797
6. Number of Elements	0.3663	0.9862	0.0431	0.4453	-0.2628	-0.1140
7. Number "Rejected"	1.0000	0.2322	0.0982	0.7786	-0.0008	-0.0579
8. Number "Accepted"		1.0000	0.0380	0.3465	-0.2701	-0.1012
9. Competency/Reliability-Total			1.0000	0.1367	0.1768	0.1132
10. Competency/Reliability-Rejected				1.0000	-0.0364	-0.0807
11. Competency/Reliability-Accepted					1.0000	0.3242
12. Relevance-Total						1.0000
13. Relevance-Rejected						
14. Relevance-Accepted						
15. Image State-Conflict-Total						
16. Image State-Conflict-Rejected						
17. Image State-Conflict-Accepted						
18. Total Evaluation Hours						
19. Average Hours/Rejected Elements						
20. Average Hours/Accepted Elements						
21. Change in Image State Index						
22. Contribution to Result						
23. Total Integration Hours						
24. Average/Accepted Elements						

APPENDIX O (continued)

Dependent Variable Measurement	13	14	15	16	17	18
1. Total Sources	0.3486	-0.0789	0.1799	0.3249	0.1568	0.1117
2. Internal Sources	0.3549	-0.0507	0.2131	0.3546	0.2210	0.1200
3. External Sources	0.1439	-0.0392	0.0357	0.1156	0.0031	0.0362
4. Total Search Hours	0.0932	-0.1687	0.1672	0.0722	0.1929	0.5157
5. Average Hours/Source	-0.0949	-0.1896	0.1066	-0.0982	0.1122	0.4750
6. Number of Elements	0.3629	-0.0650	0.1423	0.3397	0.1144	0.1178
7. Number "Rejected"	0.7809	0.2053	0.2606	0.7940	0.1111	0.1923
8. Number "Accepted"	0.2603	-0.0894	0.1099	0.2342	0.1027	0.0975
9. Competency/Reliability-Total	0.1086	0.1301	-0.0751	0.1056	-0.1634	-0.1089
10. Competency/Reliability-Rejected	0.8266	0.0844	0.2005	0.7926	0.0864	0.1132
11. Competency/Reliability-Accepted	-0.0223	0.3241	-0.6485	0.0178	-0.6196	-0.1071
12. Relevance-Total	0.0265	0.9327	-0.3503	0.0250	-0.3522	-0.0109
13. Relevance-Rejected	1.0000	0.1321	0.3119	0.9768	0.0806	0.1355
14. Relevance-Accepted		1.0000	-0.2951	0.1496	-0.2955	0.0265
15. Image State-Conflict-Total			1.0000	0.3105	0.8386	0.2399
16. Image State-Conflict-Rejected				1.0000	0.0574	0.1063
17. Image State-Conflict-Accepted					1.0000	0.2472
18. Total Evaluation Hours						1.0000
19. Average Hours/Rejected Elements						
20. Average Hours/Accepted Elements						
21. Change in Image State Index						
22. Contribution to Result						
23. Total Integration Hours						
24. Average/Accepted Elements						

APPENDIX O (continued)

Dependent Variable Measurement	19	20	21	22	23	24
1. Total Sources	0.3331	-0.1591	0.3819	-0.2766	0.3390	-0.1108
2. Internal Sources	0.2918	-0.0941	0.3914	-0.3061	0.3411	-0.0443
3. External Sources	0.1746	-0.1186	0.1578	-0.0814	0.1249	-0.1113
4. Total Search Hours	0.0811	0.3664	0.2119	-0.2289	0.1984	0.0054
5. Average Hours/Source	-0.0865	0.6801	-0.0572	-0.0939	-0.0054	0.0130
6. Number of Elements	0.3232	-0.1724	0.3319	-0.2990	0.2930	-0.1308
7. Number "Rejected"	0.8591	-0.0364	0.0458	-0.3157	0.4659	0.0903
8. Number "Accepted"	0.2080	-0.1747	0.3312	-0.2674	0.2378	-0.1501
9. Competency/Reliability-Total	0.1024	-0.2019	-0.0015	0.1090	-0.0782	-0.1132
10. Competency/Reliability-Rejected	0.8486	-0.0378	0.1462	-0.2460	0.3461	0.0581
11. Competency/Reliability-Accepted	-0.1274	-0.0597	-0.2426	0.4122	-0.0263	0.2155
12. Relevance-Total	-0.0813	-0.0403	-0.3640	0.5709	0.0378	0.1000
13. Relevance-Rejected	0.7782	-0.0412	0.1030	-0.2951	0.4509	0.0799
14. Relevance-Accepted	0.1057	-0.0452	-0.3754	0.4872	0.1054	0.1174
15. Image State-Conflict-Total	0.2562	0.1107	0.2078	-0.5362	0.2694	-0.0399
16. Image State-Conflict-Rejected	0.7195	-0.0519	0.0812	-0.3270	0.4117	0.0639
17. Image State-Conflict-Accepted	0.1471	0.1186	0.2366	-0.4158	0.1757	-0.0537
18. Total Evaluation Hours	0.1830	0.7391	0.1558	-0.0706	0.2767	0.1938
19. Average Hours/Rejected Elements	1.0000	-0.0299	0.0669	-0.2623	0.4030	0.0807
20. Average Hours/Accepted Elements		1.0000	0.0039	0.0547	0.0742	0.1483
21. Change in Image State Index			1.0000	-0.2883	0.0713	0.0399
22. Contribution to Result				1.0000	-0.0673	0.2005
23. Total Integration Hours					1.0000	0.6487
24. Average/Accepted Elements						1.0000

APPENDIX P

Correlation Matrix of Independent and Dependent Variables

VARIABLE MEASURES

Dependent	Independent					
	1	2	3	4	5	6
1. Total Sources	-0.1017	0.0286	-0.1472	0.2967	0.0326	0.0234
2. Internal Sources	0.0143	0.0180	-0.1582	0.1799	-0.0467	0.0242
3. External Sources	-0.1284	0.0233	-0.0568	0.2111	0.0937	0.0168
4. Total Search Hours	-0.0632	-0.0777	-0.1866	0.0156	0.0061	-0.0421
5. Average Hours/Source	-0.0275	-0.0638	-0.1256	-0.0470	0.0695	0.0127
6. Number of Elements	-0.0975	-0.0484	-0.1930	0.2957	0.0870	0.0843
7. Number "Rejected"	-0.0579	-0.0507	-0.0531	0.1835	-0.1560	0.0400
8. Number "Accepted"	-0.0966	-0.0558	-0.1995	0.2832	0.1210	0.0842
9. Competency/Reliability-Total	-0.2386	-0.3656	0.1173	0.2408	-0.0621	-0.1595
10. Competency/Reliability-Rejected	-0.1412	-0.1634	0.0707	0.1326	-0.0953	0.0852
11. Competency/Reliability-Accepted	0.0317	-0.0097	0.4378	-0.3041	0.2815	0.2842
12. Relevance-Total	-0.0843	0.1089	0.3423	-0.2134	0.1594	0.2716
13. Relevance-Rejected	-0.1053	-0.0893	-0.0308	0.1429	-0.1318	0.0779
14. Relevance-Accepted	-0.1168	0.0774	0.3442	-0.1584	0.1123	0.2499
15. Image State-Conflict-Total	-0.0880	-0.1091	-0.2983	0.2490	-0.3193	-0.1991
16. Image State-Conflict-Rejected	-0.0999	-0.1143	-0.0448	0.1403	-0.0968	0.0731
17. Image State-Conflict-Accepted	-0.0884	-0.0471	-0.2160	0.0900	-0.3032	-0.2787
18. Total Evaluation Hours	-0.0799	-0.0185	-0.0253	0.0109	-0.0588	0.0708
19. Average Hours/Rejected Elements	-0.1034	-0.0569	0.0270	0.1619	-0.2034	0.0334
20. Average Hours/Accepted Elements	-0.0635	-0.0375	0.0775	-0.1176	0.1127	0.1089
21. Change in Image State Index	0.1645	0.1416	-0.3155	0.1849	-0.1011	-0.0483
22. Contribution to Result	-0.0307	0.1465	0.2930	-0.1471	0.2980	0.2130
23. Total Integration Hours	-0.0244	0.0315	0.0208	0.1584	-0.0470	0.2472
24. Average/Accepted Elements	-0.0192	0.0873	0.0716	0.0569	0.0585	0.3510

APPENDIX P (continued)

Correlation Matrix of Independent and Dependent Variables

VARIABLE MEASURES

Dependent	Independent					
	7	8	9	10	11	12
1. Total Sources	0.0419	-0.0458	0.0054	0.1980	0.2817	-0.1945
2. Internal Sources	0.0383	-0.0363	-0.1968	0.1528	0.2730	-0.1438
3. External Sources	0.0163	-0.0379	0.1728	0.1125	0.1221	-0.1222
4. Total Search Hours	-0.2330	0.1136	0.0136	-0.1356	0.4140	-0.1048
5. Average Hours/Source	-0.2589	0.1868	-0.0076	-0.2541	0.2253	-0.0171
6. Number of Elements	0.0565	0.0245	-0.0181	0.1098	0.2539	-0.2022
7. Number "Rejected"	0.0239	0.0760	-0.1437	0.0693	-0.0105	-0.0370
8. Number "Accepted"	0.0556	0.0217	-0.0053	0.0962	0.2590	-0.1985
9. Competency/Reliability-Total	-0.0333	-0.2642	0.0807	0.4640	-0.2363	0.1237
10. Competency/Reliability-Rejected	-0.0341	0.1026	-0.2130	0.1759	0.0165	0.0427
11. Competency/Reliability-Accepted	-0.0170	0.0012	-0.1741	-0.1831	0.2196	-0.4138
12. Relevance-Total	0.2057	-0.0219	0.0822	-0.1854	-0.1390	0.2030
13. Relevance-Rejected	0.0555	0.0391	-0.1569	0.1097	-0.0200	0.0238
14. Relevance-Accepted	0.1964	0.0106	0.0291	-0.1557	-0.1469	0.1529
15. Image State-Conflict-Total	0.0320	-0.0158	-0.2525	0.2424	0.2653	-0.2755
16. Image State-Conflict-Rejected	0.0427	0.0624	-0.1513	0.0769	-0.0308	0.0282
17. Image State-Conflict-Accepted	-0.0725	0.0110	-0.2935	0.1778	0.2578	-0.2440
18. Total Evaluation Hours	-0.1396	0.0647	-0.0313	-0.0638	0.2195	-0.0741
19. Average Hours/Rejected Elements	0.0172	0.0630	-0.2036	0.1278	-0.0461	0.0055
20. Average Hours/Accepted Elements	-0.2409	0.0795	-0.0316	-0.1583	0.1068	-0.0313
21. Change in Image State Index	0.0579	-0.2000	0.0685	0.1689	0.3135	-0.2046
22. Contribution to Result	0.0369	-0.0210	0.1243	-0.0969	-0.1605	0.2074
23. Total Integration Hours	0.0666	0.0466	-0.2135	0.1227	0.2124	0.0966
24. Average/Accepted Elements	0.1232	0.1748	-0.0504	-0.0532	0.0582	0.2521

APPENDIX P (continued)

Correlation Matrix of Independent and Dependent Variables

VARIABLE MEASURES

Dependent	Independent						
	13	14	15	16	17	18	19
1. Total Sources	0.3447	0.1894	-0.0399	0.3819	0.1327	-0.0172	0.0504
2. Internal Sources	0.2400	0.1388	-0.0660	0.3914	0.0553	-0.1074	-0.0777
3. External Sources	0.2180	0.0962	0.0123	0.1578	0.1151	0.0662	0.1179
4. Total Search Hours	0.0760	0.5714	-0.0827	0.2119	0.2871	0.0561	0.2136
5. Average Hours/Source	-0.1275	0.5599	-0.0487	-0.0572	0.1757	0.0595	0.1446
6. Number of Elements	0.3316	0.2256	-0.0285	0.3319	0.1939	-0.0648	-0.0025
7. Number "Rejected"	0.1725	0.1408	-0.0101	0.0458	0.1091	0.0899	-0.0534
8. Number "Accepted"	0.3090	0.2168	-0.0231	0.3312	0.1932	-0.0703	-0.0017
9. Competency/Reliability-Total	0.1415	-0.1799	0.0884	-0.0015	-0.2522	0.0407	-0.2565
10. Competency/Reliability-Rejected	0.2419	0.1107	0.0256	0.1462	0.1414	0.0367	-0.0937
11. Competency/Reliability-Accepted	-0.0841	-0.1683	0.4666	-0.2426	0.0172	0.3887	-0.2232
12. Relevance-Total	-0.2662	-0.2098	0.3022	-0.3640	0.0910	0.4590	-0.2829
13. Relevance-Rejected	0.1608	0.1141	0.0938	0.1030	0.1355	0.0971	-0.1225
14. Relevance-Accepted	-0.1768	-0.1562	0.2255	-0.3754	0.1049	0.4485	-0.2743
15. Image State-Conflict-Total	0.2006	0.2362	-0.2994	0.2078	0.1103	-0.2444	0.1039
16. Image State-Conflict-Rejected	0.1458	0.0900	0.0966	0.0812	0.1561	0.1140	-0.1140
17. Image State-Conflict-Accepted	0.2211	0.2649	-0.2641	0.2366	0.1209	-0.2155	0.1078
18. Total Evaluation Hours	0.1658	0.3696	0.1083	0.1558	0.2583	0.0087	-0.0219
19. Average Hours/Rejected Elements	0.1691	0.1107	-0.0013	0.0669	0.0522	0.0161	-0.0700
20. Average Hours/Accepted Elements	0.0266	0.3547	0.0006	0.0039	0.1156	0.0305	0.0831
21. Change in Image State Index	0.3211	0.0792	-0.0880	1.0000	-0.0976	-0.3167	0.0233
22. Contribution to Result	-0.2567	-0.2472	0.2695	-0.2883	-0.1311	0.3407	-0.2153
23. Total Integration Hours	0.1100	0.4365	0.0702	0.0713	0.1399	0.1241	-0.1180
24. Average/Accepted Elements	0.0660	0.3142	0.1538	0.0399	0.2189	0.1063	-0.1575

APPENDIX Q

Canonical Roots

Root Number	Canonical Root*	Chi Square	Degrees of Freedom	Rejection Probability
1	0.7601	120.639	27	0.
2	0.5174	61.561	25	0.
3	0.5839	74.083	23	0.
4	0.3173	32.252	21	.058
5	0.2658	26.111	19	.130
6	0.2461	23.868	17	.126
7	0.1824	17.016	15	.319
8	0.1181	10.618	13	.644
9	0.0852	7.526	11	.758

*The canonical correlation coefficient is equal to the square root of the canonical root.