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The Ohio State University, Ph.D., 1974
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PATTERNS OF ORGANIZATIONAL VARIABLES AND
RELATIONSHIPS: THEORY WITH PREDICTIONS
USING A SIMULATION METHODOLOGY

DISSERTATION

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

By

Thomas William Ferratt, B.B.A., M.B.A.

* * * * *

The Ohio State University
1974

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Faculty of Management Sciences
ACKNOWLEDGMENTS

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INTRODUCTION

This research effort is directed at constructing and investigating a limited theory of organizational structure and behavior. The writers who have contributed to the development of the proposed, limited theory have been clustered into four groups: the structural perspective, the contingency perspective, the behavioral perspective, and the complex perspective. Writers within each perspective have many differences, such as the specific variables discussed, the conceptual and operational definitions of variables, and organizational units of analysis. These differences make any grouping of writers a questionable undertaking. Any model presented as representative of a specific perspective is necessarily a composite model arrived at through judgment and synthesis. Therefore, the derived model cannot be representative of any single writer. However, the benefits derived from grouping the various writers outweigh the costs. These benefits include frameworks for: (1) developing simplified, composite models of organizational behavior that are useful in presenting the proposed theory, (2) reviewing the literature from which the proposed theory is developed, and (3) developing propositions to guide the investigation of the proposed theory.

1Representative writings from these perspectives are cited in Chapter 1.
STRUCTURAL PERSPECTIVE

| Structure of the Organizational Unit | Efficiency |

CONTINGENCY PERSPECTIVE

| Critical Variable | Structure of the Organizational Unit | Effectiveness |

BEHAVIORAL PERSPECTIVE

| Decision Behavior | Performance Outcomes |

Fig. 1.—Simplified, composite models of the structural, contingency, and behavioral perspectives.

Fig. 2.—Simplified, composite model of the complex perspective.
The four historical perspectives

Figures 1 and 2 present simplified, composite models of the four historical perspectives. The structural perspective emphasizes the importance of organizational structure in determining efficiency. Both structure and efficiency have a range of possible values. In general, the structuralists prescribe a value of high (rather than low) structure, believing that this value for structure will lead to a value of high (rather than low) efficiency.

The contingency perspective emphasizes the importance of a critical variable in determining structure. In conjunction with the critical variable, structure determines effectiveness. The two variables most often cited as critical are environment and technology. All three variables—the critical variable, structure, and effectiveness—in the simplified model have a range of possible values. In general, the writings of the contingency perspective suggest that a stable environment or routine technology requires high structure to achieve high effectiveness, whereas a changing environment or non-routine technology requires low structure to achieve high effectiveness.

The behavioral perspective emphasizes the importance of behavior (rather than structure) in determining performance outcomes. Behavior has a set of possible forms, and performance outcomes have a range of possible values. In general, the writings of the behavioral perspective suggest that maximizing (rather than satisficing or non-maximizing) behavior leads to high (rather than low) performance outcomes.

This section is only intended to give the reader a brief overview. More detail on the perspectives is presented in Chapter 1.
The complex perspective recognizes the importance of multiple variables and relationships in determining performance outcomes. In addition, the element of time is included in this perspective. Each of the variables—structure, perceptions, environment, and performance outcomes—has a range of possible values, and each of the relationships—behavior, evaluation, and learning—has a set of possible forms. No general statement about all the variables and relationships can be derived, however, from the complex perspective because of major differences among writers included in this perspective.

**Problem statement**

Although the writers in each perspective have contributed to the field of organizational behavior, three specific weaknesses are evident upon reviewing this literature. First, conceptualization of variables is fuzzy within specific writings and confusing across writings. Derivation of models for each perspective is particularly difficult because of this problem.

Second, the processes by which variables, such as structure and environment, are transformed into other variables, such as performance outcomes, are ignored in the structural and contingency perspectives. Conversely, the behavioral perspective ignores variables while focusing on process as the prime factor. Both variables and relationships are important factors in the study of organizational behavior. The distinction between variables and relationships is appropriate when distinguishing between values of variables, e.g., low and high structure, and forms of relationships, e.g., maximizing and satisficing behavior. In
experimental design terminology both values of variables and forms of relationships can be considered factor levels. The integration of writings and empirical investigations across perspectives is untenable because critical factors of one perspective are excluded from another.

Third, all four perspectives recognize a set of possible factor levels only for those factors included within their models. Factors not included are either ignored or implicitly assumed to have specific levels. Sometimes these implicit levels can only be guessed. For those factors included within their models a fairly restricted set of levels is often used.

These three weaknesses are subsumed within a larger problem: the lack of an explicit theory including all of the variables and relationships of the four historical perspectives. Some writers, notably in the complex perspective, have presented theoretical models (e.g., March and Simon, Cyert and March, and Porter and Lawler); however, none has explicitly stated a range of possible values for each variable or a set of possible forms for the relationships among variables.

Research objective

In this research the objective is to develop a complex, explicit theory of organizational structure and behavior and to use the theory to derive a set of predictions, or hypotheses. The proposed theory should include explicit conceptualizations of all variables and relationships. In addition, a range of possible values for each variable and a set of alternative forms for each relationship should be explicitly defined. Finally, the theory should allow predictions, or
hypotheses, to be derived from it.

Methodology

To develop the proposed theory a set of variables and relationships distilled from writers in the four historical perspectives are presented and conceptually defined in a general theoretical model. A wide range of possible values for the variables and a large set of alternative forms for the relationships are discussed within the context of this general theoretical model. A limited set of these variable values and relationship forms are then operationalized and investigated to derive hypotheses regarding selected patterns of variables and relationships.

The limited theory is investigated using a simulation methodology specifically developed for this study. Because of the complex nature of the operationalized theory, analytical derivation of hypotheses from the theory is not possible; therefore, simulation becomes a reasonable methodology for investigating the implications of the proposed theory. Propositions derived from the historical perspectives guide the selection of the patterns of variables and relationships to be investigated using the simulation methodology.

Scope

This study is limited to the development of a general, theoretical model, the development of a simulation methodology, and the investigation of a selected portion of the proposed theory through the use of the simulation methodology. The factors included in the general, theoretical model consist of factors explicitly found in the four historical
perspectives. In an evolutionary fashion, this study clarifies and extends the writings of the four historical perspectives.

The scope of the theory operationalized in the simulation methodology includes all of the variables and relationships presented in the general theoretical model; however, the values of variables and forms of relationships operationalized are limited to a subset of those discussed in the general theoretical model. Primarily, those values and forms not operationalized are also excluded from investigation by writers of the four historical perspectives. Future research could be focused on expanding the operationalization of those factor levels excluded from the scope of this study.

The scope of the portion of the theory investigated to derive hypotheses for future research is determined by the most dominant concerns of the four historical perspectives. These dominant patterns are detailed in Chapter 3. The results of investigating the patterns are compared with propositions derived from the historical perspectives. In addition, the results provide hypotheses for guiding future empirical research with respect to the proposed theory.

Limitations

As with any study various resource constraints affect this study. These constraints primarily affect the method of investigating the proposed theory. Two potential research methodologies are empirical field research and computer simulation research. Empirical investigation of a large sample of organizations operating under various patterns of variables and relationships is costly and time consuming, if not
impossible for some patterns. Likewise, development of a computer simulation methodology is costly and time consuming. In addition, intriguing questions regarding its technical feasibility exist.

Because of resource availability (as cited in the Acknowledgments) and intellectual curiosity regarding its feasibility, a computer simulation research approach has been chosen. This methodology allows investigation of a large number of patterns of variables and relationships. In addition, it illustrates the application of a relatively neglected methodology in the behavioral sciences.

While a large number (e.g., in the thousands) of patterns of variables and relationships could be investigated with a computer simulation methodology, time considerations suggest that a limited set of patterns be investigated. To that end, a limited set of factor levels from the general, theoretical model are operationalized in the computer simulation model. The limitations are guided by the factor levels discussed in the four historical perspectives. In addition, a limited set of patterns containing high and low structure are investigated using the simulation methodology. Once again, the selection of these patterns is guided by the historical perspectives.

Although this study is limited to a theoretical investigation using the computer simulation methodology, empirical investigation of the proposed, general theory by other researchers would be quite useful and, indeed, welcomed.
Justification

This study enriches the field of organizational behavior by developing the general theory, developing the simulation methodology, and investigating the selected patterns of variables and relationships. Developing the theory brings the current state of knowledge into sharper focus. To specify a theory the variables and relationships must be conceptualized explicitly. Assumptions must also be stated explicitly. Stating these conceptualizations and assumptions explicitly exposes areas where current knowledge is strong, weak, or lacking and thereby helps guide research into appropriate areas. In addition, the theoretical model provides a basis for clarifying previously inconsistent findings. The theoretical model also provides a framework for integrating previous research and making future research on various segments of the model comparable.

The simulation methodology provides a flexible tool for further investigations of the theory. Only a selected portion of the theory is investigated in this study. Other researchers can use the simulation model to investigate the implications of portions of the theory that are of particular interest to them. In addition, the use of simulation as a methodology provides an example of an alternative research methodology from that traditionally used in organizational research. The simulation model can also be combined with laboratory subjects to investigate certain portions of the theory or further refine operationalizations of specific factors.

Investigation of selected patterns of factors under conditions of high and low structure extends traditional research concerned with the
effects of organizational design. The results of the investigation should add weight to traditional writings or suggest new avenues of research.

Plan for remainder of the thesis

Chapter 1 presents the general, theoretical model and reviews the literature of the four historical perspectives from which it is derived. Chapter 2 develops the limited simulation model. Chapter 3 presents propositions from the historical perspectives and the selected portion of the theory to be investigated as a result of these historical propositions. Chapter 4 contains the implications of the selected portion of the theory as derived using the simulation methodology. Chapter 5 reviews both the findings with respect to the general, theoretical model and the value of the simulation methodology.
CHAPTER 1

THEORETICAL MODEL

Ideally, the total theoretical model could be presented and explained in detail for the reader to grasp all at one time; however, the size and complexity of the total model require a different approach. The total model is presented initially with little explanation. Various segments of the model are then presented in detail along with clarifying examples from the literature. Variables and relationships are conceptualized. A wide range of values is discussed for each variable; a large set of forms for relationships is discussed. After all segments of the total model are presented, the model is reviewed as a whole. Initial presentation of the total model with little explanation will undoubtedly raise unanswered questions. Hopefully, as the various segments of the model are explained in detail, these questions will be answered. In addition, the reader should be able to place the various segments into a total framework and build an understanding of the total model as the segments are explained.

The models of the structural, contingency, behavioral, and complex perspectives provide the basis for the theoretical model proposed in
this chapter. Instead of placing primary emphasis on variables and ignoring the processes by which the variables are related to each other, as is found in the structural and contingency perspectives, this model includes both variables and processes for relating them over time. In developing the model, variables and processes are separated conceptually. Variables are viewed as the inputs and outputs of processes. Processes serve to relate sets of input variables to sets of output variables; therefore, processes are referred to as relationships. For example, structure of the organizational unit and perceptions of the environment are two variables serving as inputs to search and choice behavior. A chosen program of task behavior is the variable serving as the output of search and choice behavior. The process, or relationship, designated as search and choice behavior transforms the input variables into the output variable. Throughout the remainder of this

---

Writers grouped in the structural perspective include those authors commonly called the classical writers and those predominantly advocating bureaucracy. Particularly useful sources are Massie (1965), Gulick and Urwick (1937), Taylor (1911), and Hall's (1962) discussion of Weber's bureaucracy.

Writers grouped in the contingency perspective include those authors advocating environment or technology as determinants of the appropriate organizational structure. Particularly useful sources are Lawrence and Lorsch (1969), Woodward (1965), and Emery and Trist (1965).

Writers grouped in the behavioral perspective have focused on single-stage, static decision making situations. For useful reviews of research on decision behavior see particularly Rapoport and Wallsten (1972), Becker and McClintock (1967), and Edwards (1961).

Writers grouped in the complex perspective have presented models of organizational behavior that include multiple variables and relationships over time. Particularly useful sources are March and Simon (1958), Cyert and March (1963), Thompson (1967), and Porter and Lawler (1968).
thesis, relationships are designated in figures by rectangles. Input and output variables are designated by parallelograms. (See Figure 3).

The Theoretical Model

The theoretical model is composed of six relationships and associated variables. These variables and relationships are intended to be related to a unit of analysis that is a subsystem of the total organization. With appropriate modification, the model should also be useful for theorizing about an individual member of the organization or the organization itself. Inclusion of all these variables and relationships within a single model allows researchers to investigate them within an interdependent framework.

The six relationships in the model are the following:

1) Environmental change process
2) Organizational unit design process
3) Search and choice behavior process
4) Task behavior process
5) Performance evaluation process
6) Learning behavior process

Each of these relationships has certain variables associated with it. These variables are shown in Figure 3. In particular, the following variables are associated as inputs or outputs with the following relationships:
Fig. 3—Variables and relationships in the theoretical model. (Variables are represented by parallelograms. Relationships are represented by rectangles.)
<table>
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<tr>
<td>2. Organizational unit design process</td>
<td>Designers' perceptions of the environment</td>
<td>Structure of the organizational unit</td>
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<tr>
<td>3. Search and choice behavior process</td>
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This model most closely resembles the complex perspective. It also suffers from one of the major defects of the complex perspective: lack of empirical or analytical investigation. Investigations of these sets of variables and relationships in toto are non-existent. This study does not attempt an empirical investigation. It does conduct an investigation via simulation to derive a set of predictions or hypotheses concerning various patterns of variable values and relationship forms.
Detailed Explanation

The total model is explained in five segments: 1) organizational unit design process, structure of the organizational unit, and performance outcomes; 2) designers' perceptions of the environment, organizational unit's perceptions of the environment, degree of internal control, environmental change process, and environment; 3) search and choice behavior process, program of task behavior, and task behavior process; 4) structure of the organizational unit, performance evaluation process, and performance evaluations; and 5) learning behavior process.

The four historical perspectives are roughly related to these various segments. The structural perspective is closely related to the first segment. The variables and relationships of the second segment correspond to the critical variable found in the contingency perspective, which grew out of the structural perspective. The behavioral perspective is particularly related to the third segment. The fourth segment is found in writings of all perspectives. Finally, the complex perspective is related to all five segments but particularly to the fifth segment since it introduces a feedback, or time, element. The five segments of the theoretical model are identified in Figure 4.

Segment 1: Organizational Design Process, Structure, and Outcomes

As noted above, this segment is closely related to the structural perspective. In that perspective the structure that is determined in the design process leads to performance outcomes. The process whereby structure is transformed into outcomes, however, is ignored in the structural perspective. The intervening processes in the proposed
Fig. 4.—Five segments of the theoretical model.
theory are shown in Figure 4.

**Organizational unit design process**

**Conceptualization**

Although the dynamics of this process are beyond the scope of this thesis, an understanding of the results of this process is important. What happens during this process affects structure at each point in time. Instead of the process itself being conceptualized, the results of the process are conceptualized. The organizational unit design process, therefore, is conceptualized as determining the structure of the organizational unit at each point in time.

This conceptualization extends the conceptualization of the design process as found in the structural and contingency perspectives. In reading the writers included in these perspectives, it is easy to view the design process as occurring at one point in time. Once structure is determined, it remains the same for all time. The results of the design process are static, or stable. The conceptualization presented above extends the design process to include the possibility of a changing structure.

Although the dynamics of the design process are beyond the scope of this study, an input to the design process has been included in the theoretical model. Designers' perceptions of the environment is included as an input for two reasons: (1) to increase conceptual clarity by recognizing the possibility of perceptions by both designers and performers (as discussed in the presentation of segment 2 of the model), and (2) to provide a basis for selecting a prescribed program of task
behavior, given that the dynamics of the design process lead to a set of goals and high structure. It is assumed that the designers follow the same kinds of search and choice strategies when selecting a prescribed program of task behavior as those followed by the organizational unit when selecting a program of task behavior under low structure. (See the discussion of search and choice behavior in the presentation of segment 3 of the model).

Set of alternative forms

Two alternative forms of the design process have already been suggested: stable and changing. An organizational unit has one form or the other. These two alternatives, therefore, span the range of possible forms. Various kinds of stability and change can be suggested; however, specifying the kind of stability or change approaches the realm of operationalizing the theory. Only the general concepts of the theory are being presented in this chapter.

Structure of the organizational unit

Conceptualization of structure

Structure is conceptualized as having several dimensions. A review of the historical perspectives indicates that the various dimensions of structure are intended to shape the behavior of members of the organizational unit. To reflect this conceptualization, structure is defined as those characteristics (or dimensions) of the organizational

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1Many writers have defined various dimensions of structure. See particularly Pugh et al. (1968), Hall (1972), and Hage, Aiken, and Marrett (1971).
unit intended to shape the behavior of organizational members. Specifically, two major dimensions are conceptualized: (1) goals (or tasks) and (2) means for achieving goals. Both are intended to shape the behavior of the members of the organizational unit. The first dimension indicates the direction in which behavior is shaped. The second dimension indicates how it is shaped.

Goals are included notwithstanding Georgiou's recent condemnation of the goal paradigm and Pugh et al.'s silence regarding them in their conceptualization of organizational structure. They have been included implicitly in the four historical perspectives. This conceptualization explicitly includes them in structure. Means for achieving goals include various dimensions discussed in Pugh et al. and in the four historical perspectives. Both goals and means are presented below and conceptualized further.

Goals

**Conceptualization.**—Goals are conceptualized as having several characteristics: (1) the number of goals, (2) aspiration levels for each goal, and (3) the importance of each goal. At any point in time, these characteristics can be used to describe the direction in which behavior is intended to be shaped. As such, they are useful components of structure.

In the structural perspective goals are not discussed as a dimension of structure. They are discussed as being important in guiding behavior. For example, Mooney cites indoctrination in the common

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5 Georgiou (1973), Pugh et al. (1963), (1968).
purpose, or goal, of the organization as ensuring

"the highest collective efficiency and intelligence in the pursuit of the objective." (Mooney, p. 96)

Notice that "objective" is in the singular. Goals are generally discussed in the singular by the structural writers. There is some common purpose, or objective, or task that the organizational unit attempts to meet or accomplish.

Although goals are not discussed as a dimension of structure by the contingency writers, again they are discussed as being important in guiding behavior. For example, Lawrence and Lorsch (1969) found that organizational subunits were differentiated on the basis of subunit goals. In addition, a more complex view of goals is presented than is found in the structural perspective. For example, Woodward (1965) states that although all the firms in her study had a common objective of manufacturing and selling goods, there was considerable difference among the firms. In some organizations managers were aware of their firm's objectives and how they had changed over time. In other organizations objectives were difficult to define, and, indeed, they may not have been consciously planned. Also, Emery and Trist suggest that organizations have a hierarchy of objectives. The goals may be arranged in a hierarchy of importance, where some goals are given more value and attention than others.

As in previous perspectives goals are not discussed as part of structure by writers of the complex perspective; however, the concept of an aspiration level indicates a level of achievement toward which behavior is directed. Cyert and March (1963) suggest that organizational
units set minimum acceptable levels of aspiration.

From all of these perspectives comes the conceptualization of goals stated above and the range of possible values presented below. The reader should keep in mind that the definition of goals applies at any point in time. The number of goals, aspiration levels, and importance of each goal can all remain the same over time, or, conceivably, they can change if the organizational unit design process is changing.

Range of possible values for goal characteristics.—An organizational unit can have any number of formally recognized goals ranging from none to many. If any goals are specified, they can have various aspiration levels specified, ranging from none specified, through specification of a desired range of achievement, to specification of an exact desired level of achievement.

Levels of aspiration are conceptualized as continua anchored at either end by the lowest and highest achievement levels considered likely to occur. By specifying the endpoints in such a manner the continua can be segmented. For example, each continuum can be halved, giving a high and low end of the continuum. Aspiration levels, then, can be classified as high or low.

Each specified goal can also have some importance relative to the other goals. One goal may be more important than all others. One set of goals may be more important than another set. All goals may be considered equally important. In other words, goals are hierarchically arranged with goals at the same level being equally important and goals at higher levels being more important than goals at lower levels.
Means for achieving goals

Based on the literature review, six variables are defined that are further intended to shape the behavior of organizational members. These include the prescription of task behavior, the prescription of communication channels, the specification of a control system, the specification of a reward system, the configuration of the organizational unit, and authority to change structure. If no goals are specified, then obviously these "means for achieving goals" do not direct the behavior of members toward specific goals. Nevertheless, since organizations are "intendedly rational"\(^1\) implying some goal set) and these six component variables are intended to shape behavior at least toward some implicit goal set, "means for achieving goals" is a useful and descriptive phrase to use.

Conceptualization.—Prescription of task behavior describes the expected degree of search for alternative actions and their consequences by the organizational unit. In addition, it describes the expected degree of discretion to be exercised by the organizational unit in selecting an alternative action. Prescription of communications channels is similar to prescription of task behavior. It describes the expected degree of search for alternative interactions and their consequences by the organizational unit. In addition, it describes the expected degree of discretion to be exercised by the organizational unit in selecting interactions.

\(^{6}\)March and Simon (1958, pp. 156, 170).
Specification of a control system includes specifying three component variables: (1) what is reviewed, (2) the frequency of review, and (3) the delay between performance and review. Specification of a reward system has three similar components: (1) what is rewarded, (2) the frequency of reward, and (3) the delay between performance and reward.

The configuration of the organizational unit refers to the role structure within the organizational unit. It includes both horizontal and vertical differentiation of roles within the organizational unit.

Authority to change structure refers to the organizational unit's formal ability to change the two dimensions of structure: (1) goals and (2) means for achieving goals. Authority, therefore, refers to its formal ability to alter that which shapes its behavior.

Range of possible values for the six means for achieving goals.---As the means for achieving goals are defined further by their possible values, their values as discussed by various writers in the structural, contingency, and complex perspectives are also presented.

Prescription of task behavior.---Prescription of task behavior, the first means of achieving goals, ranges from low prescription to high prescription. At the extreme of low prescription, the organizational unit is required to invent and elaborate a program of task behavior. At the extreme of high prescription, the unit is required to follow a specified program of task behavior.

The structuralists specify a value of high prescription. For example, Frederick Taylor (1911) stated that determination of the method for performing a routine productive task was not a worker's function.
A detailed program of behavior was to be determined scientifically, through analysis of time-study and various other records and observation. James Mooney (1937, p. 93) spoke of "the exact definition of every job and every function". For Max Weber's bureaucracy, procedures for each work situation were highly defined.

The writers of the contingency perspective note that the appropriate value for prescription of worker behavior is contingent upon a critical variable. For example, Woodward (1965, p. 23) found that most effective organizations had more highly prescribed worker behavior when the degree of internal control was in the middle range (i.e., large batch and mass production). When the degree of internal control was low (i.e., unit and small batch production) or high (i.e., process production), jobs lost much of their formal definition.

Within the complex perspective March and Simon (1958, pp. 139-140) particularly contributed to the development of this variable. They stated that tasks of members of the organizational unit may range from routine to problem-solving. Routine tasks require no search for alternative actions and their consequences. At the problem-solving extreme, tasks require invention and elaboration of performance programs. A performance program for a routine task specifies activities to be performed. Little discretion is involved. Prescription is high. A performance program for a less routine task specifies the quantity and quality of output desired. Less prescription is involved since discretion must be exercised to determine the means (or activities) for meeting the prescribed ends.
Prescription of communications channels.—This second means of achieving goals ranges from low prescription to high prescription. At the extreme of low prescription, the organizational unit is required to invent and elaborate communications channels. At the extreme of high prescription, the unit is required to use specified channels.

Writers in the structural, contingency, and complex perspectives all suggest that specific communications channels should exist. They do not all agree about where communications channels should exist or how they should be used. For example, structuralists focus primarily on intra-unit channels. In the complex perspective, Thompson particularly discusses both intra-unit and boundary-spanning communications channels. Woodward provides two differing examples within the contingency perspective regarding the use of channels. Communications were in the form of consultation rather than passing up information and receiving orders, when the degree of internal control was low or high. When it was in a middle range, communications were in the form of information filtering up and instructions flowing down. These differences do not provide for a neat synthesis; however, they have contributed to the development of the concept of a range of possible values (from low to high) for prescription of communications channels.

Specification of a control system.—This third means of achieving goals has three component variables: (1) what is reviewed, (2) the frequency of review, and (3) the delay between performance and review. Each of them has a range of possible values. What is reviewed ranges from behavior to goal achievement. If the control system reviews behavior, it examines search, choice, and task behaviors to determine
whether the goals have been achieved. The specified goals determine the performance outcomes examined if the control system and goals are congruent. It is possible, also, to conceptualize the two as not being congruent, i.e., something other than the goals are used to determine the performance outcomes examined.

Frequency of review ranges from frequent to infrequent. If a task is repeated over time, whether the cycle time is a minute, day, week, month, etc., the most frequent review is every task cycle. The larger the number of task cycles between reviews, the more infrequent the review.

Delay in review ranges from no delay to large delay. The larger the number of task cycles between the cycle in which review occurs and the cycle in which performance occurred, the larger the delay in review. For example, if review occurs in task cycle seven for what took place in task cycle one, the delay is six periods. If task cycle seven is reviewed during task cycle seven, no delay occurs.

Although structuralists stress the importance of control, the conceptualization of this variable is derived from writers in the contingency perspective. Particularly, Lawrence and Lorsch (1969) in their measure of formal structure used the following scaled variables:

1. average span of control
2. number of hierarchical levels
3. time span of review of departmental performance
4. specificity of the review
5. importance of rules
6. specificity of criteria for evaluating role occupants
The third, fourth, and sixth variables relate to specification of a control system as conceptualized herein.

**Specification of a reward system.**—This fourth means of achieving goals has three component variables similar to those for a control system. What is rewarded ranges from behavior to goal achievement. The frequency of reward ranges from frequent to infrequent. The delay between performance and reward ranges from no delay to large delay. All three of these are defined in a manner similar to that used for the three components of specification of a control system.

The reward system is congruent with the control system if it rewards what the control system reviews. In addition, the reward system is congruent with goals if it rewards the achievement of goal levels commensurate with those specified in goals.

Structural and contingency writers discussing reward systems propose the use of reward systems congruent with goals. Taylor suggested an incentive wage system where the amount of wages would be tied to the amount of productivity. One of Weber's dimensions of bureaucracy is differential rewards by office, which can be interpreted as a reward system tied to the contribution of the office holder to organizational goals. Lawrence and Lorsch suggest that rewards be tied to accomplishment of overall objectives. Although congruent reward systems are proposed by these writers, non-congruent reward systems are also within the realm of theoretical (and actual) possibility.
The scheduling of rewards has not been given much, if any, attention by writers within the structural, contingency, and complex perspectives.\(^7\)

**Configuration of the organizational unit.**—This fifth means of achieving goals ranges in value from simple to complex. It has been used by several writers to indicate the degree of horizontal and vertical differentiation of roles in organizational units.\(^8\) No standards have been developed for defining what is a simple or complex configuration.

Writers in the structural, contingency, and complex perspectives label the horizontal differentiation of roles variously as the division of labor, differentiation, or specialization. The vertical differentiation of roles is referred to as the chain of command, hierarchy, or levels of management. Particularly with respect to the horizontal differentiation of roles, the structuralists propose one value for all organizations: a high degree of specialization. Writers in the contingency and complex perspectives, however, suggest that the degree of specialization is dependent on some other variable, such as the environment. Little is discussed concerning the vertical differentiation of roles.

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\(^7\) See Nord's (1969) discussion of Skinner and operant conditioning for a review of the scheduling of rewards. This material falls outside the four perspectives discussed in this thesis; however, it is closely akin to the behavioral perspective. Others may even include it in that perspective.

\(^8\) See particularly Hall (1972), Hage, Aiken, and Marrett (1971), and Blau and Schoenherr (1971).
Authority to change structure.---This sixth and last means for achieving goals ranges in value from low to high. Authority refers to the organizational unit's formal ability to change goals and the means of achieving them. Under high authority the organizational unit is able to make any kind of change. Under low authority it is not able to make any change. (Note, however, that an organizational unit may have low authority but also low prescription of task behavior).

This concept most closely resembles centralization of authority found in the structural and contingency perspectives. The difference between the two concepts results from viewing the organizational unit of analysis as a subsystem of a total organization. Authority to change structure refers to the unit's authority as an entity to change its structure. Centralization of authority, if used to describe the organizational unit, would refer to the distribution of that authority within the unit.

Under the structural perspective, the lower the unit's location in the hierarchy of the total organization, the lower its authority. Under the contingency perspective, the amount of authority is dependent on another variable. For example, Lawrence and Lorsch suggest that as uncertainty increases, the amount of authority allowed at lower levels of the hierarchy should increase.

Concluding remarks regarding structure.---If all of the components of structure were measured and aggregated according to a specified procedure, an overall measure of structure would be obtained. Such a measure is non-existent for one primary reason: structure has not been conceptualized previously in the same manner as presented above. Even
with previous conceptualizations, overall measures of structure are rare; however, discussions of overall structure are common. High structure and low structure are discussed often. For example, the structuralists suggest that high structure is required to achieve high efficiency. Writers in the contingency perspective suggest that high structure leads to high effectiveness under stable or routine conditions, whereas low structure does under changing or non-routine conditions. In the next chapter, operational definitions of low and high overall structures are presented.

Performance outcomes

Conceptualization

Performance outcomes are the actual levels of attainment on various goal dimensions during a task cycle. Any actual performance measure can be used as a performance outcome. Efficiency in the attainment of the common purpose is the outcome of prime interest to the structuralists. Effectiveness is the outcome of prime interest to the writers of the contingency perspective. Conventional economic measures of performance are typical of the performance outcomes used to determine effectiveness. For example, Lawrence and Lorsch (1969, p. 39) used change in profits over the past five years, change in sales volume over the past five years, and new products introduced in the past five years as a percent of current sales. Organizations were ranked to

9 See, however, Woodward's (1965, p. 23) discussion of her results in terms of mechanistic and organic management systems. Also, see Lawrence and Lorsch's (1969) formality of structure measure, which includes six scaled variables.
determine the more effective ones. The information gathered by Woodward (1965) included the state of the industry, the position of the organization in the industry, annual reports and financial accounts for a five year period, and other factors, such as stock price fluctuations, reputation of the firm as an employer, level of salaries paid to senior management, and relationships between the firm and outside organizations. This information was used to rank organizations as above average, average, or below average.

Range of possible values

The number of performance outcomes ranges from few to many. Each outcome dimension (or level of achievement) is conceptualized similar to a level of aspiration continuum. The ends of the continuum are anchored by the lowest and highest achievement levels considered likely to occur. Therefore, each outcome dimension can be segmented, giving, for example, a high end and low end to each dimension. In this conceptualization a high outcome has higher value to the organizational unit than does a low outcome.

Summary of factors in segment 1

Table 1 summarizes the range of possible factor levels for the organizational design process, structure of the organizational unit, and performance outcomes. These three factors were presented as segment 1 of the total model. Figure 5 shows the factors of segment 1 in conjunction with those of segment 2. Appendix E also contains a summary of these factors.
Fig. 5.—Segments 1 and 2 of the theoretical model.
TABLE 1
POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 1

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Organizational Unit Design Process</td>
<td>1. stable</td>
</tr>
<tr>
<td></td>
<td>2. changing</td>
</tr>
<tr>
<td>B. Structure of the Organizational Unit</td>
<td></td>
</tr>
<tr>
<td>1. Goals</td>
<td></td>
</tr>
<tr>
<td>a. number</td>
<td>none</td>
</tr>
<tr>
<td>b. specification of aspiration levels</td>
<td>none specified</td>
</tr>
<tr>
<td>c. importance of each</td>
<td>no goals important</td>
</tr>
<tr>
<td></td>
<td>all goals most important</td>
</tr>
<tr>
<td>2. Means for achieving goals</td>
<td></td>
</tr>
<tr>
<td>a. prescription of task behavior</td>
<td>low</td>
</tr>
<tr>
<td>b. prescription of communication channels</td>
<td>low</td>
</tr>
<tr>
<td>c. specification of a control system</td>
<td></td>
</tr>
<tr>
<td>1) what is reviewed</td>
<td>goal achievement</td>
</tr>
<tr>
<td>2) frequency of review</td>
<td>infrequent</td>
</tr>
<tr>
<td>3) delay in review</td>
<td>large</td>
</tr>
</tbody>
</table>

RANGE OF POSSIBLE VALUES

<table>
<thead>
<tr>
<th>ONE EXTREME</th>
<th>OTHER EXTREME</th>
</tr>
</thead>
<tbody>
<tr>
<td>levels exactly specified</td>
<td>(may range from low levels to high levels)</td>
</tr>
<tr>
<td>no goals important (a hierarchy of goals with all being at the bottom)</td>
<td>all goals most important (a hierarchy of goals with all being at the top)</td>
</tr>
<tr>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>infrequent</td>
<td>frequent</td>
</tr>
<tr>
<td>large</td>
<td>none</td>
</tr>
</tbody>
</table>
4) congruence with goals
   high          low

d. specification of a reward system
1) what is rewarded  goal achievement  behavior
2) frequency of reward  infrequent  frequent
3) delay in reward  large  none
4) congruence with control system  high  low
5) congruence with goals  high  low
e. configuration of the organizational unit  simple  complex
f. authority to change structure  high  low

C. Performance Outcomes

<table>
<thead>
<tr>
<th></th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ONE EXTREME</td>
</tr>
<tr>
<td>1. Number</td>
<td>few</td>
</tr>
<tr>
<td>2. Levels of Achievement</td>
<td>low</td>
</tr>
</tbody>
</table>

Segment 2: Environment, Environmental Change, Organizational Unit's Perceptions, Designers' Perceptions, and Degree of Control

These five factors have been poorly or not at all distinguished from one another in all perspectives but particularly by writers in the contingency perspective. (Writers in the structural perspective have generally ignored these factors by making implicit assumptions about them). Writers of the contingency perspective have been singled out because of their reliance upon a poorly conceptualized critical variable.
(See Figure 1.) They usually encompass two, three, four or all five of the above factors within that critical variable without realizing it. These five factors are presented as segment 2 of the total model to provide a conceptual clarification of the muddled critical variable and to place the resulting expanded number of factors in their appropriate places in the overall theoretical model.

Environment
Conceptualization

The environment is composed of those social or physical entities external to the organizational unit that are immediately or potentially relevant for goal seeking behavior. Thompson (1967) has used a similar definition for the task environment but has restricted it to organizations that make a difference. Duncan's (1972) definition of environment, although including both internal and external environments, is more general in that it includes both social and physical factors rather than just organizations. Thompson's definition with Duncan's elaboration to include both social and physical factors is the conceptualization used in this thesis.

Social components of the environment consist of other individuals or organizations that the focal organization must take into account as it performs over time. These entities may consist of similar or non-similar organizations as discussed by Emery and Trist (1965). They may consist of the market, customers, competitors, production equipment sources, raw materials sources, or labor markets as discussed by Lawrence and Lorsch (1969, p. 8). Physical entities may consist of
the methods of manufacturing, i.e., the technology, as discussed by Woodward, or the production equipment itself in Lawrence and Lorsch's techno-economic subenvironment. They may also consist of the products manufactured. All of these components form the basis for defining the environment at any point in time.

Two levels of information about the environment exist. One level concerns the environment as a whole and is referred to as aggregate characteristics. The second level concerns individual components of the environment and is referred to as characteristics of components.

Range of possible values for aggregate characteristics

Aggregate characteristics include the size of the environment and the distribution of characteristics associated with individual components. The size of the environment represents the number of components in the environment. Size ranges from small to large. If there are few components, size is small. If there are many components, size is large. No absolute standards exist, however.

Since environmental components have characteristics, the environment as a whole can be classified according to the manner in which characteristics are distributed over the environment. Other writers have used homogeneous and heterogeneous (or diverse) as extremes for classifying environments. Many characteristics could be used to arrive at just as many classifications of the environment. In other words, the environment could be homogeneous on some characteristics and heterogeneous

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1Lawrence and Lorsch (1969), Thompson (1967), and Duncan (1972).
on others.

Potential outcomes associated with environmental components are a specific type of characteristic. The distribution of outcomes, besides being homogeneous or heterogeneous, can be classified as ranging from poor to good.\(^1\) Other characteristics may also be thought of as having a low to high range of possibilities. Therefore, the distribution of characteristics in an environment can be classified along two dimensions: (1) homogeneous/heterogeneous and (2) low/high. For example, all supply components of the environment may have a similarly low cost for an input required by the organizational unit. Since low cost would be regarded as a high (where high means positively valued) outcome by the organizational unit, the environment would be classified as having a homogeneous/high distribution for this potential outcome.

Range of possible values for characteristics of components

Besides the macro characteristics of size and the distribution of characteristics for the overall environment, micro characteristics of the environment are useful in describing the environment. Of particular utility are the potential outcomes associated with each environmental component. The number of potential outcomes ranges from few to many. The level of each potential outcome ranges from low to high. End points of each potential outcome are defined in a manner similar to that used in defining the end points of aspiration levels and performance outcomes. Using the end points as anchors, then, low and high potential

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\(^1\)March and Simon (1958) refer to the degree of munificence of the environment.
outcomes can be defined by dividing the range of potential outcomes into a low end and a high end.

Concluding comments regarding the environment

Other writers (Lawrence and Lorsch, 1969), (Thompson, 1967), and (Duncan, 1972) have included a static/dynamic dimension in their conceptualization of the environment. How the environment changes over time is not part of the above definition of environment. It is included in the definition of the environmental change process. The definition of environment, therefore, is a static picture at a point in time. This conceptualization allows the environment to be defined in terms of the components existing at any point in time. The process whereby the environment changes, therefore, need not distort that definition.

Environmental change process

Conceptualization

This process defines how the environment changes over time. Changes can be defined in aggregate terms, such as a change in the size or the distribution of characteristics, or they can be defined in individual terms, such as a change in the characteristics of specific components. For example, Lawrence and Lorsch (1969) use the growth rate of sales (a change in the level of a potential outcome) and new product introduction (a change in the number of components) as measures of environmental stability. As noted above, the change process is distinct from the conceptualization of the environment itself.
Set of alternative forms

As in the case of the organizational unit design process, the results of the environmental change process are of prime interest. A theory of environmental dynamics is not being proposed. Alternative forms for the process, therefore, are based on the results of the process. If the result, i.e., the environment, is the same over time, the process is stable. If the task environment is changing over time, the process is changing. A changing environment can be either growing or declining. The set of alternative forms, therefore, consists of 1) a stable process, 2) a changing process with growth, and 3) a changing process with decline. Any process can be deterministic or stochastic, linear or non-linear. A particular organization would have one of these forms for its environmental change process.

Organizational unit's perceptions of the environment

Conceptualization

This variable has three component variables: (1) the number of perceived environmental components, (2) beliefs about cause and effect relationships, and (3) uncertainty regarding beliefs.

Perceived environmental components are important presumably because they are relevant for goal attainment. In this theory the assumption is made that environmental components become relevant through interaction with, or use by, the organizational unit. The organizational unit interacts with social components and uses physical components. Through interaction or use (i.e., a cause), outcomes (i.e., effects) occur. The organizational unit's beliefs about the number of outcomes
and levels of attainment on them associated with each perceived environmental component comprise the second element of perceptions of the environment.

Uncertainty of the organizational unit regarding beliefs is the third dimension of perceptions. Notice that uncertainty is associated with the organizational unit, not the environment. Uncertainty can be expressed as probabilities associated with the relationship between interaction with or use of an environmental component and attainment of various outcomes. A probability density function for the outcomes obtained from an environmental component represents both beliefs and uncertainty regarding cause and effect relationships with respect to that component.

This conceptualization of perceptions of the environment differs from various conceptualizations in the literature. It is broader and clearer than Lawrence and Lorsch's (1969) measure of uncertainty, which is obtained by asking for the knowledge of cause and effect relationships. It is conceptually sounder than the concept of environmental uncertainty. Notwithstanding the controversy regarding measurement of environmental uncertainty, \(^1\) it is argued elsewhere and assumed herein that such a concept is contradictory in its terminology. \(^2\) A more meaningful concept is uncertainty regarding beliefs about cause and effect relationships among the organizational unit and environmental components.

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\(^1\) See Lawrence and Lorsch (1969) and Tosi, Aldag, and Storey (1973).

\(^2\) For further development of this argument see Ferratt (1973).
Range of possible values

Each of the three component variables has a range of possible values. The perceived environmental components range from few to many, where few and many have no absolute standards. An example from Duncan's (1972) research indicates that 4 components are many!

For each environmental component the organizational unit has beliefs or estimates of the potential outcomes associated with the component. Outcome dimensions are conceptualized in the same manner as aspiration levels for goal dimensions. Therefore, beliefs range from a low estimated outcome to a high estimated outcome for each outcome dimension. The number of outcome dimensions ranges from few to many just as potential outcomes range from few to many.

Uncertainty regarding beliefs ranges from low uncertainty to high uncertainty. Once again no absolute standards are proposed for this range of values.

Designers' perceptions of the environment

Conceptualization

This variable has three component variables: (1) the number of perceived environmental components, (2) beliefs about cause and effect relationship, and (3) uncertainty regarding beliefs. These are all conceptualized similar to the component variables comprising the organizational unit's perceptions of the environment. The only difference is in the entity perceiving the environment. This conceptualization explicitly recognizes the possible existence of separate planning and doing functions. Note, however, that the possibility exists
(particularly under high authority to change structure) that the designers are members of the organizational unit; in other words, the planners and performers could be the same people.

Range of possible values

The three component variables have the same range of possible values as those comprising the organizational unit's perceptions of the environment. The number of perceived environmental components range from few to many. Beliefs range from a low estimated outcome to a high estimated outcome for each outcome dimension. Uncertainty regarding beliefs ranges from low uncertainty to high uncertainty.

Degree of internal control

Conceptualization

This variable has been conceptually separated from the environment and from perceptions of the environment. The organizational unit can take the degree of internal control into account when determining perceptions, but the two variables have different purposes in the theoretical model. The conceptualization of environment does not include interactions among environmental components. The degree of internal control does take environmental turbulence into account. This variable indicates how closely the organizational unit can attain, through its own interactions and actions, the potential outcomes available. Conversely, it indicates how much the turbulence of the environment affects the outcomes attained by the organizational unit.
This variable has not been conceptualized distinctly from the environment, the environmental change process, and perceptions of the environment by writers in the contingency perspective. For example, Emery and Trist's (1965) discussion of turbulence and ability to predict is particularly difficult to unravel, partially, if not entirely, because of the lack of conceptual clarity.

Range of possible values

If the manner in which the organizational unit performs its task largely determines the outcomes that occur, the unit has high internal control of outcomes. If, on the other hand, the outcomes that occur are not directly related to the performance behavior of the organizational unit, the unit has low internal control of outcomes.¹

Summary comments regarding the factors included in segment 2

Table 2 summarizes the range of possible factor levels for the environment, the environmental change process, the organizational unit's perceptions of the environment, the designers' perceptions of the environment, and the degree of internal control. These five factors were presented as segment 2 of the total theoretical model. Figure 6 shows the factors of segment 2 in conjunction with those of segment 3. Appendix E also contains a summary of these factors.

¹For a similar concept see Rotter's (1966) discussion of internal-external control. Although the label "degree of internal control" has been used in this thesis, future writers may prefer to use the label "degree of external control."
This variable has not been conceptualized distinctly from the environment, the environmental change process, and perceptions of the environment by writers in the contingency perspective. For example, Emery and Trist's (1965) discussion of turbulence and ability to predict is particularly difficult to unravel, partially, if not entirely, because of the lack of conceptual clarity.
segment 2

DEGREE OF INTERNAL CONTROL

ENVIRONMENTAL CHANGE PROCESS

ENVIRONMENT

ORGANIZATIONAL UNIT'S PERCEPTION OF THE ENVIRONMENT

DESIGNERS' PERCEPTIONS OF THE ENVIRONMENT

ORGANIZATIONAL UNIT DESIGN PROCESS

STRUCTURE OF THE ORGANIZATIONAL UNIT

segment 3

SEARCH AND CHOICE BEHAVIOR

PROGRAM OF TASK BEHAVIOR

TASK BEHAVIOR

PERFORMANCE OUTCOMES

STRUCTURE OF THE ORGANIZATIONAL UNIT

PERFORMANCE EVALUATION PROCESS

PERFORMANCE EVALUATIONS

LEARNING BEHAVIOR

Fig. 6.—Segments 2 and 3 of the theoretical model.
### TABLE 2
POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 2

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Environment</strong></td>
<td>ONE EXTREME</td>
</tr>
<tr>
<td>1. Aggregate characteristics</td>
<td></td>
</tr>
<tr>
<td>a. size</td>
<td>small</td>
</tr>
<tr>
<td>b. distribution of characteristics</td>
<td>homogeneous/low</td>
</tr>
<tr>
<td>2. Characteristics of components</td>
<td></td>
</tr>
<tr>
<td>a. number of potential outcomes</td>
<td>few</td>
</tr>
<tr>
<td>b. levels of outcome dimensions</td>
<td>low</td>
</tr>
<tr>
<td><strong>B. Environmental Change Process</strong></td>
<td>SET OF ALTERNATIVE FORMS</td>
</tr>
<tr>
<td>1. stable</td>
<td></td>
</tr>
<tr>
<td>2. changing with growth</td>
<td></td>
</tr>
<tr>
<td>3. changing with decline</td>
<td></td>
</tr>
<tr>
<td><strong>C. Organizational Unit's Perceptions of the Environment</strong></td>
<td>RANGE OF POSSIBLE VALUES</td>
</tr>
<tr>
<td>1. Perceived environmental components</td>
<td>one extreme</td>
</tr>
<tr>
<td>2. Beliefs about cause and effect relationships</td>
<td></td>
</tr>
<tr>
<td>a. number of outcome dimensions</td>
<td>few</td>
</tr>
</tbody>
</table>
b. estimated level on each outcome

3. Uncertainty regarding beliefs

D. Designers' Perceptions of the Environment

<table>
<thead>
<tr>
<th>PERCEIVED ENVIRONMENTAL COMPONENTS</th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELIEFS ABOUT CAUSE AND EFFECT RELATIONSHIPS</td>
<td>ONE EXTREME</td>
</tr>
<tr>
<td>NUMBER OF OUTCOME DIMENSIONS</td>
<td>few</td>
</tr>
<tr>
<td>ESTIMATED LEVEL ON EACH OUTCOME</td>
<td>low</td>
</tr>
</tbody>
</table>

E. Internal control of outcomes

<table>
<thead>
<tr>
<th>INTERNAL CONTROL OF OUTCOMES</th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONE EXTREME</td>
<td>OTHER EXTREME</td>
</tr>
<tr>
<td>high</td>
<td>low</td>
</tr>
</tbody>
</table>

Segment 3: Program of Task Behavior, Search and Choice Behavior, and Task Behavior

The three factors in this segment (shown in Figure 6) are derived from the behavioral and complex perspectives. The writings of the structural and contingency perspectives ignore behavior. These three factors provide the linkages for structure, perceptions, environment, and performance outcomes, all which are salient variables in either the structural or contingency perspectives. These linkages also provide a basis for interrelating micro- and macro-level studies of organizational behavior.
The search and choice behavior process and task behavior process are assumed to be repeatable over time. The behavior of the organizational unit, therefore, can be identified as cyclical. Consequently, these two processes are part of the organizational unit's task cycle.

**Program of task behavior**

**Conceptualization**

The organizational unit must use or interact with components of the environment during its task cycle. Conceptually the environment can be partitioned into three sets of components. One set of components consists of potential suppliers of inputs. Another set of components consists of potential transformation, or technological, processes for use with the inputs. The third set of components consists of potential receivers of the organizational unit's outputs. Therefore, the organizational unit must interact with some subset of the suppliers and receivers to obtain inputs and dispose of outputs. It must also use a particular subset of technological components to produce its outputs.

A program of task behavior is defined as the particular set of environmental components chosen by the organizational unit to complete its task. This program defines the interactions (to obtain inputs and dispose of outputs) and actions (to use the technology) required of the organizational unit. Each program of task behavior has a set of potential outcomes associated with it.

---

1 This conceptualization provides a possible basis for integrating the writings of the contingency perspective that use technology or environment as the critical variable.
Range of possible values

Alternative programs of task behavior may be perceived by the organizational unit. The range of possible programs of task behavior consists of all possible combinations of input components, output components, and technological components perceived by the organizational unit. Potential outcomes associated with each program range from all high outcomes, through mixed outcomes (i.e., some high outcomes and some low outcomes), to all low outcomes.

Search and choice behavior

Conceptualization

Search and choice are regarded as cognitive processes requiring the organizational unit to determine a program of task behavior.\(^1\) Search involves the generation of alternative programs of task behavior and the assessment of outcomes associated with them. Choice involves arraying alternatives in a rank order and selecting one for the task behavior process.

Set of alternative forms for both search and choice

Three bases are used for classifying alternative forms of search and choice behavior. First, the search and choice behavior process is classified according to organizational unit members' willingness to

---

\(^1\) The development of differences between cognitive and acognitive processes is beyond the scope of this paper. If the reader prefers to regard an abbreviated search and choice process, wherein probabilities of outcomes are not evaluated at a cognitive level when an alternative is repetitively chosen, as an acognitive process, the theory developed herein is still useful.
behave within the constraints of the unit's structure. If search and choice behavior is guided by the prescribed goals when structure is low and means for achieving goals when structure is high, behavior is classified as compliant. Otherwise it is classified as non-compliant.

Second, the search and choice behavior process is classified according to the organizational unit's pattern of search and choice over time. If search and choice behavior follows the same strategy over all task cycles, it is classified as consistent. Otherwise it is classified as inconsistent. Third, the search and choice behavior process is classified according to search and choice strategies. Five alternative strategies have been formulated: 1) random search and choice, 2) no search and trivial choice, 3) satisficing search and choice, 4) rational search and choice, and 5) maximizing search and choice. Each of these is explained in more detail below. The three bases for classifying search and behavior provide that at any point in time such behavior is either compliant or non-compliant and follows one of the five search and choice strategies; over time such behavior is either consistent or inconsistent.

Set of alternative forms for search strategies. When the organizational unit must search for a program of task behavior, i.e., when prescription of task behavior is low and, therefore, no program of task behavior is prescribed, the unit can perform this search according to a number of strategies. For compliant behavior, a continuum of search strategies guided by the goals defined in structure (see the discussion of segment 1) has been discussed in the literature. At one end is satisficing search; here the perceived environment is searched until one
satisfactory alternative is found. At the other end is maximizing search; here all task programs in the perceived environment are searched to find the best alternative. In the middle of the continuum is rational search; here the perceived environment is searched until a number of satisfactory alternatives are found.¹ For non-compliant behavior, the above search strategies may be used, but they would be based on goals other than those specified in the structure of the organizational unit. Alternately, search may be eliminated under non-compliant behavior.

When prescription of task behavior is high, search is not required since a program of task behavior is prescribed. Under compliant behavior, no search occurs. The organizational unit chooses the program of task behavior prescribed. Under non-compliant behavior, search may occur. In this case, maximizing, rational, or satisficing search strategies may be employed where the goals are either those specified in structure or another set of goals. Alternately, search may not occur.

A fifth strategy, in addition to no search, satisficing search, rational search, and maximizing search, is random search. No definite plan for searching exists under this strategy.

_Direction of search under various strategies._—The above description of the extent of search, where no search is the least extensive and maximizing search is the most extensive with satisficing and rational search lying between these extremes, does not completely describe

¹For satisficing search see March and Simon (1958). Maximizing search is derived from normative decision theorists. Kozielecki (1971) has formalized both satisficing and maximizing search. Rational search is derived from Schrenk (1969).
search strategies. In addition to the extent of search, the direction of search needs specified. When no perceived alternative programs of task behavior are searched, direction of search does not need specification because no search occurs. Also, when all perceived alternative programs of task behavior are searched, direction of search does not need specification because the entire set of alternatives is searched.

For satisficing and rational search, however, the direction of search needs specification. In these two search strategies it is assumed that only a small number of alternatives are considered by the organizational unit at any one time. March and Simon (1958) refer to these alternatives as the set of evoked alternatives. Cyert and March (1963, p. 121) have suggested that search beyond the current alternative is stimulated when the organizational unit "fails to satisfy one or more of its goals or when such a failure can be anticipated in the immediate future." When search is stimulated, the organizational unit can follow a strategy of searching in the set of evoked alternatives. If not enough satisfactory alternatives (one for satisficing search, several for rational search) are found in the evoked set, search must be expanded to other alternatives. If expanded search does not yield enough satisfactory alternatives, levels of aspiration may be lowered. This strategy for directing search has been suggested by Cyert and March (1963, pp. 120-122). Other strategies could be followed by organizational units. For example, search could be conducted among other organizational units in the task environment to determine what
programs they follow. Another possibility is opportunistic search.\(^1\) Here search is continual, not just a result of unsatisfactory performance outcomes, and therefore not just in the area of current alternatives, i.e., the evoked set.

The five search strategies mentioned above are limited in the sense that they do not include any strategy for increasing the number of perceived alternatives. All of the strategies are based on the set of perceived alternatives. Note, however, that the set of perceived programs of task behavior can be much larger than the evoked set since the evoked set is a subset of all perceived alternatives.

**Set of alternative forms for choice strategies.**—When task prescription is high, the choice of a program is specified. Under compliant behavior, therefore, the choice strategy is to choose the prescribed alternative. Under non-compliant behavior or when task prescription is low, some other choice strategy is followed.

A simple strategy is just to select an alternative randomly. More complex strategies result when a rationale is used to justify a selection. Choosing among alternatives with multiple outcomes requires a method of ranking the alternatives to make an eventual selection. One method consists of weighting the outcomes hierarchically to correspond to the hierarchy of goals. Under compliant behavior this process is assumed to occur. Under non-compliant behavior, another scheme may be used.

\(^1\) Thompson (1967, p. 151) discusses opportunistic surveillance.
More complexity is added to the choice strategy when the outcomes of the alternatives are not defined with complete certainty. A risk philosophy must be incorporated in the choice strategy. The organizational unit may be risk averse, may be interested in expected values, or may be a risk taker. The organizational unit may look at not only the perceived mean values of outcomes associated with alternative programs but also higher moments of the probability distribution of outcomes, such as the variance.

Each choice strategy correlates directly with each search strategy. When no search is employed as a search strategy, the choice strategy consists of selecting the program of task behavior that is specified in structure. When satisficing search is employed as a search strategy, the first alternative is chosen whose perceived outcomes (according to a specified risk philosophy) meet (i.e., satisfy) the aspiration levels and goal hierarchy specified in structure. When a rational search strategy is employed, several satisfactory alternatives are selected. The best one, i.e., the one whose perceived outcomes (according to a specified risk philosophy) are closest to the aspiration levels and specified goal hierarchy, is chosen. When a maximizing search strategy is employed, all alternatives are ranked according to how well their perceived outcomes (according to a specified risk philosophy) meet the aspiration levels and specified goal hierarchy. The highest ranking alternative is then chosen. When a random search strategy is employed, a random choice is made.

Summary of alternative forms for search and choice behavior.—Because of the correspondence between search and choice strategies, the
two behaviors of search and choice can be combined and referred to as decision behavior. The five alternative decision behaviors for determining a program of task behavior given structure and perceptions of the environment are the following: (1) no search, trivial choice, (2) satisficing search and choice, (3) rational search and choice, (4) maximizing search and choice, and (5) random search and choice. At any point in time decision behavior may be compliant or non-compliant. Over time, it may be consistent or inconsistent. This set of alternative forms is fairly exhaustive. Search and choice behavior of practically any organizational unit should approach one of these alternative forms of behavior.

**Task Behavior**

Conceptualization

In task behavior the organizational unit performs its task by following the chosen program of task behavior. It interacts with the chosen suppliers of inputs to obtain the inputs. It uses the chosen technological components to transform inputs into outputs. Finally, it interacts with the chosen receivers of outputs to dispose of the outputs.

Set of alternative forms

The other inputs to task behavior besides the chosen program are the actual (rather than perceived) characteristics associated with the program of task behavior and the degree of internal control of outcomes. All of these inputs combine to determine the performance outcomes. The program of task behavior chosen by the organizational unit determines which environmental components are involved in task performance. The
degree of internal control determines whether the interactions and actions of the organizational unit and chosen environmental components lead directly to performance outcomes or whether external influences affect performance outcomes.

Task behavior ranges from compliant to non-compliant. It ranges from consistent to inconsistent. Under compliant behavior the organizational unit performs to meet the demands of the structure whereas in non-compliant behavior some other demands guide behavior. Consistency refers to the kind of compliance over time. Under both compliant and non-compliant behavior it is assumed that the chosen program of task behavior is the one followed for task performance.

Summary of factors presented in segment 3

Conceptually the performance behavior of an organizational unit has been partitioned into (1) search and choice behavior and (2) task behavior. In search and choice behavior the organizational unit attempts to find alternative programs of task behavior and choose one to use for completing its task. In task behavior the organizational unit follows the program of task behavior, i.e., interacts with suppliers of inputs to obtain inputs, uses the technological components to transform inputs into outputs, and interacts with receivers of outputs to dispose of outputs.

Alternative forms of the two behavior processes were presented that encompass a wide range of behaviors. The possible factor levels for the three factors discussed as segment 3 of the total theoretical model are presented in Table 3. Figure 7 shows search and choice behavior, the
Fig. 7—Segments 3 and 4 of the theoretical model.
program of task behavior, and task behavior in conjunction with the factors of segment 4. Appendix E also contains a summary of these factors.

TABLE 3
POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 3

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>RANGE OF POSSIBLE VALUES</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Program of Task Behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The chosen set of environmental components to supply inputs, receive outputs, and transform inputs into outputs</td>
<td>All possible combinations of input, output, and transformation components perceived by organizational unit</td>
<td></td>
</tr>
<tr>
<td>2. Potential outcomes associated with a program</td>
<td>All high, mixed, or all low</td>
<td></td>
</tr>
<tr>
<td>B. Search and Choice Behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Relative to structural constraints</td>
<td>a. compliant</td>
<td>a. consistent</td>
</tr>
<tr>
<td></td>
<td>b. non-compliant</td>
<td>b. inconsistent</td>
</tr>
<tr>
<td>2. Search and choice strategies</td>
<td>a. no search, trivial choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. satisficing search and choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. rational search and choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. maximizing search and choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. random search and choice</td>
<td></td>
</tr>
<tr>
<td>3. Over time</td>
<td>a. consistent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. inconsistent</td>
<td></td>
</tr>
<tr>
<td>C. Task Behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Relative to structural constraints</td>
<td>a. compliant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. non-compliant</td>
<td></td>
</tr>
<tr>
<td>2. Over time</td>
<td>a. consistent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. inconsistent</td>
<td></td>
</tr>
</tbody>
</table>
Segment 4: Evaluation Process Structure and Evaluations

Review of the organizational unit's performance is the focus of the three factors presented as segment 4 of the total theoretical model. (See Figure 7). This segment of the model is not particularly strong in any of the perspectives. Writers in the structural perspective discuss the importance of control, which includes the three factors in this segment, but do not develop the discussion to include conceptual definitions and possible levels for factors. In the contingency perspective Lawrence and Lorsch (1969) have contributed the most through three of their measures of formal structure. Other writings that have contributed to the development of this segment of the theory are those of Cummings, Schwab, and Rosen (1971) and Scott et al. (1967).

Performance evaluation process

Conceptualization

The procedures whereby performance outcomes or behavior are measured, compared to predetermined criteria, and fed back to the organizational unit and designers comprise the performance evaluation process. Notice that expansion of the theoretical model's scope could include feedback to other organizational units or environmental components. To define this process, several unknowns must be specified. These include what is reviewed (i.e., measured), what the aspiration levels (i.e., predetermined criteria) are, and what the timing is for the feedback (i.e., what the frequency and delay in review are). Notice that these unknowns are included in the specification of the control system under organizational structure.
Set of alternative forms

The evaluation process is assumed to occur according to the specifications of the control system. One basis for defining alternative forms of the performance evaluation process, therefore, is the specified control system. A correspondence exists between possible values for the control system and alternative forms of the evaluation process. The process is either goal achievement oriented or behavior oriented. Reviews are frequent or infrequent. Delays in review are small or large. Finally, the predetermined criteria are congruent or incongruent with the remaining structural demands, particularly, goals, prescription of task behavior, and prescription of communications channels.

A second basis for defining alternative forms of this process is the validity of the resulting evaluations. Evaluations may be valid. Alternately, because of either a conscious managerial decision or bias in information feedback mechanisms, the evaluations that result from this process may be consistently low or high relative to actual performance outcomes. These three alternative forms, then, are biased low, unbiased, or biased high.

Structure of the organizational unit

This variable has already been conceptualized. The reason structure is mentioned in this segment is because of its importance to the evaluation process. The sub-variables of structure, particularly the specified control system, goals, prescription of task behavior and prescription of communications channels serve as inputs to the performance

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1 See Cummings, Schwab, and Rosen (1971).
evaluation process. Goals are important inputs if the evaluation process is goal achievement oriented. Prescribed task behavior and communications channels are important inputs if it is behavior oriented.

Performance evaluation
Conceptualization

Feedback to the organizational unit and designers concerning the performance level for a particular task cycle on specific performance measures is the definition of performance evaluations. Evaluations are conceptually distinct from outcomes to reflect dependence on information from other sources regarding level of performance. Feedback may not be immediate. Elaborate data capturing and analysis systems may be required to give feedback to the organizational unit and designers regarding performance outcomes.

Range of possible values

Compared to a performance outcome, a performance evaluation may be lower than, equal to, or greater than the outcome actually received. In an absolute sense, performance evaluations have a continuum of possible values. This continuum is conceptualized in the same manner as that for aspiration levels and performance outcomes; therefore, the midpoint of the range defined by the highest and lowest evaluations likely to occur provides a point for establishing evaluations as low or high.

Summary of factors presented as segment 4 of the theoretical model

The performance evaluation process, using the structure of the organizational unit as a guide, takes performance outcomes or the
behavior producing those outcomes and generates performance evaluations. The specified control system, defined as part of the structure of the organizational unit, particularly determines what is evaluated, the criteria for evaluation, and the timing of the evaluation process.

Table 4 presents the range of possible levels for the three factors presented as segment 4 of the theoretical model. The performance evaluation process, structure of the organizational unit, and performance evaluations are also shown in Figure 8 in conjunction with the factor for segment 5 of the model. Appendix E also contains a summary of these factors.

Segment 5: Learning

One factor, the learning behavior process, is presented as segment 5 of the total theoretical model. (See Figure 8.) This relationship is ignored in the structural and contingency perspectives. Extensions of the behavioral perspective that investigate multiple-stage decision situations include learning. Writings of the complex perspective also include learning. Learning completes the loop from one task cycle to the next.

Learning behavior process

Conceptualization

Learning by the organizational unit or designers is defined as the process whereby perceptions of the environment are revised. Revised perceptions become inputs to behavior in subsequent task cycles. Learning by other organizational units or environmental components is not
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Performance Evaluation Process</strong></td>
<td>1. Based on correspondence with the specified control system</td>
</tr>
<tr>
<td></td>
<td>a. orientation</td>
</tr>
<tr>
<td></td>
<td>1) behavior</td>
</tr>
<tr>
<td></td>
<td>2) goal achievement</td>
</tr>
<tr>
<td></td>
<td>b. frequency of review</td>
</tr>
<tr>
<td></td>
<td>1) frequent</td>
</tr>
<tr>
<td></td>
<td>2) infrequent</td>
</tr>
<tr>
<td></td>
<td>c. delay in review</td>
</tr>
<tr>
<td></td>
<td>1) small</td>
</tr>
<tr>
<td></td>
<td>2) large</td>
</tr>
<tr>
<td></td>
<td>d. relationship to remaining structural demands</td>
</tr>
<tr>
<td></td>
<td>1) congruent</td>
</tr>
<tr>
<td></td>
<td>2) incongruent</td>
</tr>
<tr>
<td></td>
<td>2. Based on validity of evaluations</td>
</tr>
<tr>
<td></td>
<td>a. biased low</td>
</tr>
<tr>
<td></td>
<td>b. unbiased</td>
</tr>
<tr>
<td></td>
<td>c. biased high</td>
</tr>
</tbody>
</table>

| **B. Structure of the Organizational Unit** | (See Table 1)                                                                             |

<table>
<thead>
<tr>
<th><strong>C. Performance Evaluations</strong></th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ONE EXTREME</td>
</tr>
<tr>
<td>1. Relative to performance outcomes</td>
<td>lower</td>
</tr>
<tr>
<td>2. Absolutely</td>
<td>low</td>
</tr>
</tbody>
</table>
Fig. 8.—Segments 4 and 5 of the theoretical model.
involved in this conceptualization. Also, learning with respect to other organizational factors is not included in this model. Future expansions may consider learning with respect to other factors or learning by other organizational units.

This final process in the theoretical model provides the link between performance evaluations and perceptions of the environment. Performance evaluations serve as feedback on performance and learning behavior is how the organizational unit or designers use that feedback: to revise perceptions. This conceptualization is limited in the sense that performance evaluations are the only inputs to the revision of perceptions. No other information gathering activity is included.

Set of alternative forms

Alternative forms of learning behavior range from the use of all past evaluations and prior perceptions for determining new perceptions to the use of a limited number of past evaluations and no prior perceptions for determining new perceptions. The first form is referred to as Bayesian learning in the remainder of the thesis.\(^1\) The second form is referred to as non-Bayesian learning. Both forms are extreme ends of a continuum of alternative methods whereby performance evaluations are used in revising perceptions of the environment.\(^2\) These two alternative forms are presented in Table 5. They are also summarized in Appendix E.

\(^1\)See Bierman, Bonini, and Hausman (1969) for a discussion of Bayes theorem and its use in revising prior information.

\(^2\)For a discussion of organizational learning see Cyert and March (1963).
TABLE 5
POSSIBLE FACTOR LEVELS FOR THE FACTOR OF SEGMENT 5

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Behavior Process</td>
<td>1. Bayesian (use of all past information)</td>
</tr>
<tr>
<td></td>
<td>2. Non-Bayesian (use of recent information only)</td>
</tr>
</tbody>
</table>

**Concluding Comments Regarding the Theoretical Model**

As stated earlier, a theory must specify a range of values for variables and the forms of the relationships combining them. Ranges of values have been presented to recognize the conceptual (and empirical) possibilities of various states for the variables in the proposed theory. Alternative forms for relationships have been presented to recognize the conceptual (and empirical) possibilities of different ways of getting from one state to another. In addition to specifying explicit values and forms for variables and relationships, a theory should explicitly recognize assumptions. Two such assumptions are presented now. A discussion regarding use of the theory concludes the chapter.

**Assumptions**

Two assumptions relative to the proposed theory are as follows:

1. Rewards are distributed according to the reward system specified under structure of the organizational unit.

2. The organizational unit is capable of behaving as a single entity.
Assumption 2a: The organizational unit has internal differentiation (or some degree of complexity), but at the same time it has integrative mechanisms allowing the subsystems to be coordinated as a whole.

The first assumption is stated because the theoretical model does not show rewards being distributed. Although this assumption states how rewards are distributed, it does not state the role of rewards. Recall that the specified reward system is part of structure and that structure is intended to shape the behavior of members of the organizational unit. The role of rewards, therefore, is to shape the behavior of unit members. As with other elements of structure, members' responses to the intent of rewards range from compliance to non-compliance. When a limited portion of the theory is operationalized in the next chapter, another assumption regarding rewards is cited. That assumption is more restrictive regarding the role of rewards in the limited theory.

The second assumption and its corollary are implicit in any other writings that focus on a unit of analysis larger than the individual. Whether that unit is a group of individuals, a department, a subsystem of a larger organization, or an entire organization, the unit of analysis is regarded as a single entity capable of unitary, goal-seeking behavior. As examples, consider the following authors. Structural perspective writers such as Mooney (1937), Fayol (1937), and Weber (1947) focused on the entire organization and assumed it was a unit capable of behaving as a single entity. Lawrence and Lorsch (1969) from the contingency perspective focused on both subunits of the entire organization and the entire organization. They assumed the subunits were capable of singular action and investigated the workings of
integrative mechanisms for the entire organization. Cyert and March (1963) from the complex perspective focused on the entire organization as a unit of analysis and assumed it was capable of singular activity.

**Using the theory**

To investigate the implications of the proposed theory, certain variables must be given initial values. Forms for the relationships must be specified. If the relationships are consistent over time, these same forms will continue to govern the transformation of one set of variables into another. Otherwise the forms must be specified each task cycle. Given initial values for the variables and forms for the relationships, the values for other variables in the proposed theory can be predicted or traced over time. Figure 9 presents the total model once again and identifies the six relationships. Figures 10 and 11 indicate what and when variables and relationships must be specified to derive predictions from the theory.

For example, environment can be specified initially as homogeneous with high outcomes available. The change process governs how environment changes over time. If this relationship is specified as providing environmental stability, environment remains the same for all task cycles. Structure can be specified as low. If the design process is specified as stable, structure remains low over time. Search and choice behavior can be specified as compliant, satisficing and consistent. The degree of internal control can be specified as low. The performance evaluation process can be specified as leading to low performance evaluations. Learning behavior can be specified as weighting recent
Fig. 9.—Theoretical model with six relationships noted.
After time $t=1$ the values of these variables determined by a previous relationship. Forms of these relationships must be specified by the researcher for each task cycle. Values for these variables at time $t=1$ must be specified by the researcher. Values for these variables determined by the relationship.

Initial values are not specified.

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**ENVIRONMENTAL CHANGE PROCESS**

$\rightarrow$ **ENVIRONMENT**

**DESIGNERS' PERCEPTIONS OF THE ENVIRONMENT**

$\rightarrow$ **ORGANIZATIONAL UNIT DESIGN PROCESS**

$\rightarrow$ **STRUCTURE OF THE ORGANIZATIONAL UNIT**

Values after $t=1$ governed by change and design processes.

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**STRUCTURE OF THE ORGANIZATIONAL UNIT**

$\rightarrow$ **SEARCH AND CHOICE BEHAVIOR**

$\rightarrow$ **PROGRAM OF TASK BEHAVIOR CHOOSEN AT t**

---

**Fig. 10.—Specifying factor levels associated with the first three relationships.**
Values of these variables determined by a previous relationship.

Forms of these relationships must be specified by the researcher for each task cycle.

Values for these variables at time $t=1$ must be specified by the researcher.

Values for these variables determined by the relationship. Initial values are not specified.

**Fig. 11.—Specifying factor levels associated with the last three relationships.**
evaluations heavily. Given this pattern of variable values and forms for relationships, the results on such variables as performance outcomes and perceptions of the environment can be predicted or traced over time.

Another use for the theory is to determine what patterns, if any are feasible, are required for some variables and relationships in order to obtain a particular set of performance outcomes, given a specific pattern for other variables and relationships. For example, given a set of high performance outcomes and a poor environment with growth, the theory can help determine what patterns, if any, of structure and search and choice behavior are required to achieve the set of performance outcomes. Use of the theory for this purpose is not explored in this study.

Because of the complexity of the proposed theory, its implications are not immediately comprehensible. The remainder of the thesis is directed at deriving implications. A large number of combinations, i.e., patterns, of variable values and relationship forms are possible. Chapter 2 operationalizes a limited number of variable values and relationship forms in a simulation model. The model can be used to investigate, or derive, the implications of the numerous patterns of factor levels operationalized. Chapter 3 presents the specific patterns that are investigated in the following chapters.
CHAPTER 2

THE SIMULATION MODEL

Operationalizing the Theory

For continuity in presentation the same five segments used to present the general theoretical model are used to present the limited simulation model. The purpose of the simulation model is to provide a methodology for investigating implications of the general theoretical model presented in chapter 1. There are two major differences between the general theoretical model of chapter 1 and the simulation model of chapter 2. First, the simulation model operationalizes the conceptual definitions of the factors in the general theoretical model. Operationalization consists of providing specific (rather than general) values for variables and specific (rather than general) forms for the relationships. Second, the simulation model is more limited than the general theoretical model. A limited set of variable values and relationship forms are operationalized. In conjunction with the limited set of factor levels, more restrictive assumptions are listed for the simulation model than for the general theoretical model. In general, the simulation model's limitations, both in factor levels operationalized and in restrictive assumptions, are limitations existing in the four historical perspectives. Although these limitations of the historical perspectives continue to be found in the simulation model, others have been removed.
These will become more evident as the simulation model is presented.

**Segment 1: Organizational Design Process, Structure, and Outcomes**

**Organizational unit design process**

The set of alternative forms for this process includes two alternatives. One leads to a stable structure, the other to a changing structure. Only one of these forms is operationalized in the simulation model: the one leading to stable structure. Once the initial structure is specified, it is assumed to stay the same over the time horizon investigated.

\[ \text{Structure}_t = \text{Structure}_{t-1} = \text{Structure \ initial} \]  \hspace{1cm} (2.1)

Many writers implicitly assume that structure is stable, i.e., a relatively enduring feature of the organizational unit. For example, Woodward (1965) classified organizations as having mechanistic or organic structures implying that these structures were relatively enduring. Similarly, Lawrence and Lorsch (1969) implicitly assumed that structure was relatively fixed when determining whether the organizations in their study had high or low formal structures. In fairness to the contingency writers, they implicitly suggest that if the critical variable changes (e.g., from a stable to a changing environment), the structure should change to maintain a proper fit.

In the simulation model, therefore, only a stable design process is possible. Future research could expand the scope of the model by incorporating a changing design process. Explicit recognition of the two alternative forms forces students of organizational behavior to
recognize that the design process does not always have to be conceptualized as relatively fixed.

The dynamics of the initial design process lead to a type of structure. In the simulation model, the researcher specifies the type of structure. If the type of structure includes highly prescribed task behavior, a prescribed program of task behavior must be specified. Under these circumstances, as noted in the first chapter, the designers select a prescribed program following any of the same kinds of search and choice strategies followed by the organizational unit when it is under low structure. (See the operationalization of search and choice behavior in the presentation of segment 3 of the simulation model).

**Structure of the organizational unit**

As noted above, structure as a whole has been classified as mechanistic or organic, and high or low. Primarily, the higher the structure, the more closely it specifies the intended behavior of organizational members. The limited values for the sub-variables comprising structure used in this study have been chosen with this concept in mind. Values have been chosen for groups of the sub-variables so that both low and high structure can be represented in the simulation model. Where a value for one of the sub-variables is related to both low and high structure, that assumption is noted.

**Goals**

The values of the following three sub-variables must be operationalized: (1) the number of goals, (2) the importance of each goal, and
(3) the specification of aspiration levels for each goal. The extreme values for the number of goals are none and many. The larger the number of goals an organizational unit must meet, the more constrained is its behavior.\(^1\) Given the above concept for low and high structure, the higher the structure, the larger the number of goals. Few goals, therefore, is consistent with low structure. Many goals is consistent with high structure. Neither of these values, however, is directly operationalized. They are indirectly operationalized in the values used for goal importance. Instead, a value of "multiple" goals, which is between none and many is used, where multiple is operationalied as 3 goals. Three is a number that allows for a minimum number of multiple goals. This value is used for both low and high structure.

**Goal importance.**--The "importance of each goal" has two values. The value associated with high structure is that all goals (three in this operationalization) are most important. The value associated with low structure is that one goal is most important. That goal is chosen randomly in the model. The remaining goals (two in this case) are not that important and are placed at the bottom of the goal importance hierarchy.

The three goals do not need to be named, but for discussion purposes throughout the remainder of the study, they are called the following: (1) cost to obtain inputs, transform inputs into outputs, and dispose of outputs, (2) time to obtain inputs, transform inputs into outputs, and dispose of outputs, and (3) accuracy of outputs. For

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\(^1\)See Simon's (1964) discussion of goals as constraints.
short, they are referred to as cost, time, and accuracy. Other goal names could be used, such as satisfaction of the organizational unit with the program of task behavior or income received from disposition of outputs. It should be noted, though, that the goals are operationalized as being related to the performance of the program of task behavior only and not directly related to either search and choice behavior or learning behavior.

Aspiration levels.—For the "specification of aspiration levels," two values are used: (1) a minimum desired aspiration level and (2) a small acceptable range around an exact aspiration level. The first value is less restrictive in shaping the organizational unit's behavior than the second value.

These two values, therefore, correspond to low and high structure respectively. They are not the values of the extremes presented in the discussion of possible values, but they are more moderate values toward either end of the continuum.

The minimum desired and exact aspiration levels specified range from a low to a high level for each goal. Since multiple goals are used, the combinations of low and high levels need to be specified. Three combinations are used to cover a wide range of possibilities: (1) aspiration levels for all goals are low, (2) aspiration levels for all goals are high, and (3) aspiration levels are mixed, i.e., some levels are high and some low.

Each goal has a continuum for the level of aspiration. As discussed in a previous section, the ends of the continuum are anchored by the lowest and highest values most likely to occur. The continuum can
then be divided in the middle to get a low and high end of the continuum. Any value to the left of the middle is low; any value to the right is high. Figure 12 illustrates an aspiration level continuum.

<table>
<thead>
<tr>
<th>Lowest likely</th>
<th>Midpoint</th>
<th>Highest likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0)</td>
<td>(.5)</td>
<td>(1)</td>
</tr>
</tbody>
</table>

*Fig. 12.—Aspiration level continuum*

In this figure, note that the lowest likely level is operationalized as zero and the highest as one. All other values are between 0 and 1 with .5 being the midpoint. Any other range of values can be mapped onto this range of values or vice versa.

Specification of minimum aspiration levels consists of specifying a value between zero and one for each goal. Any value greater than the aspiration level (i.e., from the specified level to one) is also acceptable.

Specification of exact aspiration levels consists of specifying a level between zero and one for each goal. A small, acceptable range around that level is operationalized as the specified level plus or minus .08.¹

As noted above, the minimum aspiration levels and the exact aspiration levels can be set at all low levels, all high levels, or mixed levels. When they are all low levels, the minimum and exact levels are randomly determined using a normal probability distribution having the

¹If the standard deviation (σ) of outcomes on goal dimensions is set at .08, 3σ = .24, which is approximately one-half of the high or low end of the goal continuum.
midpoint of the low aspiration level (.25) as the mean and .08 as the
standard deviation. Likewise, for all high levels the aspiration
levels are randomly determined using a normal distribution having the
midpoint of a high aspiration level (.75) as the mean and .08 as the
standard deviation. For mixed levels, the goals for which aspiration
levels are high and low are chosen randomly; then the levels are chosen
in the same manner as just described.

Means for achieving goals

The values of the following six sub-variables must be operational­
ized: (1) prescription of task behavior, (2) prescription of communi­
cations channels, (3) specification of a control system, (4) specification
of a reward system, (5) configuration of the organizational unit,
and (6) authority to change structure. For the first two sub-variables,
operational values are given for low and high structure. For the third,
operational values are given that are useful with either low or high
structure or both. Simplifying assumptions are made for the fourth and
fifth sub-variables. One value is given for the last sub-variable.

Task behavior and communications channels.--Prescription of task
behavior and prescription of communications channels are operationalized
together. If one is low, the other is low. If one is high, the other
is high. Under low prescription fewer restrictions are placed on the
organizational unit's behavior than under high prescription; therefore,
low prescription is associated with low structure, and high prescription
is associated with high structure. Low prescription is operationalized
as meaning that no program of task behavior (which includes both actions
and interactions) is prescribed. The organizational unit, through search and choice behavior, must select a program of task behavior. High prescription is operationalized as meaning that a specific program of task behavior is prescribed. The specific program prescribed is determined by the organizational designers. It is assumed that during the organizational unit design process, the organizational designers exhibit a form of search and choice behavior to select the prescribed program. The simulation model allows the designers to exhibit any one of the forms of search and choice behavior allowed the organizational unit. (See segment 3 for a discussion of these forms.) The only difference between the designers and performers (i.e., members of the organizational unit) is that the designers are restricted to prescribing one program over the entire time horizon under investigation whereas the performers may choose a different program each task cycle. In effect, the designers act as though they are selecting a program of task behavior in a single stage, static decision situation. To summarize, low prescription means no program of task behavior is prescribed. High prescription means one is.

Control system.—Specification of the control system includes operationalizing the following four sub-variables: (1) what is reviewed, (2) frequency of review, (3) delay in review, and (4) congruence with goals. It is assumed that the control system is congruent (rather than incongruent) with goals in the simulation model. In other words, only a congruent control system is operationalized. Future extensions

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See Woodward (1970) for an interesting discussion of designers and performers.
could operationalize an incongruent control system to investigate its implications. Operationalizing this value is consistent with implicit assumptions made in the historical perspectives. Under a congruent control system, what is reviewed is based on the prescribed goals or the prescribed program of behavior.

What is reviewed has two extreme values: behavior and goal achievement. Because of the assumption of a congruent control system, behavior is reviewed under high structure and goal achievement is reviewed under low structure. The rationale for using these values is as follows. Under high structure, the designers presumably expect that the prescribed goals will be achieved if the organizational unit behaves according to the prescribed program of behavior; therefore, behavior is reviewed under high structure to ensure that the prescribed program is followed. Under low structure, the organizational unit has few restrictions on its behavior; however, it is expected to meet the prescribed goals. Under low structure, therefore, goal achievement is reviewed.

Frequency of review and delay in review are operationalized in similar fashions. Frequent review is operationalized as every task cycle. Infrequent review is operationalized as every six task cycles. No delay in review is operationalized as zero task cycles between performance and review. Large delay is operationalized as six task cycles between performance and review. Any combination of these values is allowed under low and high structure.

Reward system.—Simplifying assumptions regarding the reward system eliminate the need for operationalizing it. Recall that it is already assumed that rewards are distributed according to the control
system thereby making reward and control systems congruent. Since the control system is congruent with goals, it is assumed that the reward system is congruent with goals. These assumptions mean that the reward system would be operationalized in the same manner as the control system. One further assumption, however, allows the reward system to be ignored in the simulation model. It is assumed that the members of the organizational unit desire the rewards provided by the reward system. This assumption is implicit in the writings of the historical perspectives. Future research could examine the implications of relaxing this assumption. Explicit recognition of the assumption forces future researchers to accept the assumption consciously or relax it.

**Configuration.**—Simplifying assumptions regarding the configuration of the organizational unit also eliminate the need for operationalizing this sub-variable. It has already been assumed in Chapter 1 that the organizational unit has a single, unified ability to search, choose, perform, and learn. It is further assumed that the degree of complexity (i.e., the configuration) does not affect the level of the organizational unit's ability to act as a single, unified entity. This assumption may be questioned by those who suggest that the internal role structure of the organization greatly affects the level of performance. An alternate assumption should answer their questions. Assume, instead, that the effects of the degree of complexity are reflected in the degree of internal control. An organizational unit that has an "appropriate" degree of complexity would have a higher degree of internal control than

1See Lawrence and Lorsch (1969) and Blau and Schoenherr (1971) for entire books on the importance of internal role structure.
one having an "inappropriate" degree of complexity. Under either as-
sumption the configuration of the organizational unit can be ignored in
the simulation model.

Authority.—The last sub-variable, authority to change structure, 
is operationalized as having one value that is used under both low and 
high structure. Only low authority is allowed. That means the organi-
zational unit cannot formally change any of the prescribed goals or 
means for achieving goals. Behavior is expected to remain shaped ac-
cording to the present structure unless structure is changed by the 
organizational designers. This expectation arises because only compli-
ant search, choice, and task behaviors are operationalized (see seg-
ment 3.) Therefore, emergent behavior is not possible in the simula-
tion model. Although the authority to change structure is low, the 
behavior of the members of the organizational unit is more or less re-
stricted depending upon the pattern of the other sub-variables already 
discussed. One pattern of values defines low structure. Another pat-
tern defines high structure. Both are allowed even though authority 
to change structure is low. Future research could be directed at in-
vestigating high authority to change structure.

Summary comments regarding structure

Low structure and high structure are the two values operationalized 
for structure. Under both values the number of goals is three, the con-
trol system is congruent with goals, the reward system and configuration 
can be ignored, and authority to change structure is low.
With low structure specific values are allowed for the importance of goals, specification of aspiration levels, prescription of task behavior and communications channels, and the frequency and delay in reviews. Only one goal is most important. Minimum desired aspiration levels are specified. For the three goals the levels can be all low, mixed, or all high. Prescription of task behavior and communications channels is low. Frequency of review can be every cycle or every six cycles. Delay in review can be zero or six cycles.

With high structure specific values are allowed for the same subvariables. All three goals are equally important. Aspiration levels are specified as small acceptable ranges around exact levels. For the three goals the levels can be all low, mixed, or all high. Prescription of task behavior and communications channels is high, i.e., a specific program of task behavior is prescribed. As with low structure, frequency of review can be every cycle or every six cycles and delay in review can be zero or six cycles.

Performance outcomes

The number of performance outcomes corresponds to the number of goals: three. In fact, a one to one correspondence exists between goals and performance outcomes. This relationship is allowed because of the assumption that the control system is congruent with goals and a later assumption that behavior is compliant. These assumptions, in effect, state that no other outcomes are relevant.

Levels of achievement on each outcome range from 0 to 1. Those below .5 are classified as low, those above as high. This
operationalization is similar to that for aspiration levels. (See Figure 5.)

Summary of segment 1

The three factors in segment 1 have had various levels operationalized. These operationalizations will be used in the simulation model to investigate the implications of a limited portion of the general theoretical model. Table 6 summarizes the operational values for the organizational unit design process, structure of the organizational unit, and performance outcomes. Appendix E also contains a summary of the factors in segment 1.
TABLE 6

OPERATIONAL VALUES FOR FACTORS IN SEGMENT 1

FACTOR

A. Organizational Unit Design Process

1. Over time
   1. stable: \[ \text{Structure}_t = \text{Structure}_1 \]
   2. changing: not operationalized

2. Search and choice behavior under high structure
   1. maximizing
   2. rational
   3. satisficing

B. Structure of the Organizational Unit

As a whole

Values of sub-variables for low and high structure

1. Goals
   a. number
   3

   b. specification of aspiration levels
      1) specificity of levels
         minimum
         desired levels
         specified (from 0 to 1)

      2) levels specified
         1. all low
         2. mixed
         3. all high

   c. importance of each
      1 most important
      all 3 important

   LOW
   HIGH
2. Means for achieving goals

a. prescription of task behavior
   low (no program specified) high (a program specified)

b. prescription of communications channels
   low (no program specified) high (a program specified)

c. specification of a control system
   1) what is reviewed goal achievement behavior
      2) frequency of review
         1. every cycle 1. every cycle
         2. every 6 cycles 2. every 6 cycles
   3) delay in review
      1. zero cycles 1. zero cycles
      2. 6 cycles 2. 6 cycles
   4) congruence with goals
      1. congruent 1. congruent
      (incongruent control system not operationalized)

d. specification of a reward system ignored because of assumptions

Assumptions:
1. Rewards are distributed according to the control system
2. Reward system is congruent with goals
3. Members of the organizational unit desire the rewards provided by the reward system

e. configuration of the organizational unit ignored because of assumptions

Assumptions:
1. The organizational unit is capable of behaving as a single entity
2. The degree of complexity does not affect the level of the organizational unit's ability to act as a single entity, or

Alternate 2
The effect of the degree of complexity is reflected
in the degree of internal control.

f. authority to change structure

<table>
<thead>
<tr>
<th>low</th>
<th>low</th>
</tr>
</thead>
<tbody>
<tr>
<td>(high authority not operationalized)</td>
<td></td>
</tr>
</tbody>
</table>

C. Performance outcomes

POSSIBLE VALUES

1. Number

2. Levels of achievement

from 0 to 1 on all 3 outcomes
Environment

Values must be specified for aggregate characteristics of the environment and for characteristics of the individual environmental components. At the aggregate level size and distribution of characteristics are operationalized. At the component level the number of potential outcomes associated with each component and the levels of those outcomes associated with each component are specified.

Aggregate characteristics

Size.—The values operationalized for size of the environment are between the extremes of large and small. The initial size of the environment can be set at either 125 or 27. The smallest value allowed is 9 and the largest value allowed 300. These values can be reached if the environmental change process is declining or growing. The numbers refer to the number of possible programs of task behavior instead of the number of environmental components. Since a program of task behavior requires supply components, technological components, and demand components, the number of possible programs of task behavior is a reflection of the number of environmental components, i.e., the size of the environment. In other words, the number of possible combinations of supply, technological, and demand components is the virtual size of the environment for the organizational unit. If there are 125 possible combinations, the size of the environment is 125 programs of task behavior.
Distribution of characteristics.—Regardless of size, characteristics are assumed to be distributed in a manner somewhat between homogeneous and heterogeneous. The only characteristic used, however, is potential outcomes. Other characteristics, which could be instrumental in determining the organizational unit's complexity, are ignored since complexity is not directly used in this study.

In addition to the kind of distribution of potential outcomes among programs of task behavior, the level of the potential outcomes distributed among these environmental elements must be specified. Since the distribution is between homogeneous and heterogeneous and there are three outcomes, the outcomes may be predominantly low, predominantly high, or predominantly mixed. If the distribution were homogeneous, the outcomes would be all (instead of predominantly) low, high, or mixed. If the distribution were heterogeneous, there would be an equal mixture of outcomes. The probability of the predominant kind of program is operationalized at .60. The probability of the other two kinds of programs is set at .20 each. For example, if programs with all low potential outcomes are predominant, the probability of finding such a program is .60. The probability of finding a program with all high outcomes is .20. The probability of finding a program with mixed outcomes is .20, also. If the environment is large, the number of programs having all low outcomes, therefore, is .60(125) or 75. The number of programs having all high outcomes is .20(125) or 25, and the number of programs having mixed outcomes is also .20(125) or 25.
An environment having predominantly high programs is labeled munificent. One having predominantly all low programs is poor. The environment with predominantly mixed programs is labeled a mixed environment.

Characteristics of individual environmental components

Since the components are grouped together into programs of behavior, the number of potential outcomes and their levels are operationalized as being associated with the entire program of behavior, not the individual components. The number of potential outcomes is set at three, just as the number of goals. The manner in which levels on potential outcome dimensions are operationalized is similar to that described for aspiration levels. Potential outcomes range from 0 to 1 with .5 being the cutting point between low and high outcomes.

The specified levels are determined within the constraints established by the distribution of characteristics for the aggregate environment. For example, in the situation with a large environment where programs with all low potential outcomes are predominant, 75 programs have all 3 potential outcomes specified as low, 25 have all 3 high, and 25 have mixed outcomes. The 75 programs having all low outcomes are determined randomly by drawing from the total list of 125 programs. Likewise, the programs having all high outcomes and mixed outcomes are randomly determined. Therefore, within the sequence of programs numbered 1 through 125, the kinds of programs (i.e., all low, all high, or mixed outcomes programs) are not sequentially arranged but randomly distributed.
Environmental change process

Both stable and changing relationships are operationalized. A stable environment could be represented by a stationary process that is either deterministic or stochastic. A changing environment could be represented by a non-stationary process that is either deterministic or stochastic. In either a stable or changing environment, the process could involve few or many independent variables. Since a theory of environmental dynamics is not being proposed, it is desirable to represent the environmental change process relatively simply.

The simplest way to represent a stable environment is by a constant, i.e., a stationary, deterministic process composed of a single, constant value:

\[ \text{Environment}_t = \text{Environment}_{t-1} = \text{Initial value} \]

for all \( t \) \hspace{1cm} (2.2)

A non-stationary process (for representing a changing environment) can range from a growth process to a process of decline. A growing environment can be represented by the following simple function:

\[ \text{Environment}_t = \text{Environment}_{t-1} + \text{Constant} \]

for all \( t \) except \( t=1 \) \hspace{1cm} (2.3)

whereas a declining environment can be represented by the following simple function:

\[ \text{Environment}_t = \text{Environment}_{t-1} - \text{Constant} \]

for all \( t \) except \( t=1 \) \hspace{1cm} (2.4)

For both a growing and declining environment the value at \( t=1 \) is represented as follows:

\[ \text{Environment}_1 = \text{Initial value} \] \hspace{1cm} (2.5)
In the mathematical operationalization of equations (2.2) through (2.5) the aggregate and individual environmental characteristics discussed above are used for initial values. The constants are specified below. The components of these equations are vectors of the following variables: (1) size of the environment, (2) distribution of characteristics among environmental programs, (3) number of potential outcomes for each program, and (4) the levels of potential outcomes for each program. Each of these variables is discussed for a stable environment, a changing environment with growth, and a changing environment with decay.

Stable environment

If the process is stable, the following relationships hold:

(1) Size

[number of programs_t = number of programs_initial for all t (2.6)]

where the initial number of task programs is set by the experimenter to one of the two operational values for size.

(2) Distribution of characteristics (where potential outcomes are the only characteristics of task programs, i.e., environmental components, considered)

[P(program type)_t = P(program type)_initial for all t (2.7)]

where the program type refers to whether the potential outcomes associated with a program are all low, all high, or mixed. P(program type) refers to the probability of the program type. The initial probabilities
for all three program types are set by the experimenter to define a munificent, mixed, or poor environment.

(3) Number of potential outcomes for each program

\[
\text{number of outcomes}_t = \text{number of outcomes}_{\text{initial}} = 3
\]

for all \( t \) \hspace{1cm} (2.8)

(4) Levels of potential outcomes for each program

\[
(\text{Levels of outcomes})_t = (\text{Levels of outcomes})_{\text{initial}}
\]

for all \( t \) \hspace{1cm} (2.9)

The initial levels of potential outcomes for each program are determined stochastically from the first three environmental characteristics according to the following algorithm:

**Step**

1. \( N_{\text{low}} \) = Number of all low programs = \((\text{Size}_t)(P(\text{all low programs})_t)\)
2. \( N_{\text{high}} \) = Number of all high programs = \((\text{Size}_t)(P(\text{all high programs})_t)\)
3. \( N_{\text{mixed}} \) = Number of mixed programs = \((\text{Size}_t)(P(\text{mixed programs})_t)\)
4. Array the total number of programs sequentially from 1 to \( \text{Size}_t \).
5. Randomly select \( N_{\text{low}} \) programs from the total array.
6. Randomly select \( N_{\text{high}} \) programs from the total array remaining.
7. The remaining programs are mixed and should equal \( N_{\text{mixed}} \).
8. Take the \( N_{\text{low}} \) programs

   Using the midpoint (.25) of the low end of the outcome scale as the mean of a normal distribution having a standard deviation of .08, randomly select the actual level for each outcome.

9. Take the \( N_{\text{high}} \) programs

   Do the same as in 8 except use the midpoint (.75) of the high end of the outcome scale for the mean.
10. Take the \( N_{\text{mixed}} \) programs
   a. Randomly select half of the \( N_{\text{mixed}} \) programs.
   b. Assign these programs to have 2 low and 1 high outcome.
   c. Assign the other mixed programs to have 1 low and 2 high outcomes.
   d. Do as in 8 for the low outcomes.
   e. Do as in 9 for the high outcomes.

Changing environment with growth

If the process indicates growth, the following relationships are used in this study:

1. Size
   \[
   S_{t} = S_{t-1} + 3 \quad \text{for all } t \text{ except } t=1, \\
   \text{subject to the following condition:} \quad S_{t} \leq 300. \\
   \text{For } t=1, \ S_{1} = \text{Initial value set by experimenter}
   \]

2. Distribution of characteristics
   \[
   P(\text{all high programs})_{t} = P(\text{all high programs})_{t-1} + .003 \\
   P(\text{all low programs})_{t} = P(\text{all low programs})_{t-1} - .0015 \\
   P(\text{mixed programs})_{t} = P(\text{mixed programs})_{t-1} - .0015 \quad (2.11)
   \]
   for all \( t \) except \( t=1 \), subject to the following conditions:
   \[
   .05 \leq P(\text{program type})_{t} \leq .90 \\
   \frac{1}{2} < P(\text{program type})_{t} = 1.00. \\
   \text{Program type } = 1
   \]
   For \( t=1 \),
   \[
   P(\text{program type})_{1} = \text{Initial value set by experimenter}
   \]
(3) Number of potential outcomes for each program

\[ \text{number of outcomes}_t = \text{number of outcomes}_{\text{initial}}^t = 3 \quad (2.12) \]

(4) Level of potential outcomes for each program

The initial levels of potential outcomes are determined in the same manner as the initial levels when the environmental change process is stable. As the size of the environment changes and the probabilities of program types change, the following algorithm is used to determine the level of potential outcomes for each program:

**Step**

A. Recompute the number of programs for each program type.

1. \( N_{\text{low}} \) = number of all low programs =
   \( (\text{Size}_t)(P(\text{all low programs})_t) \)
2. \( N_{\text{high}} \) = number of all high programs =
   \( (\text{Size}_t)(P(\text{all high programs})_t) \)
3. \( N_{\text{mixed}} \) = number of mixed programs =
   \( (\text{Size}_t) - (N_{\text{low}} + N_{\text{high}}) \)

B. Determine which program types increase and decrease from \( t-1 \).

1. Subtract \( N_{\text{low}} \), \( N_{\text{high}} \), and \( N_{\text{mixed}} \) for \( t-1 \) from \( N_{\text{low}} \), \( N_{\text{high}} \), and \( N_{\text{mixed}} \) for \( t \) (as just computed)
2. Program types with negative remainders decrease
3. Program types with positive remainders increase

C. For program types that decrease, randomly select the appropriate number (i.e., the absolute value of the remainder determined above) of programs and delete them from the list of programs for each program type decreasing in number.

D. Add any new programs and deleted programs to the program types that increase in number.
E. Determine potential levels on outcomes for new and changed programs having all low outcomes, all high outcomes, and mixed outcomes according to steps 8, 9, and 10 described under the determination of levels of outcomes in a stable environment.

Changing environment with decline

If the process indicates decline, the following relationships are used:

(1) Size

\[ \text{Size}_t = \text{Size}_{t-1} - 3 \text{ for all } t \text{ except } t=1, \text{ subject to} \]
\[ \text{Size}_t > 9. \quad (2.13) \]

For \( t=1 \),

\( \text{Size}_1 = \text{Initial value set by experimenter} \)

(2) Distribution of characteristics

\[ P(\text{all low programs})_t = P(\text{all low programs})_{t-1} + .003 \]
\[ P(\text{all high programs})_t = P(\text{all high programs})_{t-1} - .0015 \]
\[ P(\text{mixed programs})_t = P(\text{mixed programs})_{t-1} - .0015 \quad (2.14) \]

for all \( t \) except \( t=1 \) subject to the following conditions:

\[ .05 \leq P(\text{program type})_t \leq .90 \]
\[ \sum_{\text{program type} = 1} P(\text{program type})_t = 1.00 \]

For \( t=1 \)

\( P(\text{program type})_1 = \text{initial value set by experimenter} \)

(3) Number of potential outcomes for each program

\[ \text{number of outcomes}_t = \text{number of outcomes}_{\text{initial}} = 3 \quad (2.15) \]

(4) Level of potential outcomes for each program
The initial levels of potential outcomes are determined in the same manner as the initial levels when the environmental change process is stable. As the size of the environment changes and the probabilities of program types change, the following algorithm is used to determine the level of potential outcomes for each program:

**Step (only one step)**

Follow steps A through E described under determining levels of outcomes when the change process indicates growth. (Of course, there will be no new programs.)

**Summary comments regarding the environmental change process**

The three forms of change operationalized provide the opportunity to represent a wide range of environmental conditions. The stable process can be used to represent the stable environment found in the structural and behavioral perspectives. It can also be used to represent the stable environment of the contingency and complex perspectives, whereas the two processes involving change can be used to represent the changing or dynamic environments discussed in these two perspectives.

As a final comment, note that the values of the constants chosen for the two change processes allow for gradual changes. In a growing environment the number of total programs gradually increases as does the probability of all high programs. These changes represent a process whereby the number of good alternatives available to the organizational unit is increasing gradually. In a declining environment the situation worsens gradually in the same two ways: (1) the total number of programs decreases, and (2) the percentage of all low programs increases.
Organizational unit's Perceptions of the environment

A range of values for perceived environmental components, beliefs about cause and effect relationships, and uncertainty regarding beliefs is operationalized.

Perceived environmental components

Instead of perceiving the environment as composed of input suppliers, technological processes, and output receivers, the organizational unit operationally perceives a number of complete programs of task behavior, each of which can be assumed to be composed of the three kinds of environmental components. The size of the environment is determined by the number of perceived programs of task behavior. Two values are operationalized for initial perceived size. A large perceived environment is operationalized as 125 programs. A small perceived environment is operationalized as 27 programs. The largest number allowed is 300; the smallest is 9. The perceived number of components is the same as the actual number in the environment for all task cycles.

Beliefs about cause and effect relationships

The number of outcome dimensions, or effects, that are caused by execution of a program of task behavior (i.e., interaction with and use of environmental components) is set at three. These dimensions correspond with the goal and outcome dimensions described in previous sections.

Beliefs consist of estimates of the outcome levels associated with each program of task behavior (i.e., associated with each set of
environmental components). Just as with aspiration levels, the estimates of outcome levels can be all low, all high, or mixed. Recall that the outcome dimensions range from 0 to 1 with .5 being the cutting point for the low and high ends of the dimensions. When outcome levels are estimated as all low, the exact estimate is randomly drawn from a normal probability distribution having the midpoint of a low outcome (.25) as the mean and .08 or .16 (depending upon uncertainty) as the standard deviation. Likewise for estimates that are all high, the estimates are drawn from a normal distribution having the midpoint of a high outcome level (.75) as the mean and .08 or .16 (depending upon uncertainty) as the standard deviation. For mixed levels, the estimates for low and high outcomes are chosen in the same manner as just described.

The distribution of estimates (i.e., how many are all high, all low, and mixed) and which programs (i.e., environmental components) these estimates are associated with are determined in association with the distribution of characteristics for the actual environment. The perceptions of the environment can be the same as the environment or different. Operationalization when perceptions are the same as actual consists of using the same mean values (.25 or .75) for determining perceptions as were used in determining the potential outcomes associated with the programs. When perceptions are different, the reverse mean values are used.
Uncertainty of the organizational unit regarding beliefs

The beliefs about cause and effect relationships are point estimates of outcome levels. Uncertainty relates to the size of confidence intervals about those estimates and is used in determining the point estimates. Low uncertainty is operationalized as a standard deviation of .08 for a normal probability distribution with (.25) or (.75) as the mean depending on whether the estimated outcome is low or high. High uncertainty is operationalized as a standard deviation of .16.

Concluding comments regarding perceptions

These perceptions operationalized are the initial perceptions. They can be changed over time through learning behavior. As the organizational unit uses the programs of task behavior, it will obtain information (in the form of evaluations) that will be useful in revising beliefs and uncertainty. How the learning process leads to revisions in perceptions is discussed when the learning behavior process is operationalized. (See segment 5 below).

Designers' perceptions of the environment

The operationalization of designers' perceptions is identical with that of the organizational unit's perceptions with the following two exceptions: (1) the designers' perceptions are separate from those of the organizational unit, and (2) the designers' perceptions are not revised through learning. This second exception follows from the limited operationalization of the organizational unit design process. Only a stable
design process is operationalized; therefore, no need exists for learning by the designers in the simulation model. Once structure is determined initially, it is not changed. Under high structure, therefore, once a program of task behavior is prescribed using the designers' perceptions to select the initial program, that program remains prescribed over all task cycles.

Degree of internal control

The two extreme values, high and low degree of internal control, are operationalized. Each value is represented by a random variable. When outcomes are highly controlled by the task behavior of the organizational unit, the random variable is drawn from a normal distribution with a mean of 0 and a standard deviation of .04. If outcomes are externally controlled (i.e., low internal control), the random variable is drawn from a normal distribution with a mean of 0 and a standard deviation of .16. The random variable is added to the outcome obtained from task behavior to determine performance outcomes. (See discussion of the task behavior process in segment 3).

Summary of factors operationalized in segment 2

Several factor levels have been operationalized for the environment, the environmental change process, organizational unit's perceptions of the environment, designers' perceptions of the environment, and the degree of internal control. To investigate the theory a pattern of these factor levels, one level for each factor, must be specified by the researcher. A rich set of patterns is possible as a result
of operationalizing several factor levels. These levels are summarized in Table 7. In addition, they are summarized in Appendix E.

Segment 3: Program of Task Behavior, Search and Choice Behavior, and Task Behavior

Program of task behavior

Any possible combination of perceived environmental components can serve as a program of task behavior if it specifies the interactions and actions required to obtain inputs, transform the inputs into outputs, and dispose of the outputs. Operationally each program is represented and identified by a number. The entire set of programs is represented by a vector of numbers from 1 to N where N is the size of the environment. Each program has three potential outcomes associated with it as discussed in segment 2 under the environment and the environmental change process. Based on the pattern of outcome levels, a program can be classified as all low, all high, or mixed. This formulation of programs of task behavior is similar to the formulation of courses of action available to subjects in decision making experiments.1

Search and choice behavior process

In selecting a program of task behavior one of several operational forms can be used: (1) no search, trivial choice, (2) satisficing search and choice, (3) rational search and choice, and (4) maximizing search and choice. These forms represent a large set of alternative forms; however, they do not include all of those in the general theoretical model. These four alternative forms are operationalized under

1 See writings in the behavioral perspective for examples.
TABLE 7

OPERATIONAL VALUES FOR FACTORS IN SEGMENT 2

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Environment</td>
<td></td>
</tr>
<tr>
<td>1. Aggregate characteristics</td>
<td></td>
</tr>
<tr>
<td>a. size (operationalized as number of programs of task behavior)</td>
<td>1. small = 27</td>
</tr>
<tr>
<td></td>
<td>2. large = 125</td>
</tr>
<tr>
<td>b. distribution of characteristics</td>
<td></td>
</tr>
<tr>
<td>1) general probability distribution</td>
<td>Probability of predominant kind of program = .60</td>
</tr>
<tr>
<td></td>
<td>Probability of other two kinds of programs = .20 each</td>
</tr>
<tr>
<td>2) kinds of environments (predominant program type)</td>
<td></td>
</tr>
<tr>
<td>1. predominantly low on outcomes (poor)</td>
<td></td>
</tr>
<tr>
<td>2. predominantly high on outcomes (munificent)</td>
<td></td>
</tr>
<tr>
<td>3. predominantly mixed on outcomes (mixed)</td>
<td></td>
</tr>
<tr>
<td>2. Individual characteristics</td>
<td>3</td>
</tr>
<tr>
<td>a. number of potential outcomes</td>
<td></td>
</tr>
<tr>
<td>b. levels on outcome dimensions (within the constraints of aggregate characteristics)</td>
<td>1. all low: random normal variates with ( \mu = .25, \sigma = .08 )</td>
</tr>
<tr>
<td></td>
<td>2. all high: random normal variates with ( \mu = .75, \sigma = .08 )</td>
</tr>
<tr>
<td></td>
<td>3. mixed: some low values as above; some high values as above</td>
</tr>
</tbody>
</table>
B. Environmental Change Process

SET OF ALTERNATIVE FORMS

1. stable
2. changing with gradual growth
3. changing with gradual decline

C. Organizational Unit's Perceptions of the Environment

1. Number of perceived components (operationalized as number of programs of task behavior)

2. Beliefs about cause and effect relationships (for each program)
   a. number of outcomes
   b. estimated level on each (can be the same as or the reverse of individual characteristics for the programs defined in the environment)

3. Uncertainty

D. Designers' Perceptions of the Environment

POSSIBLE VALUES

1. few = 27
2. many = 125

POSSIBLE VALUES

1. low: random normal variate with \( \mu = .25, \sigma = .08 \) or \( .16 \) depending upon uncertainty.
2. high: random normal variate with \( \mu = .75, \sigma = .08 \) or \( .16 \) depending upon uncertainty.

1. low: \( \sigma = .08 \) for normal distribution with estimated level as \( \mu \)
2. high: \( \sigma = .16 \) for normal distribution with estimated level as \( \mu \)
2. Beliefs about cause and effect relationships (for each program)
   a. number of outcomes
   b. estimated level on each (can be the same as or the reverse of individual characteristics for the programs defined in the environment)

3. Uncertainty

E. Degree of Internal Control

1. low: random normal variate with $\mu=.25$, $\sigma=.08$ or .16 depending upon uncertainty.
2. high: random normal variate with $\mu=.75$, $\sigma=.08$ or .16 depending upon uncertainty.

1. low: $\sigma=.08$ for normal distribution with estimated level as $\mu$
2. high: $\sigma=.16$ for normal distribution with estimated level as $\mu$

POSSIBLE VALUES

1. high: random variable from normal distribution having $\mu=0$ and $\sigma=.04$
2. low: random variable from normal distribution having $\mu=0$ and $\sigma=.16$
compliant, consistent behavior. Non-compliant, inconsistent behavior is not operationalized. The bulk of the writing in the four historical perspectives has implicitly assumed that members of the organizational unit behave according to the prescribed goals when structure is low and means for achieving goals when structure is high and that this behavior is consistent over time. Operationalization of non-compliant or inconsistent behavior is left for future research.

With compliance and consistency as guides for formulation of search and choice behavior, the following model is suggested:

$$\text{program of task behavior}_t = f(\text{structure}_t, \text{organizational unit's perceptions of environment}_t)$$

where the functional relationship is defined by the search and choice algorithm; structure$_t$ and perceptions of the environment$_t$ serve as parameters to complete specification of the relationship. Four algorithms exist for determining which program of task behavior results from decision (i.e., search and choice) behavior. The algorithm used is the one specified by the researcher using the simulation model.

For each of the four alternative algorithms the program of task behavior is represented by a number ranging from 1 to N, where N is the size of the environment; the relevant subvariables of structure and perceptions of the environment also have their operational values as discussed in segment 1. The relevant sub-variables of structure are:

1. the number of goals,
2. the specification of aspiration levels,
3. the importance of each goal, and
4. the prescription of task behavior.

The number of goals is three. Aspiration levels are ranges of desired values from 0 to 1 associated with each of the three goals.
Each goal has a weight associated with it to indicate its importance, with the highest weight indicating most importance. Prescription of task behavior is either low or high. If it is high, the number of the prescribed task program is specified. If it is low, search and choice must take place.

No search, trivial choice

In this algorithm, the prescribed program is chosen. If, and only if, structure is high, this type of decision behavior should be specified, since only compliant behavior is being investigated in this simulation model. The algorithm for this behavior is the following simple statement:

\[
\text{program of task behavior}_t = \text{program of task behavior prescribed} \quad (2.17)
\]

Satisficing search and choice

This and the following decision behaviors are valid if, and only if, prescription of task behavior is low.\(^1\) The algorithm is fairly complex and consists of the following phases: (1) evaluation of the current alternative, (2) evaluation of a small set of nearby alternatives, i.e., alternatives in the evoked set, if necessary, (3) expansion of search,

\(^1\)This statement is true; however, the same algorithms for satisficing, rational, and maximizing decision behavior can be used to determine the prescribed program when structure is high. The decision behavior specified is exhibited prior to any task cycles to select a program to be used during task cycles. A few minor changes in the algorithms are made to accommodate high structure: (1) No one goal is most important; all are equally important; therefore, all goals must meet (2.18) or (2.19); and (2) the rank (2.20) of each program is determined by summing the squared deviations from the average aspiration level for each goal.
if necessary, and (4) revision of aspiration levels, if necessary. In addition to specification of these phases, this section also presents alternative methods for determining the programs of task behavior in the initial evoked set.

**First phase.**—Phase (1) is the evaluation of the current alternative. For \( t=1 \) no current alternative exists. It is, therefore, necessary to proceed to phase (2) when \( t=1 \). For all other \( t \), a current alternative program of task behavior exists. It is the program that was performed during the previous task cycle. Evaluation of this alternative consists of determining if the perceptions of outcome levels associated with this alternative fall within the minimum and maximum aspiration levels for those goals most important. Perceptions are operationalized as the estimated level of outcomes, i.e., the mean value of the normal distribution with \( \mu = \text{estimated level} \). If the perceptions fall within the acceptable range, no further search nor choice behavior is required:

For the most important goal,

\[
\text{if } \text{aspiration}_{\min} \leq E (\text{outcome level for program of task behavior being evaluated}) \leq \text{aspiration}_{\max},
\]

\[
\text{program of task behavior}_{t} = \text{program of task behavior}_{t-1}
\]

If the expected value of the outcome level does not fall in the acceptable range, alternative programs of behavior in the evoked set are then searched.
Second phase. --Phase (2) is the search in the set of evoked alternatives. This set is defined to hold seven alternatives including the current alternative. Alternatives are selected randomly for evaluation. The procedure specified in (2.18) is followed for the alternative presented. If the alternative is not acceptable, another alternative is presented for evaluation. This process continues until a satisfactory alternative is found or the set is exhausted. If a satisfactory alternative is found, no further search nor choice behavior occurs at time t; however, if no satisfactory alternative is found, search expands.

Third phase. --Phase (3) is the expanded search. Alternatives from the entire set of programs in the environment are eligible for evaluation. The number of searches is limited to a maximum of seven or the size of the environment, whichever is smaller. Each alternative that is presented is evaluated according to the procedure in (2.18). If a satisfactory alternative is found, no further search nor choice behavior occurs at time t; however, if no satisfactory alternative is found, the range of acceptable aspiration levels is revised.

Fourth phase. --Phase (4) is the revision of aspiration levels. The minimum aspiration level for the most important goal is lowered by .25, which is one-half of the high or low range. The maximum aspiration level is raised by .25, if it is not already 1.00. Evaluation then proceeds back to phase (1). If the acceptability requirements must be lowered again, it is feasible to do so as long as the minimum level does not fall below the minimum possible level, i.e., 0.00.

Initial evoked set. --These four phases describe selection of a program of task behavior. However, they do not describe how the initial
evoked set of alternatives is determined. Several alternative methods are conceivable. Two are suggested here. The researcher can choose the one he desires.

The first method consists of randomly selecting seven alternatives from the set of perceived alternatives. The second method consists of searching the set randomly until a few (3) satisfactory alternatives are found and then selecting the other four randomly.

Rational search and choice

Rational search is a more extensive search process than satisficing search. It is also a parallel evaluation of several alternatives when choice behavior is exhibited. As in satisficing search and choice there are four phases: (1) evaluation of current alternative, (2) evaluation of nearby alternatives, i.e., alternatives in the evoked set, if necessary, (3) expansion of search, if necessary, and (4) revision of aspiration levels, if necessary. As in satisficing decision behavior, search is instigated when dissatisfaction arises with the current alternative.

First phase.—Phase (1) is the evaluation of the current alternative. For \( t=1 \) no current alternative exists. It is therefore necessary to proceed to phase (2) when \( t=1 \). For all other \( t \), the current alternative is evaluated using the same procedure described in (2.18) for satisficing search. If the current alternative is satisfactory, no further search nor choice behavior is required. If it is not satisfactory, nearby alternatives are evaluated.

Second phase.—Phase (2) is the evaluation of alternatives in the evoked set. This set is defined to hold seven alternatives.
Alternatives are selected randomly for evaluation:

For the most important goal,

\[ \text{if } \text{aspiration}_{\text{min}} < E(\text{outcome level for program of task behavior being evaluated}) < \text{aspiration}_{\text{max}}, \]  

place alternative in the set of acceptable alternatives; if the number of alternatives in the set is less than three, select another alternative for evaluation.

If the number of alternatives in the set of acceptable alternatives is three, the alternatives are ranked, and the highest one is assigned to the program of task behavior for time \( t \). Ranking is determined as follows:

\[ \text{Rank} = (\text{aspiration}_{\text{max}} - \text{estimated level})^2 \text{ (for the goal with highest rank)} + \sum_{1}^{2} |\text{aspiration}_{\text{max}} - \text{estimated level}| \text{ (for the other 2 goals)}. \]  

This weighting scheme heavily penalizes relatively poor performance on the most important goal. The highest ranking alternative is the one with the lowest numeric value for rank. If more than one alternative have the same rank, the one chosen is determined randomly. If the number of alternatives in the set of acceptable alternatives is less than three after the evoked set has been totally searched, search must be expanded.

**Third phase.**—Phase (3) is the expansion of search. Alternatives from the entire set of programs are eligible for evaluation. Since rational search is more extensive than satisficing search, the maximum
number of alternatives searched is fourteen or the size of the environment, whichever is smaller. Each alternative is evaluated according to the procedure in (2.19). If three satisfactory alternatives are found, a choice is made based on the rankings as determined in (2.20). If three satisfactory alternatives are not found, the range of acceptable aspiration levels is revised.

**Fourth phase.**—Phase (4) is the revision of aspiration levels. It has the same procedures as described in phase (4) of satisficing decision behavior.

Maximizing search and choice

Maximizing search is defined as a complete search of all perceived environmental alternatives. All alternative programs of behavior are ranked according to the procedure of (2.20). The highest ranking alternative, i.e., the one with the lowest numeric score, is then chosen as the best alternative and assigned as the program of task behavior for time t.

Summary of decision behavior alternatives

These four algorithms—(1) no search, trivial choice, (2) satisficing search and choice, (3) rational search and choice, and (4) maximizing search and choice—are the four alternative forms of compliant decision behavior that an organizational unit can exhibit in the simulation model. Since decision behavior is explicitly assumed to be consistent, the organizational unit can exhibit only one form over time.
Task Behavior

Compliant, consistent task behavior is chosen for further investigation in this study. This kind of task behavior is similar to the form of search and choice behavior chosen for further investigation. Since search, choice, and task behavior have been discussed as distinct behaviors for conceptual reasons only, it is reasonable to use a similar form for all three behaviors. Under compliant task behavior the organizational unit performs the program of task behavior to achieve the prescribed goals.

The three performance outcomes obtained as a result of performing a specific program of task behavior are functions of the potential outcomes associated with the program and the degree of internal control. The potential outcomes are used as mean values of normal distributions with standard deviations of .08. Outcomes for each goal are obtained by drawing from each of the three distributions so defined. These outcomes are modified by the random variable, "uncontrolled", obtained from a normal distribution using a mean of zero and a standard deviation defined by the degree of internal control to obtain the performance outcomes.

\[
\text{performance outcome}_{t, \text{goal } i} = \text{outcome}_{t, \text{goal } i} + \text{uncontrolled}_{t, \text{goal } i} \quad i = 1,2,3. \tag{2.21}
\]

The only constraints are that the performance outcome must be less than or equal to 1.00 and greater than or equal to 0.00. If the sum of "outcome" and "uncontrolled" violates one of these constraints, the sum is modified to conform to the constraint that has been violated.
Summary of factors operationalized in segment 3

The factor levels in segment 3 provide alternative forms of transforming structure, perceptions, environment, and degree of internal control into performance outcomes. Search and choice behavior, particularly, simulates a rich set of alternative forms of decision behavior. The researcher can investigate the implications of each of these forms in conjunction with other variables, if he so desires. The major limitations on the scope of the simulation model with respect to behavior are that only compliant and consistent behavior are operationalized.

The factor levels operationalized for segment 3 of the total theoretical model are summarized in Table 8. These factor levels for the program of task behavior, search and choice behavior, and task behavior are also summarized in Appendix E.
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Program of Task Behavior</td>
<td>Possible values include: a vector of programs represented by numbers 1 to N, where N = size of the environment. A program can have all high, mixed, or all low outcomes.</td>
</tr>
<tr>
<td>B. Search and Choice Behavior Process</td>
<td><strong>SET OF ALTERNATIVE FORMS</strong></td>
</tr>
<tr>
<td>1. Relative to structural constraints</td>
<td>1. complaint</td>
</tr>
<tr>
<td>2. Search and choice strategies</td>
<td>2. non-compliant not operationalized.</td>
</tr>
<tr>
<td>a. under high structure</td>
<td>Set of alternative forms: 1. no search, trivial choice</td>
</tr>
<tr>
<td>b. under low structure</td>
<td>1. satisficing search and choice</td>
</tr>
<tr>
<td></td>
<td>2. rational search and choice</td>
</tr>
<tr>
<td></td>
<td>3. maximizing search and choice</td>
</tr>
<tr>
<td></td>
<td>4. Random search and choice not operationalized</td>
</tr>
<tr>
<td>C. Task Behavior</td>
<td><strong>SET OF ALTERNATIVE FORMS</strong></td>
</tr>
<tr>
<td>1. Relative to structural constraints</td>
<td>1. compliant</td>
</tr>
<tr>
<td>a. compliant</td>
<td>2. non-compliant not operationalized.</td>
</tr>
<tr>
<td>b. non-compliant not operationalized</td>
<td>2. Over time</td>
</tr>
<tr>
<td>a. consistent</td>
<td>a. consistent</td>
</tr>
<tr>
<td>b. inconsistent not operationalized</td>
<td>b. inconsistent not operationalized.</td>
</tr>
</tbody>
</table>
Evaluation process

A large portion of the evaluation process has been specified with operationalization of values for the control system. Recall that a particular specification of what is reviewed is appropriate under high structure and a particular one is appropriate under low structure. Behavior is evaluated under high structure, goal achievement under low structure. Frequency of evaluation is either every cycle or every six cycles. Delay in evaluation is either no cycles or six cycles. Either value of frequency or delay is appropriate under both high and low structure.

The performance evaluation process can also have alternatives relative to the validity of the evaluation. Only two forms of invalid evaluations are used herein. Because of either a conscious managerial decision or bias in information feedback mechanisms, the evaluations that result from this process may be consistently low or high relative to actual performance outcomes. The researcher specifies which alternative is to be used with a particular pattern of other variables and relationships.

Evaluating behavior.—If structure is high, the orientation of the process is toward behavior rather than performance outcomes, as noted above. Evaluations, therefore, do not contain any information regarding the outcomes associated with a program of task behavior, but rather contain information regarding how well behavior conformed to the prescribed means for achieving goals. As a result, evaluations cannot be
used to revise perceptions and have no effect on the other processes in the theoretical model. Since behavior is compliant, i.e., the same program is chosen each cycle, and evaluations of performance outcomes do not serve as inputs to later organizational unit decisions, the organizational unit ignores (or does not receive, presumably) the evaluation of performance outcomes. Under this orientation, therefore, no performance evaluation process is conducted in the simulation model.

**Evaluating goal achievement.**—If the orientation of the process is toward outcomes rather than behavior, the following stochastic model is used to determine performance evaluations for each of the performance outcomes:

$$\text{performance evaluation}_{i, \text{outcome } j} = \text{performance outcome}_{i, \text{outcome } j} + \text{bias}_{i, \text{outcome } j}$$

$$i = (t - \text{delay} - (\text{frequency} - 1)) \text{ to } (t - \text{delay})$$

$$j = 1, 2, 3.$$ 

Evaluations for outcomes 1 through 3 are performed only when \(t\) is a multiple of the frequency of review. Performance outcomes from task cycles between those reviewed during the last review and \((t - \text{delay})\) are reviewed if \(t\) is a multiple of frequency. A random variable, bias, is added to a performance outcome to obtain the performance evaluation. Each performance evaluation is constrained to the values 0 to 1 inclusive. Bias is a random variable from a normal distribution with a mean of \(.06\) and a standard deviation of \(.02\) if the bias of the process is toward evaluations higher than actual outcomes. It has a mean of \(-.06\) if the bias is toward lower evaluations. The
researcher determines which form of the relationship to use with patterns of other variables and relationships. Each time the performance evaluation process is performed, i.e., for each outcome and for each task cycle, a value of bias is determined by drawing from the appropriate normal distribution.

**Structure of the organizational unit**

As discussed above the values specified for structure as a whole and for the control system also specify a large portion of the performance evaluation process. See Table 6 for possible operational values associated with structure.

**Performance evaluations**

This variable can take on two kinds of values: (1) less than or equal to actual performance outcomes, and (2) greater than or equal to performance outcomes. In an absolute sense, evaluations range from 0 to 1 in the same manner as aspirations, potential outcomes, estimated levels on outcomes, and performance outcomes.

**Summary of factors operationalized in segment 4**

The value of structure highly determines the factor levels of the evaluation process. Alternative levels are available for researchers to select in determining the patterns of variables and relationships of interest to them. Table 9 summarizes the factor levels operationalized. Appendix E also summarizes the factors levels for the performance evaluation process, structure, and performance evaluations.
TABLE 9

OPERATIONAL VALUES FOR FACTORS IN SEGMENT 4

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Performance Evaluation Process</td>
<td>1. Relative to high and low structure</td>
</tr>
<tr>
<td></td>
<td>a. what is evaluated (i.e., orientation)</td>
</tr>
<tr>
<td></td>
<td>1) behavior (under high structure)</td>
</tr>
<tr>
<td></td>
<td>2) performance outcomes (under low structure)</td>
</tr>
<tr>
<td></td>
<td>b. frequency of evaluation (under either high or low structure)</td>
</tr>
<tr>
<td></td>
<td>1) every task cycle</td>
</tr>
<tr>
<td></td>
<td>2) every 6 task cycles</td>
</tr>
<tr>
<td></td>
<td>c. delay in evaluation (under either high or low structure)</td>
</tr>
<tr>
<td></td>
<td>1) no delay</td>
</tr>
<tr>
<td></td>
<td>2) delay of 6 task cycles</td>
</tr>
<tr>
<td></td>
<td>2. Relative to validity of evaluation</td>
</tr>
<tr>
<td></td>
<td>a. biased low</td>
</tr>
<tr>
<td></td>
<td>b. biased high</td>
</tr>
</tbody>
</table>

B. Structure of the Organization Unit

(See Table 6)
C. Performance evaluations

POSSIBLE VALUES

1. Relative to actual performance outcomes
   a. lower than or equal to
   b. greater than or equal to

2. In absolute terms:
   range from 0 to 1
Segment 5: Learning

Learning by the organizational unit is not relevant when prescription of task behavior is high. Under compliant behavior no search and a trivial choice is required because an alternative program of task behavior is specified. Since no search and a trivial choice is required, the organizational unit does not use perceptions of the environment to guide search and choice behavior. Therefore, using performance evaluations to revise perceptions is useless or irrelevant. (Under the alternative behavior, i.e., non-compliant search and choice behavior, learning behavior could be relevant when prescription of task behavior is high).

Besides no learning (because of its irrelevancy), the other two operational forms of learning behavior are: (1) use of all past evaluations for revising probabilities and (2) use of a limited number of past evaluations for revising probabilities.

No learning

Under no learning the following relationship holds for perceptions concerning all programs of task behavior:

\[ \text{Estimated level on outcome } i \text{ at time } t = \text{initial estimated level} \]

\[ (2.23) \]

for all \( t \) and \( i = 1,2,3 \).
Use of all past evaluations (Bayesian learning)

If more than one evaluation exists for the performance of a particular program of task behavior, the following relationships hold:

Let

The estimated level on outcome 1 at time \( t = \bar{X}_{1,t} \) and uncertainty at time \( t = s_t \);
the mean value of all past evaluations of outcome 1 for this program = \( \bar{X}_{1,\text{obs}} \);
the variance of all past evaluations of outcome 1 for this program = \( s^2_{\text{obs}} \);
the variance of pooled past evaluations of all three outcomes for this program = \( s^2_{\text{all}} \); and
the new estimated level on outcome 1 = \( \bar{X}_{1,t+1} \) and the new uncertainty = \( s_{t+1} \).

Then

\[
\bar{X}_{1,t+1} = \frac{(\bar{X}_{1,t})(1/s^2_{t}) + (\bar{X}_{1,\text{obs}})(1/s^2_{\text{obs}})}{(1/s^2_{t}) + (1/s^2_{\text{obs}})}
\]

(2.24)

\[
s_{t+1} = \sqrt{\frac{(s^2_{t}) (s^2_{\text{all}})}{s^2_{\text{all}} + s^2_{t}}}
\]

(2.25)

\[1\]These formulas are adapted from Bierman, Bonini, and Hausman's (1969) discussion of Bayesian revision of parameters for a normal distribution.
Use of recent evaluations
(non-Bayesian learning)

Under this form of learning the four most recent evaluations of a program of task behavior are used to revise beliefs about cause and effect relationships. The following relationship describes the revision process:

Let

the mean value of the four most recent evaluations of outcome for the program of task behavior \( \overline{X}_{i,obs} \),

and the new estimated level on outcome \( i = \overline{X}_{i,t+1} \)

Then

\[ \overline{X}_{i,t+1} = \overline{X}_{i,obs} \] (2.26)

This form of learning behavior ignores previous perceptions unless less than four evaluations exist. In this case, perceptions are used in place of the lacking evaluations to obtain the new perception.

Summary of segment 5

The alternative forms of learning behavior that an organizational unit can exhibit in the simulation model are presented in Table 10 and Appendix E. The designers do not exhibit any learning behavior since structure is stable. Goals and prescribed behavior, therefore, do not change. As a result, designers' perceptions do not need to change in the simulation model.
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Behavior Process</td>
<td></td>
</tr>
<tr>
<td>1. By the organizational unit</td>
<td>1. Bayesian learning, using all past evaluations to update the most recent perceptions regarding a program of task behavior</td>
</tr>
<tr>
<td></td>
<td>2. Non-Bayesian learning using only the four most recent evaluations of a program of task behavior to revise perceptions regarding the program.</td>
</tr>
<tr>
<td></td>
<td>3. No learning, when structure is high.</td>
</tr>
<tr>
<td>2. By the designers</td>
<td>Not operationalized</td>
</tr>
</tbody>
</table>
Concluding Remarks Regarding the Simulation Model

To investigate the implications of the general theoretical model, the researcher must specify the pattern, or patterns, of values of the variables and forms of the relationships of interest to him. Then the researcher can run the simulation model over time to observe the effects of the pattern, or patterns, specified.

Because of the explicit assumption of compliant behavior, two major classifications of patterns of variables and relationships emerge. The first classification is based on high structure as the value for structure. The second classification has low structure as the value for structure. Under high structure an exact program of task behavior is specified. Under low structure the organizational unit must choose a program. If the organizational unit is compliant, specific alternative forms of search and choice behavior and learning behavior can be exhibited under low and high structure.

At this point, our understanding of the theory's implications is incomplete. Given specified initial values for variables, such as environment, structure, and perceptions, and specified forms for relationships, such as the environmental change process, search and choice behavior, and learning behavior, it is not entirely evident what performance outcomes are obtained. By running the simulation model over time for the initial values and forms of interest (i.e., for the patterns of interest), the researcher can compare, for example, the effects of different structures given specific environmental conditions and behaviors of the organizational unit.
Computer programs have been developed for the simulation model. They are listed in Appendix A. Appendix B contains examples of the results of simulation runs for two patterns of variables and relationships. In the next chapter the specific patterns selected for further investigation are presented.
CHAPTER 3

EXPERIMENTAL DESIGN

The theory as proposed so far has suggested no explicit hypotheses. It may be argued that some implicit hypotheses can be found. For example, the following hypothesis could be proposed:

Compliant search and choice behavior is maximizing, rational, or satisficing.

Another example of an implicit hypothesis is the following:

Control systems range from behavior oriented to goal achievement oriented.

These hypotheses could be empirically investigated. If other forms of compliant search and choice behavior or control systems were found, the theory could be modified to include these.

Consider the following hypothesis that compares one pattern of factor levels to another:

A pattern of factor levels consisting of high structure, certain perceptions of the task environment, high internal control of outcomes, and a stable environmental change process leads to higher performance outcomes than a pattern of factor levels consisting of low structure, certain perceptions of the task environment, high internal control of outcomes, and a stable environmental change process.

Given the proposed theory, hypotheses such as this one are not immediately obvious. However, such complex hypotheses can be derived. To test the theory empirically, such hypotheses should be readily recognizable. The remainder of this dissertation is directed at deriving such
hypotheses through use of the simulation model.

Although no empirical data is being gathered, an experimental design is needed to determine the patterns of variables and relationships for which predictions are derived and compared. The simulation model is employed to derive the predictions. To guide the running of the simulation "experiments," in which one simulation run under one pattern of variables and relationships corresponds to an empirical observation on one organization, an experimental design as needed. In this chapter the experimental design, i.e., the patterns (or combinations) of variables and relationships, is presented.

Experimental Design

The values of variables and the forms of relationships correspond to factor levels in traditional analysis of variance experimental designs. Any pattern (or combination) of values of variables and forms of relationships corresponds to the treatment applied to a cell in an analysis of variance design. Making several simulation runs for one pattern of variables and relationships corresponds to gathering observations on several subjects within a particular treatment, or cell. Through the gathering of simulation data for various patterns of variables and relationships, the various patterns (or cells, or treatments) can be compared with each other.

The problem at this point is to determine the patterns of variables and relationships for which simulation data will be gathered. A large number of patterns are possible because of the several variables and relationships and their possible values and forms. If these could be
reduced, the problem would be simplified.

A comparison with a field or laboratory study can be made to help simplify the problem. In a field or laboratory study, some variables are controlled, while others are assumed to be distributed randomly or are ignored completely. Information is obtained on some variables, while others are ignored. The theoretical framework that guides the researcher includes some variables but not others. In setting up the field or laboratory study the researcher uses all or only a part of the total framework to determine the gathering of data. In this study the theoretical framework is large and complex. The largeness is caused by the number of variables and relationships. The complexity is caused by the interactions of these factors, particularly the interactions over time. As in a field or laboratory study, the number of factors controlled could be limited, or the portion of the theoretical framework investigated could be limited. Since this study is aimed at deriving hypotheses from the total, complex theory, the latter simplification is not reasonable. However, because of the largeness of the theoretical framework, a limited number of critical factors can be controlled while the others are distributed randomly over the simulation runs for the controlled treatments. This simplification leads to greater realism in the sense that a field or laboratory study would have a number of uncontrolled factors that could affect the results obtained just as this simulation study does. In both it is hoped that the critical factors have been controlled and that the uncontrolled factors do not cause the results to be significantly affected.
To guide the selection of the critical factors propositions from the historical perspectives are used. Since the structural, contingency, and complex perspectives represent what could be called the mainstream of organizational level literature, propositions from these perspectives are used to guide the selection of the critical factors. Propositions from the behavioral perspective are presented to raise the question of whether or not behavior of members of the organizational unit can or should be examined when investigating organizational level phenomena such as structure and environment. Indeed, inclusion of the behavioral perspective may be looked upon as an attempt to integrate both macro- and micro-organizational concepts within the same theoretical framework. The following sections present the propositions and patterns of variables and relationships suggested by the propositions derived from the three mainstream perspectives and the behavioral perspective.

Structural perspective: propositions and patterns

The pattern of variables and relationships suggested by the structural perspective is the following: (1) variables—high structure, certain perceptions of the environment, munificent environment, and high performance outcomes, and (2) relationships—stable (i.e., non-changing) environmental change process. The most important factor for the proponents of the structural perspective is structure. The other factors are implicitly assumed to have the levels specified. Structure should be high rather than low. If the value of the variable were low, another pattern of variables and relationships could be considered: (1) variables—low structure, certain perceptions of the environment,
munificent environment, and low performance outcomes, and (2) relationships—stable environmental change process. By removing performance outcomes from the two patterns and using it as a basis for comparing them, the following proposition can be derived from the structural perspective:

Proposition 1: The pattern of factor levels consisting of high structure, certain perceptions of the environment, munificent environment, and a stable environmental change process leads to higher performance outcomes than the pattern of factor levels consisting of low structure, certain perceptions of the environment, munificent environment, and a stable environmental change process.

This proposition is shown in Figure 13.

**CRITICAL FACTORS**

1. Structure : 
   - Low
   - High
2. Perceptions : Certain
3. Environment : Munificent
4. Environmental change : Stable

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Performance Outcomes</td>
<td>Higher Performance Outcomes</td>
</tr>
</tbody>
</table>

Fig. 13.—The two patterns from proposition 1

**Contingency perspective:**

**propositions and patterns**

Proponents of the contingency perspective have suggested that effectiveness requires structure to be contingent upon a critical variable, e.g., environment or uncertainty. This suggestion is expanded into two propositions regarding four patterns of factor levels:
Proposition 2: The pattern of factor levels consisting of high structure, certain perceptions of the environment, high degree of internal control of outcomes, and a stable environmental change process leads to higher performance outcomes than the pattern of factor levels consisting of low structure, certain perceptions of the environment, high degree of internal control of outcomes, and a stable environmental change process.

Proposition 3: The pattern of factor levels consisting of low structure, uncertain perceptions of the environment, low degree of internal control of outcomes, and an expanding environmental change process leads to higher performance outcomes than a pattern of factor levels consisting of high structure, uncertain perceptions of the environment, low degree of internal control of outcomes, and expanding environmental change process.

These propositions are shown in Figure 14.

CRITICAL FACTORS

Proposition 2
1. Structure : Low High
2. Perceptions : Certain
3. Degree of internal control : High
4. Environmental change : Stable

Proposition 3
1. Structure : Low High
2. Perceptions : Uncertain
3. Degree of internal control : Low
4. Environmental change : Expanding

Fig. 14.—The four patterns from propositions 2 and 3
**Complex perspective: propositions and patterns**

The three propositions presented below are derived from Thompson's (1967, pp. 71-72) propositions:

**Proposition 4:** The pattern of factor levels consisting of high structure and a stable environmental change process leads to higher performance outcomes than a pattern of factor levels consisting of low structure and a stable environmental change process.

**Proposition 5:** The pattern of factor levels consisting of high structure, certain perceptions of the environment, and a stable environmental change process leads to higher performance outcomes than a pattern of factor levels consisting of low structure, certain perceptions of the environment, and a stable environmental change process.

**Proposition 6:** The pattern of factor levels consisting of low structure, low degree of internal control of outcomes, and a changing environmental change process leads to higher performance outcomes than a pattern of factor levels consisting of high structure, low degree of internal control of outcomes, and a changing environmental change process.

These propositions are shown in Figure 15. Other propositions are not easily derived from the complex perspective because of: (1) a lack of theorizing and empirical study with entire patterns of a large number of factors, or (2) a lack of precise specification of the values of variables and the forms of their relationships.
Proposition 4
1. Structure : 
2. Environmental change: Stable

Proposition 5
1. Structure : 
2. Perceptions : Certain
3. Environmental change: Stable

Proposition 6
1. Structure : 
2. Degree of internal control : Low
3. Environmental change: Changing

Fig. 15.—The six patterns from propositions 4, 5, and 6

Behavioral perspective: propositions and patterns

The key relationship in the single-stage decisions of the behavioral perspective is the search and choice behavior process. The following proposition can be derived for comparing two patterns of variables and relationships:

Proposition 7: If a large number of single-stage decisions are observed, the pattern of factor levels consisting of maximizing search and choice behavior leads to higher performance outcomes than a pattern of factor levels consisting of satisficing search and choice behavior.

In multiple-stage decisions the key relationships are the search and choice behavior process and the learning behavior process. The
following propositions can be derived for comparing four patterns of variables and relationships:

**Proposition 8:** The pattern of factor levels consisting of a stable environmental change process, maximizing search and choice behavior, and Bayesian learning behavior leads to higher performance outcomes than a pattern of factor levels consisting of a stable environmental change process, maximizing search and choice behavior, and non-Bayesian learning behavior.

**Proposition 9:** The pattern of factor levels consisting of a stable environmental change process, maximizing search and choice behavior, and Bayesian learning behavior leads to higher performance outcomes than a pattern of factor levels consisting of a stable environmental change process, satisficing search and choice behavior, and Bayesian learning behavior.

**Proposition 10:** The pattern of factor levels consisting of a stable environmental change process, maximizing search and choice behavior, and Bayesian learning behavior leads to higher performance outcomes than a pattern of factor levels consisting of a stable environmental change process, satisficing search and choice behavior, and non-Bayesian learning behavior.
CRITICAL FACTORS

Proposition 7

1. Search and choice behavior : Maximizing Satisficing
2. Environmental change: Stable
   | Higher Performance Outcomes | Lower Performance Outcomes |

Proposition 8

1. Learning behavior : Bayesian Non-Bayesian
2. Search and choice behavior : Maximizing
3. Environmental change: Stable
   | Higher Performance Outcomes | Lower Performance Outcomes |

Proposition 9

1. Search and choice behavior : Maximizing Satisficing
2. Learning behavior : Bayesian
3. Environmental change: Stable
   | Higher Performance Outcomes | Lower Performance Outcomes |

Proposition 10

1. Search and choice behavior : Maximizing Satisficing
2. Learning : Bayesian Non-Bayesian
3. Environmental change: Stable
   | Higher Performance Outcomes | Lower Performance Outcomes |

Fig. 16.— The six patterns from propositions 7-10

Specific patterns investigated in this study

The 12 patterns suggested by the propositions from the three mainstream perspective comprise the patterns investigated in this study.
CRITICAL FACTORS

Patterns 1 and 2

1. Structure : Low High
2. Perceptions : Certain
3. Environment : Munificent LOWER HIGHER
4. Environmental change : Stable

Patterns 3 and 4

1. Structure : Low High
2. Perceptions : Certain
3. Degree of internal control : High LOWER HIGHER
4. Environmental change : Stable

Patterns 5 and 6

1. Structure : Low High
2. Perceptions : Uncertain HIGHER LOWER
3. Degree of internal control : Low
4. Environmental change : Growing

Patterns 7 and 8

1. Structure : Low High
2. Environmental change : Stable LOWER HIGHER

Patterns 9 and 10

1. Structure : Low High
2. Perceptions : Certain
3. Environmental change : Stable LOWER HIGHER

Patterns 11 and 12

1. Structure : Low High
2. Degree of internal control : Low HIGHER LOWER
3. Environmental change : Changing

(Cell values indicate the predicted relationship between the 2 patterns on performance outcomes).

Fig. 17.—The twelve patterns investigated in this study.
The patterns form the behavioral perspective are suggestive of patterns that other researchers may wish to investigate using the same simulation methodology. This study allows the stream of literature found in the structural, contingency, and complex perspectives to be investigated with a different methodology than is traditionally used. In particular, it provides a rigorous investigation of the interdependencies over time of a complex set of factors through the use of the simulation model. The 12 patterns investigated are summarized in Figure 10.

Only the levels for the critical factors in each pattern are specified. To specify the experimental design completely, the other factors from the theoretical model are distributed randomly to the simulated organizations in the twelve cells of the experimental design.

For example, the performance evaluation process, which can have two levels—one leading to high evaluation and the other to low evaluations—is distributed randomly among the simulated organizations having low structure. Appendix C contains the patterns of critical and non-critical factor levels for organizations in each of the twelve cells.

Data Generated by the Simulation Runs

In all cells, the data generated consist of the program of task behavior selected each task cycle and the performance outcomes obtained

---

1Each pattern of critical and non-critical factors specifies an organization. Each simulated organization within a cell requires a run with the simulation model.

2Recall that the performance evaluation process as operationalized is irrelevant with high structure.
for the three performance outcomes each task cycle. Other measures are derived, such as the number of programs searched each task cycle and the number of switches in programs of task behavior over the total number of task cycles.

The performance outcomes obtained from each simulation run are not one single number that allows various patterns to be easily compared. Rather, they are three time series. As such, single measures of each outcome, such as the mean ($\mu$) and variance ($\sigma^2$), are derived from each complete time series. In addition, the time series is segmented, and the same measures (mean and variance) are derived for the various segments. Segmenting is desirable to observe how the simulated organization performs over various time periods. Observations toward the end of the simulation run indicate whether the simulated organization converges on certain values or has certain limiting conditions.

These multiple measures (i.e., means and variances for each performance outcome) are as difficult to use as a time series to make comparisons among patterns of variables. The ideal situation would entail comparing the patterns on the basis of a single criterion. A linear combination of the three performance outcomes obtained each task cycle allows a single mean and variance to be obtained for each simulated organization. These linear combinations are computed and then used to derive a single mean and variance for each group of simulated organizations within a cell, i.e., for each pattern of critical factors.
The data regarding performance outcomes indicate the organization's level of goal achievement relative to task behavior. Other indicators may be of interest to the organizational unit or other assessors. For example, the cost of time involved in searching for a program of task behavior may be of interest. Also, the number of switches from one program of behavior to another may have implications regarding implementation time and costs. These data are obtained for each third of the total time horizon and for the total time horizon.

The time horizon used in this study is 180 task cycles. Restrictions on the lower and upper limits with respect to both the size of the environment (9 and 300) and the probabilities (.05 and .90) associated with the three program types in the total environment provide a basis for selecting a time horizon. Many limiting conditions are reached by 180 task cycles. Of those, several are reached within 60 task cycles, which is the first third of the time horizon. For example, in an initially small environment that is declining, the minimum size of the environment is reached in 6 task cycles. In an initially large environment that is declining, the minimum size of the environment is reached in 59 task cycles. Other limiting conditions are reached between 60 and 120 task cycles, the second third of the time horizon. For example, in an initially small environment that is growing, the maximum size is reached in 91 task cycles. In an initially munificent environment that is growing, the maximum probability for all high programs is reached in 100 task cycles. By using 180 task cycles and summarizing

1In the simulation model, there are no penalties for searching and switching.
observations over the total time horizon and each third of it, the model's performance can be compared over time both within a pattern and across patterns.

The summarized observations are obtained from the total number of organizations simulated within each of the twelve patterns or cells. In this study thirty organizations are "observed" within each of the cells, the observations within each cell will have differences. Even if the organizations all had the same pattern for all factors, differences would exist as a result of different random number seeds for running the simulations. A large sample is desirable to obtain summarized observations, i.e., mean values for each of the performance measures, that are normally distributed. Thirty is a minimum number for a large sample.

Summary of the data generated

As a result of the experimental design, 360 simulation runs (30 in each of 12 cells) are performed over 180 task cycles to generate the data used in this study. These data are used to derive hypotheses from the proposed theory and to compare the predictions from the theory with those from the historical perspectives. Table II summarizes the data needed for each cell in the experimental design.

Data Analysis

Data analysis should be guided by the purpose of the investigation. A limited portion of the theoretical model is being investigated to determine what the theory predicts regarding the relationship between patterns of critical factor levels. Six pairs of patterns are being investigated. Propositions from the historical perspectives focus on
### TABLE 11

DATA NEEDED FOR EACH PATTERN

| Organization | Task Cycles | Mean of the Weighted Task Combination Total Number of Total Number of Outcomes Programs Searched Program Switches |
|--------------|-------------|--------------------------------------------------|--------------------------------------------------|
| 1            | 1-60        | $\bar{X}_{11}$                                | $Y_{11}$                                        | $Z_{11}$                                        |
|              | 61-120      | $\bar{X}_{21}$                                | $Y_{21}$                                        | $Z_{21}$                                        |
|              | 121-180     | $\bar{X}_{31}$                                | $Y_{31}$                                        | $Z_{31}$                                        |
|              | 1-180       | $\bar{X}_{1}$                                 | $\Sigma Y_{11}$                                | $\Sigma Z_{11}$                                 |
|              |             |                                                  |                                                  |                                                 |
| 30           | 1-60        | $\bar{X}_{1,30}$                              | $Y_{1,30}$                                      | $Z_{1,30}$                                      |
|              | 61-120      | $\bar{X}_{2,30}$                              | $Y_{2,30}$                                      | $Z_{2,30}$                                      |
|              | 121-180     | $\bar{X}_{3,30}$                              | $Y_{3,30}$                                      | $Z_{3,30}$                                      |
|              | 1-180       | $\bar{X}_{30}$                                | $\Sigma Y_{1,30}$                              | $\Sigma Z_{1,30}$                               |

**CELL SUMMARY DATA**

- $1-60$: $(\Sigma X_{1,j,1,j})/30$, $(\Sigma Y_{1,j,1,j})/30$, $(\Sigma Z_{1,j,1,j})/30$
- $61-120$: $(\Sigma X_{2,j,2,j})/30$, $(\Sigma Y_{2,j,2,j})/30$, $(\Sigma Z_{2,j,2,j})/30$
- $121-180$: $(\Sigma X_{3,j,3,j})/30$, $(\Sigma Y_{3,j,3,j})/30$, $(\Sigma Z_{3,j,3,j})/30$
- $1-180$: $(\Sigma X_{j,1,j})/30$, $(\Sigma Y_{j,1,j})/30$, $(\Sigma Z_{j,1,j})/30$

---

The sample standard deviation associated with each of these twelve sample means is also computed.
the relationship of the two patterns within a pair. Comparisons between different pairs, therefore, are ignored in this study. One pattern within a pair is compared to the other pattern. Since there are 6 independent pairs of patterns, there are 6 independent comparisons. The appropriate data analysis technique is the comparison of differences between two mean values. A t-statistic is computed for each pair of mean values associated with each set of the two patterns being compared. Each pattern has twelve summary statistics associated with it. (See Table 11.) The six sets of comparisons, therefore, each include twelve tests for significant differences in mean values. Table 12 summarizes these comparisons for a single pair of patterns. The results of the comparisons indicate whether the pattern of factor levels leads to different performance measures than the other pattern. Two-tailed tests, therefore, are appropriate for deriving hypotheses from the theory. The results of these tests are presented in the next chapter.
Table 12

COMPARISONS FOR EACH PAIR OF PATTERNS

<table>
<thead>
<tr>
<th>Task Cycles</th>
<th>Weighted Combination of Outcomes</th>
<th>Total Number of Searches</th>
<th>Total Number of Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-60</td>
<td>$\overline{MX}<em>{1A}$ $\overline{MX}</em>{1B}$</td>
<td>$\overline{MY}<em>{1A}$ $\overline{MY}</em>{1B}$</td>
<td>$\overline{MZ}<em>{1A}$ $\overline{MZ}</em>{1B}$</td>
</tr>
<tr>
<td>61-120</td>
<td>$\overline{MX}<em>{2A}$ $\overline{MX}</em>{2B}$</td>
<td>$\overline{MY}<em>{2A}$ $\overline{MY}</em>{2B}$</td>
<td>$\overline{MZ}<em>{2A}$ $\overline{MZ}</em>{2B}$</td>
</tr>
<tr>
<td>121-180</td>
<td>$\overline{MX}<em>{3A}$ $\overline{MX}</em>{3B}$</td>
<td>$\overline{MY}<em>{3A}$ $\overline{MY}</em>{3B}$</td>
<td>$\overline{MZ}<em>{3A}$ $\overline{MZ}</em>{3B}$</td>
</tr>
<tr>
<td>1-180</td>
<td>$\overline{MX}<em>{A}$ $\overline{MX}</em>{B}$</td>
<td>$\overline{MSY}<em>{A}$ $\overline{MSY}</em>{B}$</td>
<td>$\overline{MSZ}<em>{A}$ $\overline{MSZ}</em>{B}$</td>
</tr>
</tbody>
</table>

Where

\[
\overline{MX} = (\overline{EX}_{1,j})/30; \\
\overline{MY} = (\overline{EY}_{1,j})/30; \\
\overline{MZ} = (\overline{EZ}_{1,j})/30 \\
\overline{MSY} = (\overline{ESY}_{1,j})/30; \\
\overline{MSZ} = (\overline{ESZ}_{1,j})/30
\]

(See Table 11 for further detail)
CHAPTER 4

RESULTS OF THE SIMULATION EXPERIMENTS

Each of the 360 simulation experiments was run to obtain the data indicated in Table 11.¹ (Appendix C specifies the pattern of factor levels for each experiment. Appendix D specifies the control parameters needed to replicate the experiments.) The 12 statistics for all 30 simulated organizations in each cell of the experimental design have been summarized to obtain the summary statistics for each of the 12 patterns investigated. These summary statistics state that, on the average, an organization, having the pattern of critical factor levels associated with the specific cell in the experimental design, can be expected to conduct Y number of searches for programs of task behavior, make Z switches in programs of task behavior chosen, and achieve an average weighted goal level of X over various segments of the time horizon. Since these summary statistics are averages of 30 organizations, there are differences among the organizations for each of the statistics. The differences are reflected in the sample standard deviation for each of the 12 statistics. Both mean values and sample standard deviations

¹All 360 simulation experiments were completed in 8 minutes, 22 seconds on the IBM 370/165 at the Instruction and Research Computer Center (IRCC) at The Ohio State University.
are presented in the data that follow. The t and F statistics for each pair of patterns (see Figure 17) were computed using unbiased estimates of variance \( \sigma^2 = n s^2/(n-1) \) rather than the unadjusted sample variance \( s^2 = \sum(X-\bar{X})^2/n \). The mean values of the weighted combination of outcomes were transformed from the range 0-1 to the range 0-1000 for convenience. The results for the 6 pairs of patterns are presented in Tables 13-18.

**Patterns 1 and 2**

Results.—In these two patterns perceptions are certain, the environment is munificent, the environmental change process is stable, and structure is either low or high. The results indicate a significant difference between low and high structure with respect to the number of searches and the number of switches in programs. Assuming that costs are associated with searching and switching, the data favor high structure over low structure. (An alternate assumption could be appropriate, i.e., benefits may be associated with searching and switching, e.g., in a university classroom or an R and D setting.) With respect to goal achievement

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1Significance is defined at \( \alpha = .05 \). Two-tailed tests are used since the null hypothesis is that no significant difference exists between the patterns. Where the F-test indicates significant difference in the variances, the degrees of freedom for the t-test are adjusted to the number appropriate when variance is unknown and unequal. See Smith and Williams (1971, pp. 413-427).
### TABLE 13
PATTERNS 1 AND 2

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### MEAN VALUE OF THE WEIGHTED COMBINATION OF OUTCOMES

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**PATTERNS 3 AND 4**

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Patterns 5 and 6

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#### Total Switches

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#### Mean Value of the Weighted Combination of Outcomes

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<td>7.37</td>
<td>13.16</td>
<td>3.02</td>
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</tr>
<tr>
<td>61-120</td>
<td>6.03</td>
<td>12.19</td>
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</tr>
<tr>
<td>121-180</td>
<td>2.13</td>
<td>4.06</td>
<td>2.83</td>
<td>0.00</td>
</tr>
<tr>
<td>1-180</td>
<td>15.53</td>
<td>27.66</td>
<td>3.02</td>
<td>0.00</td>
</tr>
<tr>
<td>TOTAL SWITCHES</td>
<td>470.70</td>
<td>203.57</td>
<td>1.25</td>
<td>1.03</td>
</tr>
<tr>
<td>PATTERN 9</td>
<td>504.18</td>
<td>182.84</td>
<td>1.97</td>
<td>1.28</td>
</tr>
<tr>
<td>61-120</td>
<td>182.84</td>
<td>402.69</td>
<td>2.71</td>
<td>1.47</td>
</tr>
<tr>
<td>1-180</td>
<td>538.04</td>
<td>170.69</td>
<td>207.22</td>
<td>1.47</td>
</tr>
<tr>
<td>MEAN</td>
<td>504.31</td>
<td>180.39</td>
<td>207.14</td>
<td>1.32</td>
</tr>
<tr>
<td>STD.DEV.</td>
<td>470.70</td>
<td>203.57</td>
<td>1.25</td>
<td>1.03</td>
</tr>
<tr>
<td>PATTERN 10</td>
<td>504.18</td>
<td>182.84</td>
<td>1.97</td>
<td>1.28</td>
</tr>
<tr>
<td>61-120</td>
<td>182.84</td>
<td>402.69</td>
<td>2.71</td>
<td>1.47</td>
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<td>1-180</td>
<td>538.04</td>
<td>170.69</td>
<td>207.22</td>
<td>1.47</td>
</tr>
<tr>
<td>MEAN</td>
<td>504.31</td>
<td>180.39</td>
<td>207.14</td>
<td>1.32</td>
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</table>

#### MEAN VALUE OF THE WEIGHTED COMBINATION OF OUTCOMES

<table>
<thead>
<tr>
<th>TASK CYCLES</th>
<th>PATTERN 9</th>
<th>PATTERN 10</th>
<th>T</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>1-60</td>
<td>403.13</td>
<td>207.04</td>
<td>1.25</td>
<td>1.03</td>
</tr>
<tr>
<td>61-120</td>
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<td>207.24</td>
<td>1.97</td>
<td>1.28</td>
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<td>402.69</td>
<td>207.22</td>
<td>2.71</td>
<td>1.47</td>
</tr>
<tr>
<td>1-180</td>
<td>402.97</td>
<td>207.14</td>
<td>1.99</td>
<td>1.32</td>
</tr>
<tr>
<td>MEAN</td>
<td>403.13</td>
<td>207.04</td>
<td>1.25</td>
<td>1.03</td>
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</table>
### Table 18: Patterns 11 and 12

#### Total Searches

<table>
<thead>
<tr>
<th>Task Cycles</th>
<th>Pattern 11</th>
<th>Pattern 12</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-60 MEAN</td>
<td>881.93</td>
<td>101.20</td>
<td>1.85</td>
<td>2792.00</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>2275.79</td>
<td>43.07</td>
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</tr>
<tr>
<td>61-120 MEAN</td>
<td>1274.60</td>
<td>60.00</td>
<td>2.05</td>
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<td>STD. DEV.</td>
<td>3188.98</td>
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<td></td>
<td></td>
</tr>
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<td>121-180 MEAN</td>
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<td>2.29</td>
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</tr>
<tr>
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<td>3570.77</td>
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<tr>
<td>STD. DEV.</td>
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</table>

#### Total Switches

<table>
<thead>
<tr>
<th>Task Cycles</th>
<th>Pattern 11</th>
<th>Pattern 12</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-60 MEAN</td>
<td>3.73</td>
<td>.00</td>
<td>5.31</td>
<td>0.00</td>
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<td>STD. DEV.</td>
<td>3.79</td>
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<tr>
<td>61-120 MEAN</td>
<td>1.90</td>
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<td>.00</td>
<td>3.55</td>
<td>0.00</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>1.97</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-180 MEAN</td>
<td>6.93</td>
<td>.00</td>
<td>5.50</td>
<td>0.00</td>
</tr>
<tr>
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<td>6.79</td>
<td>.00</td>
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</tr>
</tbody>
</table>

#### Mean Value of the Weighted Combination of Outcomes

<table>
<thead>
<tr>
<th>Task Cycles</th>
<th>Pattern 11</th>
<th>Pattern 12</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-60 MEAN</td>
<td>483.93</td>
<td>293.64</td>
<td>4.11</td>
<td>2.58</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>131.75</td>
<td>211.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61-120 MEAN</td>
<td>465.78</td>
<td>294.18</td>
<td>3.09</td>
<td>1.92</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>175.08</td>
<td>242.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>121-180 MEAN</td>
<td>468.88</td>
<td>300.09</td>
<td>2.87</td>
<td>1.48</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>201.11</td>
<td>245.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-180 MEAN</td>
<td>472.86</td>
<td>295.95</td>
<td>3.50</td>
<td>2.49</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>145.67</td>
<td>230.07</td>
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<td></td>
</tr>
</tbody>
</table>
the results indicate no significant difference between low and high structure in the first third of the time horizon; however, there is a significant difference over the last two-thirds of the time horizon and for the time horizon as a whole. The data favor low structure over high structure where this difference exists. Notice that the achievement level for high structure remains the same, 438, over the entire time horizon. For low structure it increases from 475 to 574 to 599.

**Discussion.**—In the short run, the one-time decision of the organizational designers in prescribing a program of task behavior leads to higher overall results since the number of searches and switches are fewer in the first third of the time horizon and achievement levels are not significantly lower than the achievement levels under low structure. (Once again, the assumption is made that cost is associated with search and choice.) Given these results, the theory proposed in Chapter 1 and operationalized in Chapter 2 leads to this hypothesis:

In the short run, the pattern of factors consisting of certain perceptions, munificent environment, stable environmental change process, and high structure leads to higher overall results than the same pattern of factors having low structure (given the limits of the operationalized theory).

In the long run, i.e., after the first third of the time horizon, low structure has higher achievement levels than high structure. The more extensive search and learning processes pro-
vide adaptive mechanisms to improve outcomes. Improved outcomes, however, are obtained at the expense of increased search and program switching as compared with high structure. Whether the improved outcomes outweigh the costs of search and switching cannot be answered in this study.

Since low structure does have an advantage with respect to achievement levels, it is apparent that more adaptive mechanisms, if built into high structure, could improve the achievement levels of high structure. Such mechanisms could include learning on the part of organizational designers and a design process that leads to changing structure. At the extreme the designers would behave exactly as the performers under low structure. In this case the advantage of fewer searches and switches disappears. An easily proposed solution is to build in adaptive mechanisms to improve outcomes but at the same time limit searches and switches.

In neither the short nor long run is proposition 1 from the historical perspectives supported. High structure does not lead to higher performance outcomes (i.e., achievement levels on goals) than low structure. The discussion above suggests an alternative hypothesis and revised avenues of research that include not only goal achievement but also search and switching.

Patterns 3 and 4

Results.—In these two patterns perceptions are certain, the
degree of internal control is high, the environmental change process is stable, and structure is either low or high. The results are very similar to those for patterns 1 and 2. There are significant differences between low and high structure for searches and switches. The direction of the difference favors high structure. There is no significant difference for the first third of the time horizon with respect to goal achievement; however, there is for the remaining two-thirds. The difference favors low structure. Under high structure outcomes are 436, but under low structure they progress from 522 to 576 to 627.

Discussion.—Since the results for this pair of patterns are so similar to those for patterns 1 and 2 (and, as will be seen, for patterns 7 and 8 and patterns 9 and 10), discussion of the results is somewhat redundant. After the results of all 6 pairs of patterns are presented, the similarities in these patterns are discussed.

It is worth noting at this point, though, that proposition 2 from the historical perspectives is not supported in either the short or long run. An alternative hypothesis from the proposed theory is as follows:

In the short run, the pattern of factors consisting of certain perceptions, high degree of internal control, stable environmental change process, and high structure leads to higher overall results (including search and switching in addition to goal achievement) than the same pattern of factors having low structure (given the limits of the operationalized theory).
Patterns 5 and 6

**Results.**—In this pair of patterns perceptions are uncertain, the degree of internal control is low, the environmental change process leads to a growing environment, and structure is either low or high. The results indicate a significant difference favoring high structure with respect to searches and switches. No significant difference is indicated with respect to goal achievement for $\alpha = .05$. For $\alpha = .10$ there is a significant difference favoring low structure in the last third of the time horizon. Under high structure outcomes progress from 464 to 490 to 547. Under low structure outcomes progress from 479 to 553 to 621.

**Discussion.**—The amount of search activity (and the variance in it) is greatly increased under low structure for this pair of patterns as compared to all other patterns. It would be interesting to investigate whether this amount of search would be as dramatically increased if maximizing search and choice behavior were prohibited, particularly since the environment is growing and all programs are searched each task cycle under maximizing behavior.

The costs of increased search are not offset by corresponding increases in outcomes achieved. Through growth in the environment the outcomes achieved under high structure are increased. (They cannot be increased as a result of adaptive behavior because the same program of task behavior is chosen each task cycle.) Outcomes under low structure are also increased; however, the resulting
outcomes are not that significantly different from those under high structure. Because of the significant difference in search and switching favoring high structure and the lack of significant difference with respect to goal achievement, the proposed theory suggests the following hypothesis:

In the short run, the pattern of factors consisting of uncertain perceptions, low degree of internal control of outcomes, a growing environmental change process, and high structure leads to higher overall results than the similar pattern having low structure (given the limits of the operationalized theory).

This hypothesis not only does not support proposition 3 (suggesting low structure leads to higher outcomes than high structure given the other factor levels of patterns 5 and 6) derived from the historical perspectives, but it suggests an almost reverse situation.

Such a development could mean one of several things. It could mean that writers in the historical perspectives overestimated the marginal benefits of low structure over high structure when the environment is growing. The natural growth in outcomes under high structure is not surpassed by greater growth in outcomes under low structure. It could mean that prior theoretical frameworks did not allow organizational writers to trace the full implications of a given set of factors. With the proposed framework these implications are now subject to rigorous investigation. It could mean that the operational model is being unduly affected by maximizing search and choice behavior, as noted above. Future research could determine whether or not satisficing and rational search under low
structure lead to similar results.

Patterns 7 and 8

Results.—In these two patterns the environmental change process is stable and structure is either low or high. The results indicate significant differences between low and high structure with respect to the number of searches and the number of switches in programs. These differences favor high structure. With respect to goal achievement the results indicate no significant differences for \( \alpha = .05 \) except during the last third of the time horizon. For \( \alpha = .10 \) the second third is also significant. The differences in goal achievement favor low structure. Under high structure the achievement level remains at 450. For low structure it progresses from 517 to 541 to 568.

Discussion.—As noted above the results for this pair of patterns are similar to those for patterns 1 and 2, 3 and 4, and 9 and 10. A general discussion for these patterns is presented after all results are presented.

It is worth noting, though, that proposition 4 (relative to goal achievement) from the historical perspectives is not supported in this research. An alternative hypothesis from the proposed theory is as follows:

In the short and intermediate run, the pattern of factors consisting of a stable environmental change process and high structure leads to higher overall results than the same pattern having low structure (given the limits of the operationalized theory).
Patterns 9 and 10

Results.—In these two patterns perceptions are certain, the environmental change process is stable, and structure is either low or high. The results indicate significant differences favoring high structure with respect to the number of searches and the number of switches. With respect to goal achievement the results indicate no significant differences for $\alpha = .05$ except during the last third of the time horizon. For $\alpha = .10$ the second third is also significant. The direction of the differences in goal achievement favors low structure. Under high structure outcomes remain at 403. Under low structure they progress from 471 to 504 to 538.

Discussion.—The results for this pair of patterns are similar to those for the other 3 patterns having a stable environmental change process. All of these patterns are discussed at a later point.

It is worth noting at this point, though, that proposition 5 (relative to goal achievement) from the historical perspectives is not supported in this research. An alternative hypothesis from the proposed theory is as follows:

In the short and intermediate run, the pattern of factors consisting of certain perceptions, a stable environmental change process, and high structure leads to higher overall results than the same pattern having low structure (given the limits of the operationalized theory).
Patterns 11 and 12

Results.—In these two patterns the degree of internal control is low, the environmental change process is changing (i.e., growing or declining), and structure is low or high. The results indicate significant differences favoring high structure with respect to the number of searches and the number of switches in programs. With respect to goal achievement the results indicate significant differences for all time periods. These differences favor low structure. Under high structure outcomes are respectively 294, 294, and 300 for periods 1, 2, and 3. Under low structure outcomes are respectively 484, 466, and 469.

Discussion.—The number of searches and switches is similar to that for all other pairs of patterns except patterns 5 and 6. At first glance it is surprising that the number of searches and switches for this pair of patterns having a changing environmental change process is not similar to the number for patterns 5 and 6 having a growing environment. It is not surprising, though, when further thought is given to the reason for the difference. Under patterns 11 and 12 both growing and declining environments are included. Since search is extremely limited in a declining environment, the total number of searches and switches for both growing and declining environments averages to a number similar to that found for stable environments.

The averaging process also prevents outcomes from increasing over time. Notice that they remain relatively stable for both low
and high structure. Although the differences in outcomes favor low structure, it is not possible in this study to state that low structure leads to higher overall results than high structure. The cost of search and switching may not be offset by the higher outcomes obtained under low structure.

The higher outcomes obtained under low structure support proposition 6 from the historical perspectives. Through adaptive behavior the organizational unit under low structure is able to cope with the changing environment and obtain higher outcomes. Under high structure the organizational unit is incapable of adapting and, thus, continues to perform the same program of behavior even if it is obsolete.

**Patterns having stable environments: summary**

**Results.**—Four of the pairs of patterns discussed above have stable environmental change processes. The only factor level specified for patterns 7 and 8 (besides structure) is a stable environmental change process. All other factors are randomly distributed. For patterns 9 and 10 the only additional factor level specified is certain perceptions; therefore, uncertain perceptions do not affect the results for this pair of patterns as they do for patterns 7 and 8. In addition to certain perceptions and a stable environmental change process, patterns 1 and 2 specify a munificent environment. Patterns 3 and 4, instead of specifying a munificent environment, specify high degree of internal control. For these last 2 pairs of patterns the same
results occur. With respect to achievement levels no significant difference ($\alpha = .05$ or $\alpha = .10$) exists between low and high structure for the first third of the time horizon; however, significant differences favoring low structure, occur for the last two-thirds of the time horizon. Likewise, for the first 2 pairs of patterns mentioned above, no significant difference ($\alpha = .05$ or $\alpha = .10$) exists between low and high structure for the first third of the time horizon. For the second third of the time horizon, however, no significant difference exists for $\alpha = .05$, but one does for $\alpha = .10$. For the final third a significant difference ($\alpha = .05$) exists. The differences favor low structure. The results for all 4 pairs of patterns, therefore, are very similar.

Discussion.—A stable environmental change process, by itself, leads to similar results as those obtained when a stable environmental change process is used in conjunction with certain perceptions, or certain perceptions and a munificent environment, or certain perceptions and high degree of internal control. Such results indicate that the factors other than the stable environmental change process contribute little to the results obtained. Other factors, such as the accuracy of perceptions, search and choice behavior, or learning behavior, in conjunction with the stable environmental change process may be more important. Alternately, the stable environmental change process by itself may be most important in contributing to the outcomes obtained. In any case, the factor levels used in this study
in conjunction with the stable environmental change process are not critical when the change process is stable. This finding suggests that future research studies can ignore the degree of certainty in perceptions, the degree of internal control, and the degree of munificence of the environment when the environmental change process is stable (and the other limitations of the operationalized theory are met, e.g., behavior is compliant).

**Patterns having dynamic environments: summary**

**Results.**—In patterns 5 and 6, where the environmental change process leads to growth, the number of searches and switches are much higher than those for patterns 11 and 12, where the environmental change process leads to either growth or decay. With respect to achievement levels, no significant differences ($\alpha = .05$) exist between low and high structure when the environment is growing. When the environment is either growing or declining for the set of organizations observed, significant differences ($\alpha = .05$) exist for all 3 segments of the time horizon. These differences favor low structure.

**Discussion.**—These findings indicate that it is important to determine the kind of environmental change process affecting the organizations under observation. Grouping both growing and declining environments in the same cell causes the results to be confused. Although changing environments lead to significant differences between low and high structure with respect to goal achievement (as found in patterns 11 and 12), the results of patterns 5 and 6 indicate that
changing environments having growth only (as opposed to both growth and decay) do not lead to significant differences.

Concluding comments regarding findings

In all 6 pairs of patterns the number of searches and switches are significantly different for low and high structure. The data indicate that high structure has fewer searches and switches than low structure. The standard deviations under low structure also indicate large differences between organizations. Since maximizing search and choice behavior searches all programs each task cycle, it is possible that organizations exhibiting this kind of behavior are unduly influencing the results under low structure. Future research could investigate this question.

In all but the last pair of patterns the hypothesis, or predictions, from the operationalized theory do not agree with the propositions derived from the historical perspectives. In 4 of the 5 cases of disagreement the environmental change process is stable. Under the 4 historical propositions it is proposed that high structure leads to higher performance outcomes than low structure. Alternative hypotheses have been proposed that are somewhat similar to the historical propositions. (See Figure 18.) Under the alternative hypotheses derived from the operationalized theory, it is proposed that high structure leads to higher overall results than low structure in the short run. In the short run, i.e., in the first third of the time horizon, high structure has fewer searches and switches. High
<table>
<thead>
<tr>
<th>PATTERNS 1 and 2 (Env. change: stable)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Lower performance outcomes</td>
<td>Lower overall results in the short run</td>
</tr>
<tr>
<td>High</td>
<td>Higher performance outcomes</td>
<td>Higher overall results in the short run</td>
</tr>
</tbody>
</table>

<table>
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<th>PATTERNS 3 and 4 (Env. change: stable)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
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<td>Lower performance outcomes</td>
<td>Lower overall results in the short run</td>
</tr>
<tr>
<td>High</td>
<td>Higher performance outcomes</td>
<td>Higher overall results in the short run</td>
</tr>
</tbody>
</table>

<table>
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<th>PATTERNS 5 and 6 (Env. change: growing)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
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</thead>
<tbody>
<tr>
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<td>Higher performance outcomes</td>
<td>Lower overall results in the short run</td>
</tr>
<tr>
<td>High</td>
<td>Lower performance outcomes</td>
<td>Higher overall results in the short run</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>PATTERNS 7 and 8 (Env. change: stable)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Lower performance outcomes</td>
<td>Lower overall results in short and intermediate runs</td>
</tr>
<tr>
<td>High</td>
<td>Higher performance outcomes</td>
<td>Higher overall results in short and intermediate runs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PATTERNS 9 and 10 (Env. change: stable)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Lower performance outcomes</td>
<td>Lower overall results in short and intermediate runs</td>
</tr>
<tr>
<td>High</td>
<td>Higher performance outcomes</td>
<td>Higher overall results in short and intermediate runs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PATTERNS 11 and 12 (Env. change: changing)</th>
<th>Propositions from the Historical Perspectives</th>
<th>Predictions from the Operationalised Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Higher performance outcomes</td>
<td>Lower performance outcomes</td>
</tr>
<tr>
<td>High</td>
<td>Lower performance outcomes</td>
<td>Higher performance outcomes</td>
</tr>
</tbody>
</table>

Fig. 18.—Comparison of Historical Propositions and Theoretical Predictions
structure also leads to performance outcomes that are not significantly different from those obtained under low structure. The hypotheses from the operationalized theory are proposed on the basis of these overall findings rather than on the basis of achievement levels, searches, or switches alone.

In the fifth case the environment is growing, and the results obtained lead to a prediction that basically contradicts the historical proposition. The hypothesis from the theory states that high structure leads to higher overall results than low structure in the short run.

The 4 hypotheses derived with respect to a stable environment are reduced to a single hypothesis as a result of the finding that the stable environmental change process is the critical variable in all of those hypotheses. This hypothesis and the two hypotheses derived with respect to a growing environment and a changing environment are summarized in Figure 19.

In the long run the adaptive mechanisms inherent in low structure lead to higher goal achievement in all pairs of patterns. Whether this higher goal achievement offsets the higher costs of search and switching associated with low structure cannot be answered in this study. It has been suggested above, though, that adaptive mechanisms be built into high structure. The operationalized theory currently does not allow investigation of an adaptive design process.

By extending the operational model to allow learning on the part of designers and include a changing design process, the above suggestion could be investigated.
### Critical Factors

**Hypothesis 1**

1. **Structure**
2. **Environmental change**

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower overall results in short run</td>
<td>Higher overall results in short run</td>
</tr>
</tbody>
</table>

**Hypothesis 2**

1. **Structure**
2. **Perceptions**
3. **Degree of internal control**
4. **Environmental change**

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower overall results in short run</td>
<td>Higher overall results in short run</td>
</tr>
</tbody>
</table>

**Hypothesis 3**

1. **Structure**
2. **Degree of internal control**
3. **Environmental change**

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher performance outcomes</td>
<td>Lower performance outcomes</td>
</tr>
</tbody>
</table>

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*Fig. 19.—Hypotheses (Predictions) from the Operationalized Theory*
CHAPTER 5

SUMMARY AND DIRECTIONS FOR FUTURE RESEARCH

The previous chapters have presented (1) a general theoretical framework for analyzing organizational behavior over time, (2) a limited operationalization of the theory, and (3) an investigation of selected portions of the operationalized theory. In this chapter the theoretical model is reviewed briefly in conjunction with the results of the investigation. The theoretical and practical value of the simulation methodology is also reviewed. Finally, directions for future research are suggested.

Review of the theory and results

Scope of the general theoretical model.--In general, the theoretical model suggests the processes by which organizational variables are related to each other over time. (See Appendix E). Structure and perceptions of the environment are related to a chosen program of task behavior through search and choice behavior. Structure, perceptions, environment, and the environmental change process are inputs to task behavior through the program of task behavior. Task behavior relates all of these factors and the degree of internal control to performance outcomes. Performance outcomes are related to performance evaluations through the performance evaluation process, which itself is related to the structure of the organizational unit. Learning behavior relates
performance evaluations to perceptions of the environment, thus completing the linkages among the factors over time.

This proposed theory is quite flexible and complex. It allows investigation of factors from the structural, contingency, behavioral, and complex perspectives within a common, interdependent framework. For example, the effects of high structure, the primary variable in the structural perspective, can be examined both over time and under various conditions (or contingencies). As another example, the effects of a stable or changing environmental change process in conjunction with either high or low structure can also be analyzed. Not only can these macro-organizational factors found in the structural and contingency perspectives be investigated, but also micro-organizational factors, such as decision behavior and learning behavior, found in the behavioral and complex perspectives can be investigated with them. For example, several kinds of decision behavior can be investigated. Although Cyert and March (1963) suggest that decision behavior is satisficing, this theory suggests that decision behavior may be satisficing, rational, or maximizing. No matter what kind of behavior is actually exhibited, it may be of interest to investigate the effects of the other kinds. All 3 kinds can be easily investigated using the operationalized theory.

Scope of the operationalized theory.—Although the general theoretical model allows a large set of factor levels to be interrelated and investigated over time, the operational model includes only a limited subset of these factor levels. Specifically, the operational model is limited to compliant, consistent decision and task behavior. It is also limited to an organizational design process that leads to stable
structure. The results of this study's investigations of selected patterns of factor levels are applicable only within these limitations, the assumptions cited in Chapter 2, and the assumptions in the experimental design.

**Major implications.**—The results indicate, for one thing, that uncertainty, a currently fashionable variable, does not critically affect outcomes when the environmental change process leads to a stable environment. Using the theory as a tool for explaining this result is instructive. Although perceptions are initially uncertain, learning occurs as outcomes are obtained. Perceptions are revised. Since the environment does not change, perceptions can approach the true potential outcomes associated with the environment.

Another currently fashionable idea is brought into question by the results. Low structure does not lead to higher results than high structure when the environment is growing. In fact, the opposite result was found in the short run. The environmental growth leads to a natural increase in the outcomes associated with high structure. These increased outcomes are not significantly lower than those for low structure. In addition, high structure has fewer searches and switches. These short run results are most interesting given the traditional suppositions.

What is additionally interesting, though, is that the theoretical model provides a rigorous basis for deriving predictions (i.e., hypotheses) regarding various patterns of factors over time. Both short and long run implications can be derived. In this case, low structure has
better adaptive mechanisms (i.e., learning and program switching) that allow low structure to obtain significantly higher performance outcomes in the long run. Whether these higher outcomes offset the higher adaptation costs involved with more searches and switches cannot be answered in this study; however, a practical suggestion does arise. Organizational units in a growing environment can probably achieve higher overall results in both the short and long runs by combining some forms of adaptive mechanisms (e.g., feedback to designers and provision for revised organizational design) with high structure. Or vice versa. Higher overall results can probably be obtained by combining low structure with some form of restricted adaptation, e.g., more constraints on the search and switching of the organizational unit.

A final result indicates another strength of having the general theoretical framework. This result provides evidence that a changing (rather than stable) environmental change process should be identified more specifically as a growing or declining process. Observations on organizational units from each kind of environment should be grouped separately; otherwise, the results become confused. With a growing environment it was found that achievement levels were not significantly different between low and high structure. With a changing environment it was found that low structure obtained higher achievement levels than high structure. The negative effect of the declining environment outweighs the neutral affect of the growing environment and leads to a result that, by itself, is misleading because not all changing environments lead to lower achievement levels under high structure. The
strength of the general theoretical framework is that it allows the different factor levels, both growing and declining environmental change processes, to be represented and results classified accordingly.

**Theoretical and practical value of the simulation methodology**

The simulation methodology used to derive predictions from the general theory was developed specifically for this study. Development of the methodology in conjunction with development of the theoretical model forced concise conceptualization of variables and relationships. The conceptualizations and operationalizations of structure, the environment, perceptions of the environment by both the organizational unit and designers, the environmental change process, and degree of internal control particularly benefited from the necessity to interrelate these factors with decision and task behavior, performance outcomes, and time.

This methodology is ideally suited for the investigation of the complex, integrative, theoretical framework. Implications of specific patterns of factor levels can be traced over time using this methodology. Not only the patterns in this study, but many other patterns can be investigated; thus, the methodology has research value far beyond this study.

The use of simulation as a methodology in this study illustrates two strengths (and weaknesses) of simulation as a research methodology in general. First, it requires a firm conceptual base before it can be used. This requirement forces the researcher to define variables and relationships precisely and to identify underlying assumptions.
Chapters 1 and 2 are evidence of this requirement. Second, it allows the researcher to investigate the implications of a complex, non-transparent set of interdependencies. Chapters 3 and 4 are evidence of such an investigation.

As with any theoretical or simulation model, the results are determined by the modeler. The conceptualization and operationalization of variables and relationships have been presented explicitly to allow others to understand and examine what the modeler has specified, or predetermined. For example, the kinds of search and choice behavior operationalized contain a built-in bias with respect to the extent of search. Maximizing search is more extensive than either rational or satisficing search. It is also more extensive than the trivial search and choice performed under high structure. Obviously, the extent of search under low structure with maximizing behavior will be higher than that under high structure. If all the results of the theoretical model were obvious, the simulation model would not be necessary to derive predictions, or hypotheses. Although some results may be obvious for some combinations of factor levels, results become increasingly obscure particularly when the environment is changing. Even when the environment is stable, the timing of results is obscure. For example, it is not obvious from the operational values of factor levels in the theoretical model that high structure and low structure will have no significant difference in achievement levels in the short run. The simulation model allows the investigation of both the obscure and not-so-obscure.
Besides its value as a research methodology, the simulation methodology developed in this study has value as a basis for developing a tool for practicing managers. It illustrates the fact that simulation of both structural and behavioral factors simultaneously is feasible. Organizations already have simulation models to use as tools in the finance, marketing, and operations research areas. A criticism often leveled at many mathematical models is that they ignore the organizational and behavioral aspects of the situation. Further development of the simulation methodology presented in this study can lead to the inclusion of the structural and behavioral factors in an integrative simulation model.

**Directions for future research**

The suggestions for future research could be numerous. Only 5 directions are suggested: (1) laboratory refinement of operational definitions, (2) expansion of the factor levels operationalized, (3) examination of assumptions, (4) expansion of the theoretical model, and (5) examination of other patterns of factor levels. These directions are not totally independent, but they are separated for discussion purposes.

**Laboratory refinement of operational definitions.**—One of the weaknesses of the simulation methodology is in the operationalizations of relationships. The current operationalizations appear reasonable. In many cases, however, a particular operationalization was chosen because no other operationalization appeared more reasonable. Useful studies would involve the investigation of how subjects in a laboratory relate
variables to each other, such as structure and perceptions to a chosen program of task behavior or performance evaluations to revised perceptions. A note of caution is necessary, however. The laboratory situations must induce the subjects to exhibit various forms of decision or learning behavior. It is presumed that subjects can be induced or trained to exhibit satisficing, rational, or maximizing decision behavior. The notion that only one kind of behavior, e.g., satisficing, is the only kind that can be exhibited is rejected. Likewise, it is presumed that subjects can be induced to exhibit Bayesian or non-Bayesian learning. One value of the theoretical model is that it allows investigation of the implications of alternative forms of behavior. Laboratory studies of the manner in which these alternative forms are manifested allow the operational definitions of these relationships in the simulation model to be strengthened.

Expansion of the factor levels operationalized.—Two particular factor levels that are not currently operationalized should be examined for possible inclusion in the simulation methodology. The easier of the two would involve adaptive behavior by designers thereby leading to a changing organizational design process. Inclusion of this factor level will allow investigation of one of the questions raised in this study, i.e., can more adaptive mechanisms under high structure offset the long run advantage of low structure that results from superior adaptive mechanisms?

The more difficult factor level to operationalize is non-compliant decision behavior. Perhaps constructive, non-compliant behavior under high structure should be an initial attempt. As envisioned, this type
of behavior would not blindly select the prescribed program of task behavior. Instead, it would involve search and choice behavior beyond the prescribed program if perceptions reached a certain point. Underlying assumptions regarding motivations and the reward system would need to be re-examined.

Examination of assumptions.—Not only are the explicit assumptions cited in Chapter 2 inherent in the operationalized theory, but also implicit assumptions are included. These implicit assumptions could be examined to determine their effects. Specifically, 5 areas are presented as potential areas for future investigation.

First, the operationalization of low structure assumes the organizational unit can easily find new programs of task behavior when the environment is expanding and that it is limited by the size of the environment when it is declining. No cost is associated with inventing or finding new programs. This assumption prevented the comparison of overall results (which include searching, switching, and goal achievement) for patterns having low and high structure.

Second, the operationalization of high structure assumes that the organizational unit continues to select the same program of task behavior even in a declining environment where the program becomes deleted from the set of possible programs. A related assumption is that the organizational designers continue to prescribe an obsolete program of task behavior. While such behavior may be representative of the real world, these assumptions should be more thoroughly examined.
Third, the operational theory assumes that the levels of potential goal achievement are independent of the kind of structure and that the kind of goal is irrelevant. Practitioners may be particularly interested in how revenues, costs, and satisfaction are related for various programs of task behavior and for various prescribed structures. The complex area of designing jobs and meeting environmental demands could be of help in investigating this assumption.

Fourth, the operational definition of environmental change assumes a gradually increasing or decreasing environment both in terms of the number of components and the degree of munificance. An investigation of alternative assumptions could be beneficial. For example, it would be interesting to know the result of a rapidly increasing or decreasing environment.

Finally, the assumption is made in the investigation of the 6 pairs of patterns that all factors other than the critical ones in a pair of patterns are randomly distributed to all organizations. Alternative distributions of factors are possible. It would be of interest to investigate empirical distributions of these factors among large groups of organizations.

Expansion of the theoretical model.—Two particular areas of expansion are noted. First, the organizational design process could be expanded to explain the process by which structure is determined. In the current model the only input to the design process is the designers' perceptions of the environment. The only manner in which these perceptions can be revised is through feedback on performance. Other information sources and other factors affecting design could be identified.
This expansion could then be used to guide the operationalization of an organizational design process that leads to a changing structure.

The second area of expansion relates to interactions among organizational units. One organizational unit is described in the theoretical model proposed in this study. The inclusion of another organizational unit, while probably quite difficult to develop, would be extremely interesting in its results and potential applications.

Examination of other patterns of factor levels.—As a final suggestion, future studies could investigate patterns of factor levels other than those investigated in this study. The propositions from the behavioral perspective suggest some patterns that may be fruitful to investigate. The results of this study suggest that patterns having low structure but excluding maximizing behavior would be interesting to compare with patterns having high structure. Finally, the investigation of seemingly non-existent patterns may be worth investigating. For example, maximizing behavior is considered to be non-existent by many writers. Even so, it is interesting to investigate both patterns having and patterns not having maximizing behavior. Such investigations may lead to insights regarding why such behavior is not exhibited or what tradeoffs are involved in attempting to get the organizational unit to exhibit such behavior.

Concluding comments

The study and results illustrate three specific contributions associated with development of the proposed theoretical framework:

(1) multiple values of variables and forms of relationships can be
rigorously investigated over time within a complex, interdependent framework of structural and behavioral factors, (2) the framework can be used to classify and compare research on organizational units under various conditions, and (3) it provides a basis for classifying the results of past and future research and clarifying inconsistencies in past research. (This last point follows from the first two.)
APPENDIX A

LIMITED OPERATIONAL MODEL OF THE GENERAL THEORY
IN THE FORM OF COMPUTER PROGRAMS

LIST OF PROGRAMS

1. **MAIN** — CONTROLS INPUT/OUTPUT OPERATIONS AND THE
   MAJOR FLOW OF THE MODEL
2. **DBGCON** — CHECK DEBUG CODE
3. **OUTVWS** — OUTPUT OPTIONAL INFORMATION FOR VIEWING
4. **LCCOUNT** — LINE COUNTER FOR CONTROLLING SPACING
5. **COMSTD** — COMPUTE STANDARD INFORMATION AND OUTPUT IT
6. **INTEV** — INITIATE THE ENVIRONMENT
7. **INTEP** — INITIATE STRUCTURE AND PERCEPTIONS
8. **INTES** — INITIATE THE EVOKED SET
9. **SRCCHC** — SEARCH AND CHOICE BEHAVIOR
10. **TASKR** — TASK BEHAVIOR
11. **PEREV** — PERFORMANCE EVALUATION PROCESS
12. **LRNB** — LEARNING BEHAVIOR
13. **ENVCH** — ENVIRONMENTAL CHANGE PROCESS
14. **ADDEL** — ADD OR DELETE PERCEPTIONS FOR PROGRAMS
   ADDED OR DELETED
15. **IRANU** — GENERATE A RANDOM INTEGER FROM A UNIFORM
   DISTRIBUTION
16. **GAUSS** — GENERATE A RANDOM NUMBER FROM A NORMAL
   DISTRIBUTION
17. **RANDL** — GENERATE A RANDOM NUMBER FROM A UNIFORM
   DISTRIBUTION OVER THE RANGE 0-1
18. **CNPR** — COMPUTE THE NUMBER OF PROGRAMS
19. **RANVEC** — GENERATE A VECTOR OF RANDOM INTEGERS OVER
   THE RANGE 1-N WITH NO REPEATS
20. **SETMPO** — SET THE VALUES IN THE MATRIX OF POTENTIAL
   OUTCOMES
21. **OUTENV** — OUTPUT INFORMATION ABOUT THE ENVIRONMENT
22. **EKROUT** — OUTPUT ERROR MESSAGES
23. **CKVSP** — CHECK THE VECTOR OF INPUT INFORMATION ON
   STRUCTURE AND PERCEPTIONS
24. **GNPERC** — GENERATE PERCEPTIONS
25. **RANCHG** — RANDOMLY CHANGE THE SET OF PROGRAMS

OVERVIEW OF PROGRAM STRUCTURE

THE ENTIRE PROGRAM IS DESIGNED TO SIMULATE

ORGANIZATIONAL BEHAVIOR OVER TASK CYCLES. THE RESEARCHER

SPECIFIES THE KIND OF ORGANIZATIONAL BEHAVIOR HE/SHE WISHES

TO SIMULATE BY SPECIFYING VARIOUS FACTOR LEVELS. (SEE
APPENDIX C FOR A LIST OF THE FACTORS AND THEIR ASSOCIATED
LEVELS.)

THE PROGRAM HAS TWO MAJOR KINDS OF SUBROUTINES:

1. INITIALIZING FACTOR LEVELS, E.G., ENVIRONMENT,
   STRUCTURE, AND PERCEPTIONS, AND

2. RUNNING THROUGH TASK CYCLES.

THESE SUBROUTINES USE THE FACTOR LEVELS AS SPECIFIED BY THE
RESEARCHER TO GENERATE PERFORMANCE OUTCOMES OVER AS MANY
TASK CYCLES AS SPECIFIED (720 MAXIMUM).

THE MAJOR SUBROUTINES CALLED BY THE MAIN PROGRAM ARE AS
FOLLOWS:

1. INITIALIZING
   A. INITIALIZE THE ENVIRONMENT
   B. INITIALIZE STRUCTURE AND PERCEPTIONS
   C. INITIALIZE THE EVOKED SET OF ALTERNATIVES

2. RUNNING THROUGH TASK CYCLES
   A. SEARCH AND CHOICE BEHAVIOR
   B. TASK BEHAVIOR
   C. PERFORMANCE EVALUATION PROCESS
   D. LEARNING BEHAVIOR
   E. ENVIRONMENTAL CHANGE PROCESS

THE OTHER SUBROUTINES ARE CALLED BY EITHER THE MAIN PROGRAM
OR THESE MAJOR SUBROUTINES TO ASSIST IN COMPLETION OF THESE
MAJOR FUNCTIONS OR TO PERFORM INPUT/OUTPUT OPERATIONS.
INTEGER DRCSPC, TCYCL, OUTCD, VPRG, SIZENV, PRESCP
INTEGER EVOKEU, PCHOSE, PROCT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRCTOUT
REAL MPPO, PROEPG, CONASP, GOALWT, MPERC, MOUTCH
REAL MPEVAL, LCMBPO
INTEGER TN, TRUNS, SCODE, CURRUN, I, J, SUBID1, SUBID2
INTEGER NUMDBG, GENW1, NUMVW1, GENW2, NUMVW2, TCNPOP
INTEGER TP1OUT, TP2OUT, PUNCH, 11N, 1OUT, IRAND, N, TP3OUT
INTEGER DEGTC(5,2), IDVW1(5), IDVW2(30), KUNIT(44)
INTEGER SUMSRC(4), SUMSWC(4)
INTEGER NI, TOTAL, JMIN, JMAX, ITEMP1
REAL MEAN, MN(4), VAR(4), TEMP1
INTEGER CYC1, CYC3, CARRC1, CARRC2, PCOUNT
REAL SSC(4)
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
1 SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
2 SEED15
COMMON /CRGSPC(20), TCYCL, CUTCD(5), VPRG(300), MPF(300, 3)
COMMON SIZENV, PROEPG(3), CONASP(3, 2), GOALWT(3),
IMPERC(300, 4), PRESCP, EVOKEU(7), PCHOSE(720), PROCT,
2MOUTC(720, 3), MPEVAL(720, 3), LCMBPO(720), LTCEVL(7), ID,
3NUMSRC(720), SWITCH(720), PRTOUT
COMMON /SVSDS/ SAVSDS(15)
REAL SAVSLS
INTEGER ZERO, ONE
DATA ZERO, ONE/0, 1/
DATA SUBID1, SUBID2/0, 10/
IN = 5
2 READ(IN, 1000) (RUNID(I), I = 1, 44)
READ(IN, 1010) (NUMBGE, (IDEGTC(I, J), J = 1, 2), I = 1, 5),
1 IN, TRUNS, SCODE, (OUTCD(I), I = 1, 5),
2 NUMDBG, ((IDEGTC(I, J), J = 1, 2), I = 1, 5),
3 GENW1, NUMVW1, GENW2, NUMVW2,
4 TCNPOP, TP1OUT, TP2OUT, PRTOUT, LIN,
5 PUNCH
READ(IN, 1020) (IDVW1(I), I = 1, 5), (IDVW2(I), I = 1, 30)
READ(IN, 1025) CARRC1, CARRC2, PCOUNT, NAPRT, TP3OUT
READ(IN, 1027) SEED1, SEED2, SEED3, SEED4, SEED5,
1 SEED6, SEED7, SEED8, SEED9, SEED10,
2 SEED11, SEED12, SEED13, SEED14, SEED15
SAVSDS(1) = SEED1
SAVSDS(2) = SEED2
IF (GENW1 .NE. 1) GO TO 5
DO 4 I = 1, NUMW1
CALL IRANN(SEED1, I, TRUNS, IRAND)
4 IDVW1(I) = IRAND
5 IF (GENW2 .NE. 1) GO TO 10
DO 7 I = 1, NUMW2
CALL IRANN(SEED2, I, TRUNS, IRAND)
7 IDVW2(I) = IRAND
10 CONTINUE
16 CONTINUE
IF (PUNCH.EQ.0) GO TO 18
WRITE(PUNCH,2001) (RUNID(I),I=1,44)
18 WRITE(PRTOUT,2000) (RUNID(I),I=1,44)
WRITE(PRTOUT,2005)
WRITE(PRTOUT,2010) TN, TRUNS, SCODE
WRITE(PRTOUT,2015) (OUTCD(I),I=1,5), TP1OUT,
WRITE(PRTOUT,2020) TP2OUT, PRTOUT
WRITE(PRTOUT,2025) IIN, TCMPOP, NUMDBG, PUNCH
WRITE(PRTOUT,2030) GENVW1, NUMVW1, GENVW2, NUMVW2
WRITE(PRTOUT,2035) ICVW1(I), I=1, NUMVW1
WRITE(PRTOUT,2040) IDVW2(I), I=1, NUMVW2
WRITE(PRTOUT,2045) CARRC1, CARRC2, PCOUNT
WRITE(PRTOUT,2050) SAVSDS(1), SAVSDS(2), SEED3,
1 SEED4, SEED5, SEED6, SEED7, SEED8, SEED9, SEED10,
2 SEED11, SEED12, SEED13, SEED14, SEED15
IF(SCODE.EQ.0) GO TO 60
20 CURRUN = SCODE
N = CURRUN - 1
IF (OUTCD(2).EQ.1) GO TO 35
READ(TP2OUT,1029) (SAVSOS(J), J=1,15)
SEED1 = SAVSDS(1)
SEED2 = SAVSDS(2)
SEED3 = SAVSDS(3)
SEED4 = SAVSDS(4)
SEED5 = SAVSDS(5)
SEED6 = SAVSDS(6)
SEED7 = SAVSDS(7)
SEED8 = SAVSDS(8)
SEED9 = SAVSDS(9)
SEED10 = SAVSDS(10)
SEED11 = SAVSDS(11)
SEED12 = SAVSDS(12)
SEED13 = SAVSDS(13)
SEED14 = SAVSDS(14)
SEED15 = SAVSDS(15)
REWIND TP2OUT
35 CONTINUE
DO 40 J=1,N
READ(IIN,1030) ID,(GPGSPC(I), I=1,20)
40 CONTINUE
IF (ID.EQ.N) GO TO 80
40 CONTINUE
GO TO 80
60 CURRUN = 1
80 IF(CURRUN.GT.TRUNS) GO TO 990
CARRC1 = 54
CARRC2 = 54
PRESPC = 0
PROGT = 0
DO 82 I=1,720
PCHOOSE(I) = 0
NUMSRC(I) = 0
SWITCH(I) = 0
LCMBPO(I) = 0.00
DO 81 J=1,3
   MDOUTCM(I,J) = 0.00
   MPEVAL(I,J) = 0.00
81 CONTINUE
82 CONTINUE
DO 86 I=1,360
   VFKG(1) = 0
   DO 84 J=1,3
      MP0(I,J) = 0.00
      MPERC(I,J) = 0.00
84 CONTINUE
   MPERC(I,4) = 0.00
86 CONTINUE
DO 88 I=1,3
   PROBPC(I) = 0.00
   GOALWT(I) = 0.00
   CONASPI(I,1) = 0.00
   CONASPI(I,2) = 0.00
88 CONTINUE
DO 90 I=1,7
   FVOKEO(I) = 0
   LTCEVL(I) = 0
90 CONTINUE
IF (NUMVW1.EQ.0) GO TO 97
DO 95 I=1,NUMVW1
   IF (IDVW1(I),EQ,CURRUN) GO TO 102
95 CONTINUE
97 OUTCD(3) = 0
IF (NUMVW2.EQ.0) GO TO 101
DO 100 I=1,NUMVW2
   IF (IDVW2(I),EQ,CURRUN) GO TO 104
100 CONTINUE
101 OUTCD(4) = 0
GO TO 106
102 OUTCD(3) = 1
OUTCD(4) = 0
GO TO 106
104 OUTCD(4) = 1
106 CONTINUE
TCYCL = 0
CALL DBGCD(MOUTCD(1),NUMDBG,D6GTC,TCYCL)
READ(IN,1030) ID, (ORGSPC(T), T=1,20)
SAVE(3) = SEED3
SAVE(4) = SEED4
SAVE(5) = SEED5
SAVE(6) = SEED6
SAVE(7) = SEED7
SAVE(8) = SEED8
SAVSOS(9) = SEEL9
SAVSOS(10) = SEED10
SAVSOS(11) = SEEL11
SAVSOS(12) = SEED12
SAVSOS(13) = SEEL13
SAVSOS(14) = SEED14
SAVSOS(15) = SEEL15
IF (OUTCD(1).EQ.0) GO TO 110
WRITE(PRTOUT,2100) ID, TCYCL, SUBID1
WRITE(PRTOUT,2105) (ORGSPC(I), 1=1,18)

110 CALL INT E
    CALL INT S P
    IF (ORGSPC(4).EQ.2) GO TO 120
    CALL INT E S

120 IF (((OUTCD(3).EQ.1).OR.(OUTCD(4).EQ.1))GO TO 122
    GO TO 126

122 IOUT = PRTOUT
    IF (NOPRT.EQ.0) GO TO 123
    I = 1
    CALL OUTVWS(1,IOUT,CARRC1,TCP0P,PCOUNT,TN)
123 CONTINUE
    IF (OUTCD(2).EQ.1) GO TO 126
    IOUT = TPIOUT
    I = 1
    CALL OUTVWS(1,IOUT,CARRC2,TCP0P,PCOUNT,TN)

126 TCYCL = 1
130 CALL DEGCDT(OUTCD(1),NUMBG,DEGC,TCYCL)
    IF (OUTCD(3).EQ.1) GO TO 132
    GO TO 136

132 IOUT = PRTOUT
    IF (NOPRT.EQ.0) GO TO 133
    I = 2
    CALL OUTVWS(1,IOUT,CARRC1,TCP0P,PCOUNT,TN)
133 CONTINUE
    IF (OUTCD(2).EQ.1) GO TO 136
    IOUT = TPIOUT
    I = 2
    CALL OUTVWS(1,IOUT,CARRC2,TCP0P,PCOUNT,TN)

136 CALL SRCHC
    CALL TASK E
    CALL P R E V
    CALL L R N B
    TCYCL = TCYCL + 1
    IF (TCYCL.EQ.TN) GO TO 160
160 CALL ENVCH
    GO TO 130

500 IF (OUTCD(1).EQ.1) GO TO 502
    GO TO 510

502 WRITE(PRTOUT,2200) ID, TCYCL, SUBID2
    IOUT = PRTOUT
    I = 3
CARRC1 = CNF
CALL OUTVWS(1, IOUT, CARRC1,ONE,ZERO, TN)
WRITE(PRTOUT, 2215) TN
CYC1 = -2
CYC3 = 0
CYC1 = CYC1 + 3
CYC3 = CYC3 + 3
IF (CYC1.GT.TN) GO TO 506
IF (CYC3.GT.TN) CYC3 = TN
WRITE(PRTOUT, 2220) CYC1, CYC3, ((MOUTCM(I, J), J=1, 3),
1=CYC1, CYC3)
GO TO 504
504 WRITE(PRTOUT, 2225) TN
CYC1 = -2
CYC3 = 0
CYC1 = CYC1 + 3
CYC3 = CYC3 + 3
IF (CYC1.GT.TN) GO TO 510
IF (CYC3.GT.TN) CYC3 = TN
WRITE(PRTOUT, 2220) CYC1, CYC3, ((MPEVAL(I, J), J=1, 3),
1=CYC1, CYC3)
GO TO 508
508 CONTINUE
506 WRITE(PRTOUT, 2225) TN
CYC1 = -2
CYC3 = 0
CYC1 = CYC1 + 3
CYC3 = CYC3 + 3
IF (CYC1.GT.TN) GO TO 510
IF (CYC3.GT.TN) CYC3 = TN
WRITE(PRTOUT, 2220) CYC1, CYC3, ((MPEVAL(I, J), J=1, 3),
1=CYC1, CYC3)
GO TO 508
508 CONTINUE
510 IF ((OUTCD(3),EQ.1).OR.((OUTCD(4),EQ.1))GO TO 522
GO TO 530
522 IOUT = PRTOUT
IF (NOTRT.EQ.0) GO TO 523
I = 3
CALL OUTVWS (1, IOUT, CARRC1, TCMP0P, PCOUNT, TN)
523 CONTINUE
IF (OUTCD(2).EQ.1) GO TO 530
IOUT = TP1OUT
I = 3
CALL OUTVWS (1, IOUT, CARRC2, TCMP0P, PCOUNT, TN)
530 IF (OUTCD(2).EQ.1) GO TO 535
IF (OUTCD(5).NE.1) GO TO 535
IOUT = TP2OUT
GO TO 540
535 IF (OUTCD(1).EQ.1) GO TO 537
GO TO 590
537 IOUT = PRTOUT
GO TO 545
540 IF (OUTCD(1).EQ.1) IOUT = PRTOUT
545 CONTINUE
CALL COMSTD(TN, IOUT, NUMSPC, SWITCH, LCMBPO, ID, ORGSPC, PRTOUT, PUNCH)
590 CURRUN = CURRUN + 1
GO TO 80
990 IF (OUTCD(2).EQ.1) GO TO 998
WRITE(TP3OUT, 2902) SAVSDS(1), SAVSGS(2), SEED3,
1 SEED4, SEED5, SEED6, SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14, SEED15
189

1000 FORMAT(44A1)
1010 FORMAT(3(I4,1X),5I1,1X,1I,10I3,E(I4,11),1X,12,
1 1X,13,4(1X,12),12)
1020 FORMAT(212,14,212)
1025 FORMAT(8F10.0)
1028 FORMAT(116X,15,12X)
1029 FORMAT(8F10.0,53X)
1030 FORMAT(9X,15,1X,2012)
2000 FORMAT(IHI,15X,15HSIMULATION RUN, 44A1,41X,5H00000,8X,1
4H0000)
2001 FORMAT(I5X,15HSIMULATION RUN, 44A1,1X,5H00000)
2005 FORMAT(16X,24H**CONTROL PARAMETERS** 9EX)
2010 FORMAT(20X,12H TASK CYCLES, 13,13H TOTAL RUNS, 14,
1 13H START CODE, 14,64X)
2015 FORMAT(20X,10H OUTCD(1-5),5I2,6H; TP1OUT, 13,8H; TP2OUT,
1 13,8H; PRTOUT, 13,60X)
2020 FORMAT(20X,3H IF.15X,13,8H; TEMPOT, 14,8H; NUMCG, 12,
1 7H; PUNCH, 13,75X)
2025 FORMAT(20X,5H DBUGIC, 5(1X,214),63X)
2030 FORMAT(20X,6H EENVW1,12,8H; NUMVW1,12,8H; EENVW2,12,
1 8H; NUMVW2,12,74X)
2035 FORMAT(20X,5H IDVW1,515,78X)
2040 FORMAT(20X,5H IDVW2,10I5,58X)
2045 FORMAT(20X,6HCARRC1,13,6H; CARRC2,13,6H; PCOUNT,15,
1 80X)
2050 FORMAT(20X,5HCARRC2,5F10.0,53X)
2100 FORMAT(16X,14,14H TASK CYCLE, 13,14H SUBROUTINE ,
1 12,80X)
2105 FORMAT(21X,10I3,5EX)
2200 FORMAT(16X,14,3X,11HTASK CYCLE, 13,
1 14H SUBROUTINE, 12,60X)
2215 FORMAT(23X,11HTASK CYCLE, 13,3X,12H PERFORMANCE ,
1 19H OUTCOMES (CYCLE), 62X)
2220 FORMAT(20X,13,1H, 13,3(1X,5F5.2),58X)
2225 FORMAT(23X,11HTASK CYCLE, 13,3X,16H PERF. EVALUATIONS ,
1 10H (CYCLE), 65X)
2900 FORMAT(1H1,15X,15H ** END OF RUN, 44A1,41X,5H99995,8X,1
4H401)
2901 FORMAT(15X,15H ** END OF RUN, 44A1,1X,5H99995)
2902 FORMAT(8F10.0,53X)
END
SUBROUTINE DBGCDE(OUTCD, NUMDBG, DBGTC, TCYCL)
INTEGER OUTCD(5), NUMDBG, DBGTC(5,2), TCYCL
IF (NUMDBG .EQ. 0) GO TO 20
DO 10 I = 1, NUMDBG
1 IF ((DBGTC(I,1) .LE. TCYCL) .AND. 
     (TCYCL .LE. DBGTC(I,2))) GO TO 20
10 CONTINUE
20 OUTCD(1) = 0
RETURN
30 OUTCD(1) = 1
RETURN
END
SUBROUTINE OUTVWS(1, IOUT, CAARC, TCMPOP, PCOUNT, TN)
INTEGER ORGSPC, TCYCL, OUTCD, VPROC, SIZENV, PRESCP
INTEGER EVOKED, PCHOSE, PROCT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPO, PROEPG, CONASP, GOALWT, MPEVAL, MOUTH
REAL MPO, PROEPG, CONASP, GOALWT, MPEVAL, MOUTH
COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROC(300), SIZENV, PRESCP,
COMMON SIZENV, PROEPG(3), CONASP(3,2), GOALWT(3),
MPEVAL(300,4), PRESCP, EVOKED(7), PCHOSE(720), PROCT,
2MOUTCM(720,3), MPEVAL(720,3), LCMP0U(720), LTCEVL(7), ID,
3NUMSRC(720), SWITCH(720), PRTOUT,
INTEGER 1, IOUT, CAARC, TCMPOP, PCOUNT, J, II, ID, TN
INTEGER IMAX, ITEMP, CYCL, CYCO, PRG1, PRG2, PRG3, CCONT
INTEGER IZERO(IO), NUMZRO
REAL PC00, PR0EPG(720), GOALWT, MPEVAL, LCM0P0
COMMON / SVDSPS / SAVSDS(15)
DATA IZEP.O, FZERO /10*0, 10*0.00/
G C (1 TO (100,200,300), I'
100 CONTINUE
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2000) CCONT, ID, TN, ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2005) CCONT,(ORGSPC(1),1=1,18), ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2006) CCONT,(SAVSDS(1), I=1,5), ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2007) CCONT,(SAVSDS(1), I=6,10), ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2008) CCONT,(SAVSDS(1), I=11,15), ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2010) CCONT,(CONASP(1,J), J=1,2), I=1,3), ID
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2015) CCONT, (GOALWT(1), I=1,2), ID
RETURN
200 CONTINUE
IF(TCYCL.EQ.1) GO TO 210
IF(LTCEVL(1).NE.0) GO TO 220
205 ITEMP = TCYCL / TCMPOP
ITEMP = TCMPOP * ITEMP
IF(ITEMP.NE.TCYCL) RETURN
GO TO 240
210 CONTINUE
CALL LCOUNT(CARRC, CCONT, PCOUNT, PRTOUT)
WRITE(IOUT,2100) CCONT, TCYCL, ID
PRG1 = -1
PRG2 = 0
PRG1 = PRG1 + 2
PRG2 = PRG2 + 2
IF (PRG1.GT.SIZENV) GO TO 216
IF (PRG2.GT.SIZENV) PRG2 = SIZENV
NUMZRO = 4*(2-(PRG2-PRG1+1)) + 1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2105) CCONT,PRG1,PRG2,(MPERC(I,J),
J=1,4),J=PRG1,PRG2),
(FZERO(I),I=1,NUMZRO),ID
GO TO 212

GO TO 240
CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2105) CCONT,TCYCL,ID
IMAX = LTCEVL(I)+1
I = 2
CONTINUE
IF (I.GT.IMAX) GO TO 230
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
J = LTCEVL(I)
11 = PCHOSE(J)
IF (I+1.GT.IMAX) GO TO 226
J = LTCEVL(I+1)
12 = PCHOSE(J)
WRITE(IOUT,2105) CCONT,11,12,(MPERC(11,J),J=1,4),
(FZERO(I),J=1,4),ID
I = I + 2
GO TO 222

GO TO 226
WRITE(IOUT,2105) CCONT,11,12,(MPERC(11,J),J=1,4),
(FZERO(I),J=1,5),ID
GO TO 245
CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2110) CCONT,TCYCL,ID
PRG1 = -2
PRG3 = 0
PRG1 = PRG1 + 3
PRG3 = PRG3 + 3
IF (PRG1.GT.SIZENV) GO TO 260
IF (PRG3.GT.SIZENV) PRG3 = SIZENV
NUMZRO = 3*(3-(PRG3-PRG1+1)) + 1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2115) CCONT,PRG1,PRG3,(MPO(I,J),J=1,3),
1 = PRG1,PRG3),
(FZERO(I),I=1,NUMZRO),ID
GO TO 245

RETURN
CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2200) CCONT,TCYCL,ID
PRG1 = -2
PRG3 = 0
PRG1 = PRG1 + 3
PRG3 = PRG3 + 3
IF (PRG1.GT.SIZENV) GO TO 310
IF (PRG3.GT.SIZENV) PRG3 = SIZENV
NUMZRO = 3*(3-(PRG3-PRG1+1)) + 1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2205) CCNT,PRG1,PRG3,((IMP(J,1),J=1,3),
1 I=PRG1,PRG3),
2 (FZER0(I),I=1,NUMZRO),ID
GO TO 305
310 CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2215) CCNT,TCYCL,ID
PRG1 = -1
PRG2 = 0
315 PRG1 = PRG1 + 2
PRG2 = PRG2 + 2
IF (PRG1.GT.SIZENV) GO TO 350
IF (PRG2.GT.SIZENV) PRG2 = SIZENV
NUMZRO = 4*(2-(PRG2-PRG1+1)) + 1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2215) CCNT,PRG1,PRG2,((MPF(I,J),J=1,4),
1 I=PRG1,PRG2),
2 (FZER0(I),I=1,NUMZRO),ID
GO TO 315
350 CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2305) CCNT,TN,ID
CYC1 = -8
CYC9 = 0
355 CYC1 = CYC1 + 9
CYC9 = CYC9 + 9
IF (CYC1.GT.TN) GO TO 360
IF (CYC9.GT.TN) CYC9 = TN
NUMZRO = 9 - CYC9 + CYC1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2305) CCNT,CYC1,CYC9,(PCHOSE(I),
1 I=CYC1,CYC9),
2 (IZERO(I),I=1,NUMZRO),ID
GO TO 355
360 CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2310) CCNT,TN,ID
CYC1 = -8
CYC9 = 0
365 CYC1 = CYC1 + 9
CYC9 = CYC9 + 9
IF (CYC1.GT.TN) GO TO 370
IF (CYC9.GT.TN) CYC9 = TN
NUMZRO = 9 - CYC9 + CYC1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2315) CCNT,CYC1,CYC9,(SWITCH(I),
1 I=CYC1,CYC9),
2 (IZERO(I),I=1,NUMZRO),ID
GO TO 365
370 CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2320) CCONT, TN, ID
CYC1 = -8
CYC9 = 0
375 CYC1 = CYC1 + 9
CYC9 = CYC9 + 9
IF (CYC1.GT.TN) GO TO 580
IF (CYC9.GT.TN) CYC9 = TN
NUMZRO = 9 - CYC9 + CYC1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2325) CCONT, CYC1, CYC9, (NUMSRC(I),
1 I=CYC1,CYC9),
2 (IZERO(I),I=1,NUMZRO),ID
GO TO 375
380 CONTINUE
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2320) CCONT, TN, ID
CYC1 = -8
CYC9 = 0
385 CYC1 = CYC1 + 9
CYC9 = CYC9 + 9
IF (CYC1.GT.TN) GO TO 390
IF (CYC9.GT.TN) CYC9 = TN
NUMZRO = 9 - CYC9 + CYC1
CALL LCOUNT(CARRC,CCONT,PCOUNT,PRTOUT)
WRITE(IOUT,2335) CCONT, CYC1, CYC9, (LCMPRO(I),
1 I=CYC1,CYC9),
2 (FZERO(I),I=1,NUMZRO),ID
GO TO 385
390 RETURN
2000 FORMAT(A1,15X,I4,3X,I3,18H TOTAL TASK CYCLES,6X,
1 1 19HORG. SPECIFICATIONS,47X,I4,9X,4H0100)
2005 FORMAT(A1,20X,18I3,41X,I4,9X,4H0111)
2006 FORMAT(A1,19X,5HSEEDS,5F10.0,41X,I4,9X,4H0121)
2007 FORMAT(A1,19X,5ESEEDS,5F10.0,41X,I4,9X,4H0131)
2008 FORMAT(A1,19X,5HSEEDS,5F10.0,41X,I4,9X,4H0141)
2010 FORMAT(A1,19X,IIHASP. GL 1 ,2F5.2,41X,I4,9X,4H0201)
2015 FORMAT(A1,19X,15HWEIGHTS GOAL 1 ,F6.3,5X,6HGOAL 2 ,
1 F6.5,5X,6HGOAL 3 ,F6.3,41X,I4,9X,4H0301)
2100 FORMAT(A1,22X,IIHTASK CYCLE ,15,3X,15HPERCEPTIONS AT ,
1 1 10HTHIS POINT,51X,I4,9X,4H0401)
2105 FORMAT(A1,19X,13,1H,13,2X,4F5.2,3X,4F5.2,41X,
1 F3.0,14,9X,4H0411)
2110 FORMAT(A1,22X,IIHTASK CYCLE ,13,3X,10HPOTENTIAL ,
1 1 22HOUTCOMES AT THIS POINT,44X,I4,9X,4H0501)
2115 FORMAT(A1,19X,13,1H-,13,3(1X,3F5.2),38X,
1 F3.0,14,9X,4H0511)
2200 FORMAT(A1,22X,IIHTASK CYCLE ,13,3X,10HPOTENTIAL ,
1 1 22HOUTCOMES AT THIS POINT,44X,I4,9X,4H0601)
2205 FORMAT(A1,19X,IIH-,13,3(1X,3F5.2),38X,
1 F3.0,14,9X,4H0611)
2210 FORMAT(A1,22X,11HTASK CYCLE,13,3X,15HPERCEPTIONS AT
1 10MTHIS POINT,51X,14,9X,4H0701)
2215 FORMAT(A1,19X,13,1H-,15,2X,4F5.2,3X,4F5.2,41X,
1 F3.0,14,9X,4H0711)
2300 FORMAT(A1,22X,13,18H TOTAL TASK CYCLES,5X,9HPROGRAMS
1 17HCHOSEN (BY CYCLE),41X,14,9X,4H0801)
2305 FORMAT(A1,19X,13,1H-,13,2X,915,39X,
1 13,14,9X,4H0811)
2310 FORMAT(A1,22X,13,18H TOTAL TASK CYCLES,6X,9HPROGRAM
1 17HSWITCHES BY CYCLE,41X,14,9X,4H0901)
2315 FORMAT(A1,19X,13,1H-,13,2X,915,39X,
1 13,14,9X,4H0911)
2320 FORMAT(A1,22X,13,18H TOTAL TASK CYCLES,5X,7HNO. OF
1 19HSEARCHES EACH CYCLE,41X,14,9X,4H1001)
2325 FORMAT(A1,19X,13,1H-,13,2X,915,39X,
1 13,14,9X,4H1011)
2330 FORMAT(A1,22X,13,18H TOTAL TASK CYCLES,7X,9HWEIGHTED
1 17HCOMB. OF OUTCOMES,41X,14,9X,4H1101)
2335 FORMAT(A1,19X,13,1H-,13,2X,4F5.2,3X,4F5.2
1 F3.0,14,9X,4H1111)
END
SUBROUTINE LCOUNT(CARRC, CCONT, PCOUNT, PRTOU1)
INTEGER CARRC, CCONT, PCOUNT, PRTOU1, BLANK
INTEGER ONE
DATA ONE /1H1/
DATA BLANK /1H /

10 CONTINUE
RETURN

11 CONTINUE
CARRC = CARRC + 1
IF (CARRC.GT.54) GO TO 15
CCONT = BLANK
GO TO 20

15 CCONT = ONE
CARRC = 1

20 IF (CCONT.NE.ONE) RETURN
IF (PCOUNT.EQ.0) RETURN
WRITE(PRTOU1,2000) PCOUNT
WRITE(PRTOU1,2005)
CCONT = BLANK
CARRC = 3
PCOUNT = PCOUNT + 1
RETURN

2000 FORMAT(1H1,70X,14,58X)
2005 FORMAT(133X)
END
SUBROUTINE COMSTD(TN, IOUT, NMSRC, SWITCH, LCMBPO,
      1 ID, ORGSPC, PRTOU, PUNCH)
INTEGER SUMSRC(4), SUMSWC(4), NMSRC(720), SWITCH(720)
INTEGER N1, TN, TOTAL, IOUT, I, JMIN, JMAX, ID, ORGSPC(20)
INTEGER PRTOU, PUNCH
REAL LCMBPO(720), STD(4), MEAN(4)
DOUBLE PRECISION MN(4), VAR(4), SSQ(4), TEMPI
COMMON / SVSDS / SAVSDS(15)
REAL SAVSDS

545 N1 = TN / 3
TOTAL = N1 + N1 + N1
IF (TN.EQ. TOTAL) GO TO 550
WRITE(PRTOU, 2400) N1

550 CONTINUE
DO 552 I=1,4
SUMSRC(I) = 0
SUMSWC(I) = 0
MN(I) = 0.0
VAR(I) = 0.0
SSQ(I) = 0.0

552 CONTINUE
DO 560 J=1,3
JMIN = N1 * (J-1) + 1
JMAX = N1 + J
DO 554 J=JMIN, JMAX
SUMSRC(I) = SUMSRC(I) + NMSRC(J)
SUMSWC(I) = SUMSWC(I) + SWITCH(J)
TEMP1 = 1000. * LCMBPO(J)
MN(I) = MN(I) + TEMPI
SSQ(I) = SSQ(I) + TEMPI**2

554 CONTINUE
TEMP1 = N1
MN(I) = MN(I) / TEMP1
MEAN(I) = MN(I)
VAR(I) = (SSQ(I) / TEMP1) - MN(I)**2
STD(I) = DSQRT(VAR(I))
SUMSRC(4) = SUMSRC(4) + SUMSRC(I)
SUMSWC(4) = SUMSWC(4) + SUMSWC(I)
MN(4) = MN(4) + MN(I)
SSQ(4) = SSQ(4) + SSQ(I)

560 CONTINUE
TEMP1 = TOTAL
MN(4) = MN(4) / 3.
MEAN(4) = MN(4)
VAR(4) = (SSQ(4) / TEMP1) - MN(4)**2
STD(4) = DSQRT(VAR(4))
WRITE(IOUT, 2500) ID, TN, ID
WRITE(IOUT, 2505) (ORGSPC(I), I=1,18), ID
WRITE(IOUT, 2506) (SAVSDS(I), I=1,5), ID
WRITE(IOUT, 2507) (SAVSDS(I), I=6,10), ID
WRITE(IOUT, 2508) (SAVSDS(I), I=11,15), ID
WRITE(IOUT, 2510) (SUMSRC(I), I=1,4),
1     (SUMSWC(I), I=1,4), ID
WRITE(IOUT,2515) (MEAN(I), I=1,4), (STD(I), I=1,4), ID
IF (PUNCH.EQ.0) GO TO 590
IOUT = PUNCH
WRITE(IOUT,2600) ID, TN, ID
WRITE(IOUT,2605) (ORGSPC(I), I=1,16), ID
WRITE(IOUT,2666) (SAVSDS(I), I=1,5), ID
WRITE(IOUT,2607) (SAVSDS(I), I=6,10), ID
WRITE(IOUT,2608) (SAVSDS(I), I=11,15), ID
WRITE(IOUT,2610) (SUMSRC(I), I=1,4), ID
WRITE(IOUT,2615) (MEAN(I), I=1,4), (STD(I), I=1,4), ID
590 CONTINUE
RETURN
2400 FORMAT(16X,'18P***NOTE*** IN NOT',
1 28HEVENLY DIVISIBLE BY 3 ***N1=,13,2H***,65X)
2500 FORMAT(16X,'14,3X,I3,24H TOTAL TASK CYCLES',
1 19HORG. SPECIFICATIONS,47X,14,2H1,8X,4H0100)
2505 FORMAT(21X,'1813,41X,14,1H2,8X,4H0111)
2506 FORMAT(20X,5HSEEDS,5F10.0,41X,14,1H3,8X,4H0121)
2507 FORMAT(20X,5HSEEDS,5F10.0,41X,14,1H4,8X,4H0131)
2508 FORMAT(20X,5HSEEDS,5F10.0,41X,14,1H5,8X,4H0141)
2510 FORMAT(20X,5HSRCHS,417,6H SWCHS,414,41X,14,1H6,8X,
1 4H1201)
2515 FORMAT(20X,2HKN,4F6.1,5H STD,4F6.1,41X,14,1H7,8X,
1 4H1301)
2600 FORMAT(15X,'14,3X,I3,24H TOTAL TASK CYCLES',
1 19HORG. SPECIFICATIONS,7X,14,1H1)
2605 FORMAT(20X,'1813,1X,14,1H2)
2606 FORMAT(19X,5HSEEDS,5F10.0,1X,14,1H3)
2607 FORMAT(19X,5HSEFD5,5F10.0,1X,14,1H4)
2608 FORMAT(19X,5HSEEDS,5F10.0,1X,14,1H5)
2610 FORMAT(19X,5HSRCHS,'417,6H SWCHS,414,41X,14,1H6)
2615 FORMAT(19X,2HGN,4F6.1,5H STD,4F6.1,1X,14,1H7)
END
SUBROUTINE INTEV
INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRFSNP
INTEGER EVOKED, PCHOSE, PROGT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPD, PROBPG, CONASP, GOALWT, MPO, LCMBPO
REAL MPFVAL, LCMBPO
COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROG(300), MPD(300,3)
COMMON SIZENV(20), CONASP(3,2), GOALWT(3),
IMPERC(300,4), PRFSNP, EVOKED(7), PCHUSE(720), PROGT,
2MOUTHML(720,3), LCMBPO(720), LTCEVL(7), ID,
3NUMSRC(720), SWITCH(720), PRTOUT
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL VSIZE(2), INDEX, I, J, V RAND(125), SUBID
DATA SUBID/17/ DATA DIS TPR(1,1), DIS TPR(1, 2), DIS TPR (1,3)/ .60, .20, .20/
DATA DIS TPR(2,1), DIS TPR(2, 2), DIS TPR (2,3)/ .20, .60, .20/
DATA DIS TPR(3,1), DIS TPR(3, 2), DIS TPR (3,3)/ .20, .20, .60/
DATA VSIZ E(1), VSIZE(2)/1.25, 2.77/
IF (((ORGSPC(6).EQ.1).OR.((ORGSPC(6).EQ.2))) GO TO 20
IF (I.EQ.1) GO TO 999
30 INDEX = ORGSPC(6)
SIZENV = VSIZE(INDEX)
IF ((ORGSPC(1).GE.1).AND.((ORGSPC(1).LE.2))) GO TO 50
50 INDEX = ORGSPC(1)
DO 60 I=1,3
60 MPBPG(I) = DIS TPR(INDEX, I)
CALL CNPR(IPGTYP, SIZENV, PROBPG)
CALL RANVEC(VRAND, SIZENV, SEED3)
JMIN = 1
JMAX = IPGTY P(1)
DO 60 J=1,3
IF (J.EQ.1) GO TO 75
JMIN = IPGTY P(1-1) + JMIN
JMAX = IPGTY P(1) + JMAX
75 DO 78 J=JMIN,JMAX
INDEX = VRAND(J)
78 VPROGT(INDEX) = 1
80 CONTINUE
do 410 I=1, SIZENV
CALL SETMPO(I, VPROG, MPD)
do 410 CONTINUE
500 IF (OUTCD(1).EQ.1) GO TO 510
GO TO 600
510 CALL OUTENV(SUBID)
600 RETURN
999 CALL ERROUT(I, ORGSPC(I), PRTOUT)
END
SUBROUTINE INTSP
INTEGER ORGSPC, TCYCL, OUTCD, VFROG, SIZENV, PRE'SCP
INTEGER EVOKED, PCHOSE, PROGT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPO, PROEPG, CONASP, GOALWT, MPERC, MOUTCM
REAL MPEVAL, LCMBPO
COMMON ORGSPC(20), TCYCL, OUTCD(5), VFROG(200), MPO(300,3)
COMMON SIZENV, PROEPG(3), CONASP(3,2), GOALWT(3),
MPERC(300,4), PRE'SCP, EVOKED(7), PCHOSE(720), PROGT,
NUMSRC(720), SWITCH(720), PRTOUT
INTEGER I, J, RVEC(3), RAN, STRUC(5), SUBID
INTEGER PRG1, PRG2
REAL WATES(2,3), MNMAT(3,3)
REAL MEAN, RANDX
COMMON 7SEED/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
1 SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
2 SEED15
DATA SUBID/27
DATA WATES(1,1), WATES(1,2), WATES(1,3)/.20, .60, .20/
DATA WATES(2,1), WATES(2,2), WATES(2,3)/.3333, .3333, 1
DATA MNMAT(1,1), MNMAT(1,2), MNMAT(1,3)/.75, .75, .75/
DATA MNMAT(2,1), MNMAT(2,2), MNMAT(2,3)/.00, .00, .00/
DATA MNMAT(3,1), MNMAT(3,2), MNMAT(3,3)/.25, .25, .25/
DATA MPOSS(1,1), MPOSS(1,2), MPOSS(1,3)/.25, .25, .75/
DATA MPOSS(2,1), MPOSS(2,2), MPOSS(2,3)/.75, .75, .75/
DATA MPOSS(3,1), MPOSS(3,2), MPOSS(3,3)/.25, .25, .75/
DATA MPOSS(4,1), MPOSS(4,2), MPOSS(4,3)/.75, .75, .25/
DATA MPOSS(5,1), MPOSS(5,2), MPOSS(5,3)/.75, .75, .25/
DATA MPOSS(6,1), MPOSS(6,2), MPOSS(6,3)/.25, .75, .75/
DATA MPOSS(7,1), MPOSS(7,2), MPOSS(7,3)/.25, .75, .75/
CALL CKVSP(STRUC, ORGSPC, PRTOUT)
100 DO 195 I=1, SIZENV
      CALL GNPERC(I, STRUC, MPERC, MPO)
195 CONTINUE
      CALL RANVEC(RVEC, 3, SEED7)
      I = STRUC(1)
      IF (I.EQ.0) I=1
      DO 210 J=1, 3
         ITEMP = RVEC(J)
210       GOALWT(J) = WATES(I, ITEMP)
      IF (STRUC(2).EQ.2) GO TO 310
      GO TO 330
310      CALL IRANU(SEED8, 1, 6, RAN)
      DO 320 J=1, 3
320      MNMAT(2, J) = MPOSS(RAN, J)
330      IF (STRUC(1).EQ.2) GO TO 400
      GO TO 450
ITEMP = STRUC(2)
MEAN = MMATR(ITEMP,1)
CALL GAUSS(SEED9,MEAN,.08,RANDX)

415

DO 415 J = 1,2
IF (CONASP(I,J,LT.0.00)) CONASP(I,J) = 0.00
IF (CONASP(I,J,GTE.1.00)) CONASP(I,J) = 1.00
CONTINUE

420 DO 420 I = 1,3
ITEMP = STRUC(2)
MEAN = MMATR(ITEMP,1)
CALL GAUSS(SEED9,MEAN,.08,RANDX)

430

DO 430 J = 1,2
IF (CONASP(I,J,LT.0.00)) CONASP(I,J) = 0.00
IF (CONASP(I,J,GTE.1.00)) CONASP(I,J) = 1.00
CONTINUE

440 DO 440 K = 1,3
ITEMP = STRUC(2)
MEAN = MMATR(ITEMP,1)
CALL GAUSS(SEED9,MEAN,.08,RANDX)

450

IF (CONASP(I,J,LT.0.00)) CONASP(I,J) = 0.00
IF (CONASP(I,J,GTE.1.00)) CONASP(I,J) = 1.00
CONTINUE

460 DO 460 K = 1,3
ITEMP = STRUC(2)
MEAN = MMATR(ITEMP,1)
CALL GAUSS(SEED9,MEAN,.08,RANDX)

470

IF (CONASP(I,J,LT.0.00)) CONASP(I,J) = 0.00
IF (CONASP(I,J,GTE.1.00)) CONASP(I,J) = 1.00
CONTINUE

480 CALL 3NTES
CALL SRCHC
PRESCP = PROGT

500 IF (OUTCD(1).NE.1) GO TO 500
WRITE(PRTOUT,2000) TCYCL, SUBID
WRITE(PRTOUT,2005) ((CONASP(I,J),J = 1,2),I = 1,3)
WRITE(PRTOUT,2010) (GOALWT(I),I = 1,3), PRESCP
WRITE(PRTOUT,2015) TCYCL

510 PRG1 = -1
PRG2 = 0

520 PRG1 = PRG1 + 2
PRG2 = PRG2 + 2
IF (PRG1.GT.SIZENV) GO TO 620
IF (PRG2.GT.SIZENV) PRG2 = SIZENV
WRITE(PRTOUT,2020) PRG1, PRG2, (HIPER(I,J),J = 1,4),

530

GO TO 620

600 IF (OUTCD(1).NE.1) GO TO 700
WRITE(PRTOUT,2000) TCYCL, SUBID
WRITE(PRTOUT,2005) ((CONASP(I,J),J = 1,2),I = 1,3)
WRITE(PRTOUT,2010) (GOALWT(I),I = 1,3), PRESCP
WRITE(PRTOUT,2015) TCYCL

610 PRG1 = PRG1 + 2
PRG2 = PRG2 + 2
IF (PRG1.GT.SIZENV) GO TO 620
IF (PRG2.GT.SIZENV) PRG2 = SIZENV
WRITE(PRTOUT,2020) PRG1, PRG2, (HIPER(I,J),J = 1,4),

620 CONTINUE

700 RETURN

2000 FORMAT(16X,14,14H TASK CYCLE ,I3,
1 14H SUBROUTINE ,12,80X)
2005 FORMAT(20X,9HASP, GL 1,2F6.3,5H GL 2,2F6.3,
1 5H GL 3,2F6.3,58X)
2010 FORMAT(20X,14HWEIGHTS GL 1,F5.3,7H GL 2,F5.3,
1 7H GL 3,F5.3,8H PRESCP,14,58X)
2015 FORMAT(23X,11HTASK CYCLE ,I3,18H PERCEPTIONS AT ,
1 10HTHIS POINT,68X)
2020 FORMAT(20X,12,1H,,13,7A4F5.3,3X,4F5.3,61X)
END
SUBROUTINE T NTE S
   INTEGER COUNTV(1, COUNT, IMAX, INDEX, J, JSK
   JMIN, K, KK, LOWASP, RAN, SERCHS, SUBID, SZES, Z, ZRANVC(300)
   COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6
1   SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
  SEED14, SEED15
   REAL SERCHS, SEED1, SEED2, SEED4, SEED5, SEED6, SEED7,
   SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
   SEED15
   REAL BIGWT, SAVASP(3, 2), PBIAS
   INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRESCP
   INTEGER EVOKED, PCHOSE, PROGT, LTCEVL, ID
   INTEGER NUMSRC, SWITCH, PRTOUT
   REAL MPO, PROBPQ, CONASP, GOALWT, MPERC, MOUTCM
   REAL MPEVAL, LCMBPO
   COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROG(300), MPO(300, 3)
   COMMON SIZENV, PROBPq(3), CONASP(3, 2), GOALWT(3),
   MPEVAL(300, 4), PRESCP, EVOKED(7), PCHOSE(720), PROGT,
   2 MOUTCM(720, 3), LCMBPO(720), LTCEVL(7), ID,
   3 NUMSRC(720), SWITCH(720), PRTOUT
   SIZES=7
   DO 16 I=1, 4
16  COUNTv(I)=0
   SERCHS=0
   LOWASP=0
   COUNT=0
   DO 1 I=1, SIZES
1   EVOKED(I)=0
   Z=PRTOUT
   IF(OUTCD(I) .NE. 1) GO TO 3
   WRITE(Z, 2) ORGSPC(16)
   2 FORMAT(20X, 14, A = ORGSPC(16))
   3 IF(ORGSPC(16) .LE. 2) GO TO 5
   WRITE(Z, 4) ORGSPC(16)
   4 STOP
   5 IF(ORGSPC(16) .EQ. 1) GO TO 10
   WRITE(Z, 24) INDEX, ORGSPC(INDEX)
   6 INDEX=12
   GO TO 20
   7 INDEX=9
   8 INDEX=1
   9 INDEX=2
   10 IF(ORGSPC(INDEX) .EQ. 1) GO TO 400
   IF(ORGSPC(INDEX) .EQ. 2) OR . ORGSPC(INDEX) .EQ. 4) GO TO 18
   11 IF(ORGSPC(INDEX) .EQ. 2 OR . ORGSPC(INDEX) .EQ. 4) GO TO 18
   12 WRITE(Z, 24) INDEX, ORGSPC(INDEX)
   13 STOP
   14 FORMAT(16X, 18, ERROR, ORGSPC(INDEX) =, 14)
   15 IF(ORGSPC(16) .EQ. 0) GO TO 25
   GO TO 200
   16 IF(ORGSPC(16) .EQ. 2) GO TO 15
   INDEX=12
   GO TO 20
15  INDEX=9
   17 IF(ORGSPC(INDEX) .EQ. 1) GO TO 400
   18 IF(ORGSPC(INDEX) .EQ. 1 OR . ORGSPC(INDEX) .EQ. 4) GO TO 18
   19 WRITE(Z, 24) INDEX, ORGSPC(INDEX)
   20 STOP
   21 FORMAT(16X, 18, ERROR, ORGSPC(INDEX) =, 14)
   22 IF(ORGSPC(INDEX) .EQ. 1 OR . ORGSPC(INDEX) .EQ. 4) GO TO 18
   23 WRITE(Z, 24) INDEX, ORGSPC(INDEX)
   24 STOP
   25 IF(SERCHS=1) GO TO 25
19 SECHS=2
   GO TO 200
25 LOWASP=0
   COUNT=0
   DO 31 KK=1,4
31 COUNTV(KK)=0
   DO 26 KK=1,4
26 COUNTV(KK)=0
   IF(ORGSPC(4).EQ.2) GO TO 35
   BIGWT=GOALWT(1)
   IF(OUTCD(1).EQ.1) WRITE(2,28)(GOALWT(I),I=1,3)
   JMIN=1
   DO 30 KK=2,3
   IF(BIGWT.GE.GOALWT(KK)) GO TO 30
   BIGWT=GOALWT(KK)
   JMIN=KK
28 FORMAT(16X,8HGOALWT1=,F6.3,9H GOALWT2=,F6.3,
   19H GOALWT3=,F6.3)
29 FORMAT(16X,3HRKK=,12)
30 CONTINUE
   JMAX=JMIN
   IF(OUTCD(1).EQ.1) WRITE(2,29) JMIN
   GO TO 40
35 JMIN=1
   JMAX=3
40 DO 55 I=1,SIZENV
   DO 50 J=JMIN,JMAX
   IF(CONASP(J,1).GT.MPERC(I,J).OR.MPERC(I,J).GT.
   ICONASP(J,2)) GO TO 55
50 CONTINUE
   DO 45 K=1,COUNT
   IF(EVOKED(K).EQ.1) GO TO 55
45 CONTINUE
   COUNT=COUNT+1
   EVOKED(COUNT)=I
   IF(COUNT.EQ.3) GO TO 60
55 CONTINUE
   GO TO 300
60 IMIN=4
   IMAX=SZES
   GO TO 205
200 IMIN=1
   IMAX=SZES
205 CONTINUE
   CALL RANVEC(ZRANVC,SIZENV,SEED11)
   KK=0
   J=IMIN-1
   DO 215 I=IMIN,IMAX
208 KK=KK+1
   RAN=ZRANVC(KK)
   DO 210 K=I,J
   IF(EVOKED(K).EQ.RAN) GO TO 208
210 CONTINUE
   EVOKED(1) = RAN
215 CONTINUE
   GO TO 400
300 LOWASP = LOWASP + 1
   COUNTV(LOWASP) = COUNT
   IF(LOWASP .NE. 1) GO TO 307
   DO 305 J = 1, 2
   DO 305 I = 1, 3
305 SAVASP(I, J) = CONASP(I, J)
307 DO 325 I = 1, 3
   IF(CONASP(I, 1) .LE. 0.25) GO TO 315
   CONASP(I, 1) = CONASP(I, 1) - 0.25
310 IF(CONASP(I, 2) .GE. 0.75) GO TO 320
   CONASP(I, 2) = CONASP(I, 2) + 0.25
   GO TO 325
315 CONASP(I, 1) = 0.00
   GO TO 310
320 CONASP(I, 2) = 1.00
325 CONTINUE
   GO TO 40
400 IF(CUTCD(1) .NE. 1) GO TO 410
   SUB1D = 3
   WRITE(Z, 402) ID, TCYCL, SUBID
402 FORMAT(1H1, 16X, 14, 14H TASK CYCLE, 13, 14H SUBROUTINE, 12)
   WRITE(Z, 404) (EVOKED(I), I = 1, SZES)
404 FORMAT(24X, 22H PROGRAMS IN EVOKED SET, 714)
   WRITE(Z, 406) LOWASP, (COUNTV(I), I = 1, 4), COUNT, 1, SERCHS
406 FORMAT(24X, 6H LOWASP, 13, 6H COUNTV, 4T2, 7H COUNT, 13, 16H SERCHS, 13)
   WRITE(Z, 408) (CONASP(I, J), J = 1, 2, I = 1, 3)
408 FORMAT(20X, 10HASP, 6L 1, 2F6.3, 5H GL 2, 2F6.3, 5H GL 3, 12F6.3)
410 IF(LOWASP .EQ. 0) RETURN
   DO 415 J = 1, 2
   DO 415 I = 1, 3
415 CONASP(I, J) = SAVASP(I, J)
RETURN
END
SUBROUTINE SRCRC
INTEGER DIRECT, EXPSCH, SRCN(14), STPLOP, PRG1, PRG5, I
INTEGER PRGEV(1), IPVE(7), CFLAG, DFLAG, COUNT(V)
INTEGER COUNT, IMAX, IMIN, INDEX, J, JMAX, JMIN, K, KK, LOWASP
INTEGER RAN, SERSCH, STHID, SZES, Z, INSAVE(3), SAVRAN(3)
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
  SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
  SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
  SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
  SEED15
REAL BIGWT, AVG(3), SAVASP(3, 2), PBIAS, MN, VALVEC(300)
INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRESCP
INTEGER EVOKED, PCHOSE, PROGT, LCTIVAL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPO, PROBP, CONASP, GOALWT, MPERC, MOUTCM
REAL MPVAL, LCMPO
COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROG(300), MPO(300, 3)
COMMON SIZENV, PROBPIC(3), CONASP(3, 2), GOALWT(3),
  MPERC(300, 3), PRESCP, EVOKED(7), PCHOSE(320), PROGT,
  2MOUTH(720, 3), MPEVAL(720, 3), LCMPO(720), LCTIVAL, ID,
  NUMSRC(720), SWITCH(720), PRTOUT
JMIN = 0
JMAX = 0
NUMCAL = 0
LOWASP = 0
EXPSCH = 0
MAXSCH = 0
MAXPKG = 0
DO 5 I = 1, 3
5 PRGEV(I) = 0
DO 7 I = 1, 4
7 COUNT(V) = 0
DO 8 I = 1, 14
8 SRCN(I) = 0
SZES = 7
IF (TCYCL .EQ. 0) GO TO 10
IF (ORGSPC(4) .EQ. 2) GO TO 30
INDEX = 12
GO TO 20
10 INDEX = 9
20 IF (ORGSPC(INDEX) .EQ. 1) GO TO 40
IF (ORGSPC(INDEX) .EQ. 2 .OR. ORGSPC(INDEX) .EQ. 3) GO TO 185
IF (ORGSPC(INDEX) .NE. 4 .AND. ORGSPC(INDEX) .NE. 5)
GO TO 6000
GO TO 318
30 PROGT = PRESCP
PCHOSE(TCYCL) = PROGT
NUMSRC = 1
ISWITCH = 0
NUMCAL = 0
GO TO 425
40  STPLOP=SIZENV
  CFLAG=0
50  IF(ORGSPC(4).EQ.2) GO TO 110
  JMAX=1
  BIGHT=GOALWT(1)
  DO 60 JJ=2,3
    IF(BIGHT.GE.GOALWT(JJ)) GO TO 60
    BIGHT=GOALWT(JJ)
  JMAX=JJ
  CONTINUE
  IF(JMAX.EQ.1) GO TO 70
  JMIN1=1
  IF(JMAX.EQ.2) GO TO 80
  JMIN2=2
  GO TO 90
  JMIN1=2
  JMIN2=3
  GO TO 90
  JMIN2=3
  DO 100 JJ=1,STPLOP
    LL=JJ
    IF(CFLAG.EQ.-1) LL=PRGEVL(JJ)
100  VALVEC(JJ)=(100.*(1.0-MPERC(LL,JMAX)))*2+100.*(1.0-MPERC(LL,JMIN1))+160.*(1.0-MPERC(LL,JMIN2))
    GO TO 145
110  DO 120 JJ=1,3
120  AVG(JJ)=(CONASP(JJ,1)+CONASP(JJ,2))/2.0
    DO 140 I=1,STPLOP
      LL=I
      IF(CFLAG.EQ.-1) LL=PRGEVL(I)
      VALVEC(I)=0.0
    DO 130 JJ=1,3
130  VALVEC(I)=VALVEC(I)+(100.*(AVG(JJ)-MPERC(LL,JJ)))*2
    CONTINUE
140  PROGT=1
    MW=VALVEC(1)
    IF (STPLOP.EQ.1) GO TO 150
    DO 150 I=2,STPLOP
          IF(MW.LE.VALVEC(I)) GO TO 150
          MW=VALVEC(I)
    PROGT=I
150  CONTINUE
    IF (CFLAG.EQ.-1) PROGT = .PRGEVL(PROGT)
    IF(CFLAG.EQ.-1) GO TO 155
155  INUMSR=SIZENV
    NUMCAL=0
    IF(TCYCL.EQ.0) GO TO 160
    ISWITC=0
    GO TO 425
160  IF(TCYCL.EQ.1) GO TO 170
    IF(PROGT.EQ.PCHCSE(TCYCL-1)) GO TO 170
    ISWITC=1
GO TO 180
ISWITC=0
180 PCHOSE(TCYCL)=PROGT
GO TO 425
185 DFLAG=0
190 IF(TCYCL.NE.0.AND.TCYCL.NE.1) GO TO 200
IF(DFLAG.EQ.-1) GO TO 320
GO TO 250
200 IF(ORGSPC(4).EQ.2) GO TO 220
JMAX=1
BIGWT=GOALWT(1)
DO 210 JJ=2,3
IF(BIGWT.GE.GOALWT(JJ)) GO TO 210
BIGWT=GOALWT(JJ)
JMAX=JJ
210 CONTINUE
JMIN=JMAX
GO TO 220
220 JMIN=1
JMAX=3
230 INDXPC=PCHOSE(TCYCL-1)
DO 240 JJ=JMIN,JMAX
IF(CONASP(JJ,1).LE.MPERC(INDXPC,JJ).AND.MPERC(INDXPC,1 JJ).LE.CONASP(JJ,2)) GO TO 240
IF(DFLAG.EQ.-1) GO TO 320
GO TO 250
240 CONTINUE
PROGT=PCHOSE(TCYCL-1)
PCHOSE(TCYCL)=PRUGT
INUMSR=1
ISWITC=0
NUMCAL=0
GO TO 425
250 MAXPPG=3
MAXSCH=14
252 LOWASP=0
EXPSCH=0
NUMCAL=0
COUNT=0
IF(ORGSPC(4).EQ.2) GO TO 270
INUMSR=1
IF(TCYCL.LE.1) INUMSR = 0
JMAX=1
BIGWT=GOALWT(1)
DO 260 JJ=2,3
IF(BIGWT.GE.GOALWT(JJ)) GO TO 260
BIGWT=GOALWT(JJ)
JMAX=JJ
260 CONTINUE
JMIN=JMAX
GO TO 220
270 INUMSR=0
JMIN=1
JMAX=3

DO 310 JJ=1,7
KK=EVOKE(JJ)
DO 290 JJ=JMIN,JMAX
IF(CONASP(JJ,1),GT,MPECC(KK,JJ),OR,MPECC(KK,JJ),GT,
CONASP(JJ,2)) GO TO 310
290 CONTINUE
IF(COUNT.EQ.0) GO TO 300
DO 300 JJ=1,COUNT
IF(EVOKE(JJ),EQ,PRGEV(JJ)) GO TO 310
300 CONTINUE
COUNT=COUNT+1
PRGEV(COUNT)=EVOKE(JJ)
IF(COUNT.LE.MAXPRG) GO TO 310
INUMSR=INUMSR+1
GO TO 315
310 INUMSR=INUMSR+1
IF(LOWASP.EQ.EXPSC) GO TO 330
GO TO 422
315 CFLAG=-1
STPLUP=MAXPRG
GO TO 50
318 DFLAG=-1
GO TO 190
320 MAXPRG=1
MAXSCH=7
GO TO 252
330 EXPSC=EXPSC+1
NUMCAL=NUMCAL+1
ISCHE=0
DO 340 JJ=1,MAXSCH
SRCHD(JJ)=0
DIREFN=1
ICOUNT=1
II=EVOKE(7)+1
340 SRCHD(ICOUNT)=II
IF (II.LE.SIZENV) GO TO 355
II=SIZENV
DIREFN=-1
GO TO 350
355 IF(II.GT.0) GO TO 360
II=1
DIREFN = 1
GO TO 350
360 DO 370 JJ=1,7
IF(EVOKE(JJ),EQ,II) GO TO 420
370 CONTINUE
IF(ICOUNT.LE.1) GO TO 390
STPLUP=ICOUNT-1
DO 360 JJ=1,STPLUP
IF(SRCHD(JJ),EQ,II) GO TO 420
380 CONTINUE
390   DO 400 JJ=JMIN,JMAX
        IF(CONASP(JJ,1).LE.MPERC(II,JJ).AND.MPERC(II,JJ).LE.
1 CONASP(JJ,2)) GO TO 410
400 CONTINUE
        COUNT=COUNT+1
        PRGEVL(COUNT)=II
        IF(COUNT.NE.MAXPRG) GO TO 410
405   INUMSR=INUMSR+1
410   GO TO 315
420   II=II+DIRECN
422   LOWASPA=LOWASPA+1
425   CONTINUE
        IF((TCYCL.EQ.O).AND.(ORGSPC(4).EQ.2)) PRESCP=PROGT
        I=TCYCL
        IF((TCYCL.EQ.0).I.E.1)
428   IF((TCYCL.EQ.1).AND.(ORGSPC(4).EQ.2)) GO TO 428
430   NUMSRC(II) = INUMSR
        SWITCH(II) = ISWITC
435   IF(OUTCD(II)).NE.1) GO TO 460
440   SUBID=4
445   WRITE( PRTOUT,1010 ) ID,TCYCL,SWITC
        WRITE( PRTOUT,1020 ) NUMSRC(II),SWITCH(II)
        WRITE( PRTOUT,1030 ) (COUNTV(II),II=1,LOWASPA)
        WRITE( PRTOUT,1062 ) PROGT
        IF(ORGSPC(INDEX).EQ.1) GO TO 430
LUPLIM = MAXPKG
GO TO 440

430 LUPLIM=SIZENV
440 PRG1=-4
450 PRG1=PRG1+5
PRG5=PRG1+4
IF(PRG5.GT.LUPLIM) PRG5=LUPLIM
WRITE(PRTOU,T0,1040) PRG1,PRG5,(VALVEC(I1),I1=PRG1,PRG5)
IF(PRG5.EQ.LUPLIM) GO TO 455
GO TO 450

455 CONTINUE
IF ( ORGSPC(INDEX).EQ.1) RETURN
WRITE(PRTOU,1050) (SRCMD(I1),I1=1,MAXSC)
WRITE(PRTOU,1060) (PRGEVL(I1),I1=1,3),JMAX,JMIN.
1 PROGT
WRITE(PRTOU,1070) (EVOKE(I1),I1=1,SZFS)
460 IF(LCASP.EQ.0) GO TO 461
DO 480 I1=1,3
DO 470 JJ=1,2
470 CONASP(I1, JJ) = SAVASP(I1, JJ)
480 CONTINUE
IF(NUMCAL.EQ.0) RETURN
DO 482 I1=1,MAXPRG
INSAVE(I1) = 0
DO 482 JJ=1,SZES
IF (PRGEVL(I1).EQ.EVOKE(J1)) INSAVE(I1)=JJ
482 CONTINUE
DO 484 JJ=1,MAXPRG
SAVRAN(JJ) = 0
DO 495 I=1,MAXPRG
IF (INSAVE(I).NE.0) GO TO 495
486 CALL IRANU(SEED15,1,7,RAN)
SAVRAN(I) = RAN
IF (I.EQ.1) GO TO 488
KK = I-1
DO 488 JJ=1,KK
IF (RAN.EQ.SAVRAN(JJ)) GO TO 486
488 CONTINUE
DO 490 JJ=1,MAXPRG
IF (RAN.EQ.INSAVE(JJ)) GO TO 490
490 CONTINUE
EVOKE(RAN) = PRGEVL(I1)
495 CONTINUE
IF(OUCD(I).EQ.1) WRITE(PRTOU,1060) (EVOKE(I1),I1=1,3),RETURN
6000 WRITE(PRTOU,1000) INDEX, ORGSPC(INDEX)
STOP
1000 FORMAT(17X,32HERROR. SUBROUTINE SRCHC. ORGSPC(12,
1194) PAS ILLEGAL VALUE/13,21H. PROGRAM TERMINATED.)
1010 FORMAT(17X,14,3X,10HTASK CYCLE,14,3X,10HSUBROUTINE,
1 13)
1020 FORMAT(24X,6HNUMSPC,15,2X,6HSWITCH,12,3X,6HNUMCAL,
1 12,2X,6HEXPSC,H,12,2X,6HL0WAS,P,12)
1030 FORMAT(24X,6HCOUNTIV,4I3)
1040 FORMAT(26X,13,1H-,13,5F8.2)
1050 FORMAT(24X,17HPROGRAMS SEARCHED,714)
1060 FORMAT(24X,6HPRGEVL,3I4,3X,4HJMAX,14,3X,4HJMIN,
1 14,3X,5HPROGT,14)
1062 FORMAT(24X,6HPROGT,14)
1070 FORMAT(24X,22HPROGRAMS IN EVOKED SET,714)
1080 FORMAT(24X,10HEVOKED SET,714)
END
SUBROUTINE TASK
INTEGER SUEID
REAL MEAN
REAL DCONT(2)
INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRESCP
INTEGER EVOKED, PCLOSE, PROGT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPC, PROEPG, CONASP, GOALWT, MPFRC, MOUTCM
REAL MPEVAL, LCMBPO
COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROG(200), MPC(300, 3)
COMMON SIZENV, PROEPG(3), CONASP(3, 2), GOALWT(3),
MPERC(300, 4), PRESCP, EVOKED(7), PCLOSE(720), PROGT,
2MOUTCM(720, 3), MPEVAL(720, 3), LCMBPO(720), LTCEVL(7), ID,
3NUMSRC(720, 1), SWITCH(720), PRTOUT
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
1 SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
2 SEED15
IF (ORGSPC(2) .EQ. 1 .OR. ORGSPC(2) .EQ. 2) GO TO 100
WRITE (PRTOUT, 4) ORGSPC(2)
4 FORMAT(16X, 17HERROR . ORGSPC(2) = -.13)
STOP
100 DCONT(1) = .04
DCONT(2) = .16
DO 125 J = 1, 3
MEAN = MPC(PROGT(J),)
1 = ORGSPC(2)
CALL GAUSS(SEED12, 0.0, DCONT(1), DEVN)
CALL GAUSS(SEED13, MEAN, 0.0, MOUTCM(TCYCL, J))
IF (OUTCD(1) .EQ. 1) WRITE (PRTOUT, 126) TCYCL, J,
1 MOUTCM(TCYCL, J), DEVN
MOUTCM(TCYCL, J) = MOUTCM(TCYCL, J) + DEVN
IF (MOUTCM(TCYCL, J) .LT. 0.0) MOUTCM(TCYCL, J) = 0.
IF (MOUTCM(TCYCL, J) .GT. 1.0) MOUTCM(TCYCL, J) = 1.
125 CONTINUE
126 FORMAT(26X, 7HMOUTCM(*, 14, 1H, *, 13, 2H) = *F10.5,
17H DEVN = *F10.5)
IF (OUTCD(1) .NE. 1) RETURN
SUBID = 5
WRITE(PRTOUT, 209) ID, TCYCL, SUBID
209 FORMAT(1H, 16X, 14H TASK CYCLE , 13,
114H SUBROUTINE , 17)
WRITE(PRTOUT, 211) (MOUTCM(TCYCL, J), J = 1, 3)
211 FORMAT(24X, 8HOUTCOMES , F10.5)
RETURN
END
SUBROUTINE PEREV
INTEGER FREQ(2),DELAY(2),COUNTV(4),COUNT,1,IMAX,IMIN,
INDEX,J,MAX,JMIN,K,KK,LOWASP,RAN,SPEC8S,SUBID,SZES,
INTEGER FREQ,DLY(2),COUNT,INDEX,J,MAX,JMIN,K,KK,LOWASP,RAN,SPEC8S,SUBID,SZES,
REAL BIAS(2),PBIA8,EIGHT,SAVASP(3,2)
INTEGER ORGSPC,TCYCL,OUTCD,VPORG,SIZEENV,PRESCP
INTEGER EVOKED,PCHOSE,PR0G1,LTCEVL,ID
INTEGER NUMSRC,SWITCH,PR0TOUT
REAL MP0,PROBPC,CCNASP,GOALWT,MPERC,KOUTCM
REAL MPEVAL,LCMBPO
COMMON ORGSPC(20),TCYCL,OUTCD(5),VPORG(300),MP0(300,3)
COMMON SIZE ENV,PRESCP,PR0G1,LTCEVL,MP0(300,3),GOALWT(5),
ID
MPERC(300,4),PRESCP,EVOKED(7),PCHOSE(720),PR0G1,
COMMON MOUTCM(720,3),MPEVAL(720,3),LCMBPO(720),LTCEVL(7),ID,
NUMSRC(720),SWITCH(720),PR0TOUT
COMMON /SEEDS/SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,
SEED7,SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,
SEED14,SEED15
REAL SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,SEED7,
SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,SEED14,
SEED15
DOUBLE PRECISION TEMP1,TEMP2,TEMP3
LCMBPO(TCYCL)=0.0
TEMP1=LCMBPO(TCYCL)
DO 10 J=1,3
TEMP2=MOUTCM(TCYCL,J)
TEMP3=GOALWT(J)
TEMP1=TEMP1+TEMP2*TEMP3
CONTINUE
LCMBPO(TCYCL)=TEMP1
100 FREQ(1)=1
FREQ(2)=6
DLY(1)=0
DLY(2)=6
IF (ORGSPC(4).NE.2) GO TO 110
DO 109 I=1,7
109 WRITE(PRTOUT,114) ORGSPC(14),ORGSPC(18)
STOP
110 IF (ORGSPC(14).EQ.0.OR.ORGSPC(14).EQ.1.OR.
.ORGSPC(14).EQ.2,.AND.(ORGSPC(18).EQ.0.OR.ORGSPC(18).EQ.1,
2.EQ.0.OR.ORGSPC(18).EQ.2)) GO TO 400
WRITE(PRTOUT,114) ORGSPC(14), ORGSPC(18)
STOP
110 IF (ORGSPC(14).EQ.0.OR.ORGSPC(14).EQ.1.OR.
.ORGSPC(14).EQ.2,.AND.(ORGSPC(18).EQ.0.OR.ORGSPC(18).EQ.1,
2.EQ.0.OR.ORGSPC(18).EQ.2)) GO TO 120
WRITE(PRTOUT,114) ORGSPC(14), ORGSPC(18)
114 FORMAT(16X,19HERRRER. ORGSPC(14)=,12,
114H ORGSPC(18)=,12)
STOP
120 BIAS(1)=0.06
BIAS(2)=0.06
IF(ORGSPC(13).EQ.0.OR.ORGSPC(13).EQ.1).OF.ORGSPC(13)
1.FQ.2) GO TO 130
WRITE(PTOUT,124) ORGSPC(13)
124 FORMAT(16X,19HERROR ORGSPC(13)=,13)
STOP
130 J=ORGSPC(14)
FRQCY=FREQ(I)
IF(ORGSPC(18).NE.0) GO TO 135
DELAY=0
GO TO 140
135 J=ORGSPC(18)
DELAY=DELAY(I)
140 DO 150 J=1,7
150 LTCEVL(I)=0
IF(ORGSPC(13).EQ.0) GO TO 160
I=ORGSPC(13)
PBIAS=BIAS(I)
160 J=TCYCL/FRQCY
J=J*FRQCY
IF(J.NE.TCYCL) GO TO 500
JSAV=TCYCL
200 L=TCYCL-DELAY-(FRQCY-1)
IF(L.LT.0) GO TO 205
LTCEVL(I)=0
GO TO 400
205 K=TCYCL-DELAY
DO 220 I=L,K
DO 210 J=1,3
CALL GAUSS(14,PBIAS,0.02,MPEVAL(I,J))
MPEVAL(I,J)=MPEVAL(I,J)+MOUTCM(I,J)
IF(MPEVAL(I,J).GT.1.) MPEVAL(I,J)=1.
IF(MPEVAL(I,J).LT.0.) MPEVAL(I,J)=0.
210 CONTINUE
220 CONTINUE
230 LTCEVL(I)=FRQCY
K=LTCEVL(I)+1
L=TCYCL-DELAY-(FRQCY-1)
M=TCYCL-DELAY
I=2
DO 240 J=L,M
LTCEVL(I)=J
240 I=I+1
250 CONTINUE
GO TO 400
180 PBIAS=0.00
GO TO 160
400 IF(OUTCD(1).NE.1) RETURN
L=TCYCL-DELAY-(FRQCY-1)
M=TCYCL-DELAY
SUBID=6
WRITE(PRTOUT,404) ID, TCYCL, SUBID
404 FORMAT(17X,14,13H TASK CYCLE, I4,13H SUBROUTINE, I3)
WRITE(PRTOUT,409) (LTCEVL(I), I=1,7), FROCY, DELAY
409 FORMAT(24X,6H LTCEVL, 714, 6H FROCY, 12, 8H DELAY, I2)
WRITE(PRTOUT,414) PBIAS, LCMBPO(TCYCL)
414 FORMAT(24X,5HPBIAS, F6.2, 7H LCMBPO, F7.4)
IF(JSAV.NE.TCYCL) RETURN
IF(URGSPC(4), EQ, 2) RETURN
IF(L.LE.O) RETURN
WRITE(PRTOUT,417)
1((MPEVAL(I,J), J=1,3), I=L,M)
417 FORMAT(49X, 7H MPEVAL, 3F7.4, 5(/, 55X, 3F7.4))
RETURN
500 JSAV=J
GO TO 400
END
SUBROUTINE LRFB
INTEGER FRE(2),DLAY(2),FRQCY,DELAY
INTEGER TCMAX,PROC16,TCIND1,TCIND2,COUNTV(4),COUNT,
1 IMAX,IMIN,INDEX,J,JMAX,JMIN,K,KK,LOWASP,RAN,
2 SERCPYS,SUBID,SZES,2,VTCPND(300),CHANGP(300)
REAL BIAS(2),PEIAS,BIGWT,SAVASP(3,2)
DOUBLE PRECISION MEAN(3),VAR(3),S1(3),S2(3),ALLVAR
DOUBLE PRECISION ZERO,ONE,TEST,TEST2/0.0,1.0,0.0001,0.000001/
COMMON /SEEDS/SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,
1 SEED7,SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,
2 SEED14,SEED15
REAL SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,SEED7,
1 SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,SEED14,
2 SEED15
INTEGER ORGSPC,TCYCL,OUTCD,VPROG,SIZEFN,PRESCP
INTEGER EVOKED,PCHOSE,PROCT,LEVEL,ID
INTEGER NUMSRC,SWITCH,PTOUT
REAL MPD,PROBPG,CONASP,GOALWT,MPERC,MOUTCM
REAL MEVAL,LCMPPO
COMMON ORGSPC(20),TCYCL,OUTCD(5),VPROG(300),MPD(300,3)
COMMON SIZEFN,PROBP(3),CONASP(2,2),GOALWT(3),
1 MPERC(300,4),PRESCP,EVOKED(7),PCHOSE(720),PROCT,
2 MOUTCM(720,2),MEVAL(720,3),LCMPPO(720),LEVEL(7),ID,
3 NUMSRC(720),SWITCH(720),PTOUT
KOUNT = 0
CHANGP(1) = 0
IF(ORGSPC(4).EQ.2) GO TO 400
IF(ORGSPC(15).EQ.1.OR.ORGSPC(15).EQ.2) GO TO 10
WRITE(PTOUT,7) ORGSPC(15)
7 FORMAT(16X,18HEERR0K, ORGSPC(15)=,13)
STOP
10 IF(LTEVL(1).EQ.0) GO TO 400
IMAX=LTEVL(1)+1
1=2
KOUNT=0
J=LTEVL(1)
GO TO 50
30 J=LTEVL(1)
L=1
40 IF(CHANGP(L).EQ.PCHOSE(J)) GO TO 60
IF(L.EQ.KOUNT) GO TO 50
L=L+1
GO TO 40
50 KOUNT=KOUNT+1
CHANGP(KOUNT)=PCHOSE(J)
60 IF(1.GE.IMAX) GO TO 70
1=1+1
GO TO 30
70 IF(ORGSPC(15).EQ.1) GO TO 200
100 DO 180 1=1,KOUNT
180 PROG10=CHANGP(1)
TCIND1=LTCEVL(IMAX)
TCIND2=1
120 IF(PCHOSE(TCIND1).NE.PROGID) GO TO 125
VTCIND(TCIND2)=TCIND1
IF(TCIND2.EQ.4) GO TO 140
TCIND2=TCIND2+1
125 IF(TCIND1.EQ.1) GO TO 130
TCIND1=TCIND1-1
GO TO 120
130 K=TCIND2
GO TO 150.
140 K=5
150 DO 170 J=1,3
R=0.
DO 160 M=1,4
IF(M.NE.K) GO TO 155
R=R+(4-K+I)*MPEV(PKOGID,J)
GO TO 170
155 N=VTCIND(M)
160 R=R+MPEVAL(N,J)
170 MPEVC(PKOGID,J)=R/4.
180 CONTINUE
GO TO 400
200 CONTINUE
GO 280 I=1,KCNT
PROGID=CHANGP(I)
TCIND1=LTCEVL(IMAX)
TCIND2=0
205 IF(PCHOSE(TCIND1).NE.PROGID) GO TO 207
TCIND2=TCIND2+1
VTCIND(TCIND2)=TCIND1
207 IF(TCIND1.EQ.1) GO TO 210
TCIND1=TCIND1-1
GO TO 205
210 TC_MAX=TCIND2
IF (TC_MAX.LE.1) GO TO 280
DO 250 J=1,3
MEAN(J)=0.
S1(J)=0.
S2(J)=0.
DO 240 K=1,TCMAX
N=VTCIND(K)
MEAN(J)=MEAN(J)+MPEVAL(N,J)
TEMP1 = MPEVAL(N,J)
TEMP2 = TEMP1 * TEMP1
S1(J)=S1(J)+TEMP2
240 S2(J)=S2(J)+TEMP1
MEAN(J)=MEAN(J)/TCMAX
250 VAR(J)=((S1(J)/TCMAX)-(S2(J)/TCMAX)*(S2(J)/TCMAX))/TCMAX
1 DO 270 J=1,3
IF (VAR(J).LT.TES12) GO TO 270
TEMPI = MPERC(PROCID, J)
IF (TEMPI.EQ.ZERO) GO TO 270
TEMPI = MPERC(PROCID, 4)
TEMP2 = TEMPI*TEMPI
IF (TEMP2.EQ.ZERO) GO TO 270
TEMPI = (TEMPI/TEMP2 + MEAN(J)/VAR(J))
1/(ONE/TEMP2 + ONE/VAR(J))
MPERC(PROCID, J) = TEMPI
270 CONTINUE
DO 275 J=1,3
IF (VAR(J).LT.TESL2) GO TO 280
275 CONTINUE
ALLVAR = (VAR(1)+VAR(2)+VAR(3))/3
IF (ALLVAR.LT.TESL2) GO TO 280
TEMPI = MPERC(PROCID, 4)
TEMP2 = TEMPI*TEMPI
IF (TEMP2.LT.TESL2) GO TO 280
TEMPI = DSQRT(DABS((TEMPI*ALLVAR)/(ALLVAR+TEMP2)))
MPERC(PROCID, 4) = TEMPI
280 CONTINUE
400 IF (OUTCD(1).NE.1) RETURN
SUBID=7
WRITE(PIRTOU,404) ID, TCYCL, SUBID
404 FORMAT(16X,14,13H TASK CYCLE,14,13H SUBROUTINE,13)
WRITE(PIRTOU,409) (CHANGP(1), I=1,KOUNT)
409 FORMAT(24X,21HLEARNING FOR PROGRAMS,614)
WRITE(PIRTOU,414)
414 FORMAT(26X,24HPERCEPTIONS FOR PROGRAMS)
DO 420 I=1,KOUNT,2
N=CHANGP(1)
IF (N.EQ.0) RETURN
KK=I+1
N2=CHANGP(KK)
IF (KK.GT.KOUNT) GO TO 417
WRITE(PIRTOU,429) N,N2,(MPERC(N,J),J=1,4),
1(MPERC(N2,J),J=1,4)
420 CONTINUE
WRITE(PIRTOU,429) N,N,(MPERC(N,J),J=1,4)
RETURN
429 FORMAT(24X,13,1H,,13,2X,8F5.3)
END
SUBROUTINE ENVCH
INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRESCP
INTEGER EVOKED, PCHOSE, PROGT, LTCEVL, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPO, PROBPQ, CONASAP, GOALWT, MPEVAL, MOOUTCM
REAL MPEVAL, LCMPDO
COMMON ORGSPC(20), TCYCL, OUTCD(5), VPROG(300), MEQ(300,3)
COMMON SIZENV, PROBPQ(3), CONASAP(3,2), GOALWT(3),
1 MPEVAL(300,4), PRESCP, EVOKED(7), PCHOSE(720), PROGT,
2 MOUTCM(720,3), MPEVAL(720,3), LCMPDO(720), LTCEVL(7), ID,
3 NUMSRC(720), SWITCH(720), PRTOUT
INTEGER OLDSTIZ, NUMPRG(3), IPGTYPER(3), DIFFPG(3)
INTEGER KINDLT(3), NUMDEL, IMIN, IMAX, I, J, K, RAN
INTEGER M, L, PRGCHG(IO), PRGDEL(3), KINADD(3), NUMADD
INTEGER PRGADD(3), INDCTR, SUBID, ISCHG(3)
REAL PRGTYPER(3), RTEMP
DOUBLE PRECISION PRTSUM, DTIME, TEST1, TEST2
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
1 SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
2 SEED15
DATA TEST1, TEST2 /1.00001, 0.00001/
DATA SUBID / & &
NUMADD = 0
NUMDEL = 0
IF (OUTCD(1).NE.1) GO TO 700
K = 0
DO 510 I = 1,3
DIFFPG(I) = 0
PRGADD(I) = 0
PRGDEL(I) = 0
510 CONTINUE
DO 515 I = 1,10
PRGCHG(I) = 0
515 CONTINUE
700 CONTINUE
IF ((ORGSPC(5).GE.1).AND.(ORGSPC(5).LT.3)) GO TO 5
1 = 5
GO TO 999
5 IF (ORGSPC(5).EQ.1) GO TO 35
IF (ORGSPC(17).EQ.0) GO TO 35
IF (ORGSPC(17).EQ.1) GO TO 10
GO TO 15
10 ORGSPC(5) = 2
GO TO 35
15 ORGSPC(5) = 3
35 OLDSIZ = SIZENV
CALL CNPR (NUMPRG, OLDSIZ, PRBPQ)
INDCTR = ORGSPC(5)
GO TO (50, 300, 100), INDCTR
50 GO TO 500
SIZENV = SIZENV - 3
IF (SIZENV < 9) SIZENV = 9
PROBPG(1) = PROBPG(1) - .0015
PROBPG(2) = PROBPG(2) - .0015
PROBPG(3) = PROBPG(3) + .003
DO 105 I = 1, 3
   IF (PROBPG(I) > .90) PROBPG(I) = .90
   IF (PROBPG(I) < .05) PROBPG(I) = .05
105 CONTINUE
PRESUM = PROBPG(1) + PROBPG(2) + PROBPG(3)
IF (PRESUM > TEST1) GO TO 106
IF (PRESUM < TEST1) GO TO 106
GO TO 109
106 DO 107 I = 1, 3
   ISCHG(I) = 0
   IF ((PROBPG(I) < .90) AND (PROCPRG(I) < .05)) ISCHG(I) = 1
107 CONTINUE
DTEMP = ISCHG(1) + ISCHG(2) + ISCHG(3)
IF (DTEMP < TEST1) GO TO 108
DTEMP = (1.00 - PRESUM) / DTEMP
DO 108 I = 1, 3
   IF (ISCHG(I) < 1) PROBPG(I) = PROBPG(I) + DTEMP
108 CONTINUE
109 CALL CNFR(IPGTYP, SIZENV, PROBPG)
DO 110 I = 1, 3
110 DIFFPG(I) = IPGTYP(I) - NUMPRG(I)
DO 112 I = 1, 3
112 KINDLT(I) = 0
IF (OLDSIZ < SIZENV) GO TO 114
114 IMIN = SIZENV + 1
IMAX = OLDSIZ
DO 120 I = 1, IMIN, IMAX
   J = VPROG(I)
   VPROG(I) = 0
   KINDLT(J) = KINDLT(J) + 1
120 CONTINUE
NUMDEL = OLDSIZ - SIZENV
DO 122 I = 1, NUMDEL
   PRGDEL(I) = IMIN
   IMIN = IMIN + 1
122 CONTINUE
DO 124 I = 1, 3
   DIFFPG(I) = DIFFPG(I) + KINDLT(I)
124 CONTINUE
120 CALL RANCHG(SEED10, SIZENV, VPROG, DIFFPG, K, PRGCHG)
150 IF (NUMDEL > 0) GO TO 160
   DO 153 J = 1, 3
153 L = PRGDEL(I)
222

153 \( \text{MPO}(L,J) = 0.00 \)

155 CONTINUE

160 IF (K.EQ.0) GO TO 175

170 CONTINUE

175 GO TO 500

300 SIZENV = SIZENV + 3

1 DO 310 I=1,K

J = PRGCPCG(I)

CALL SETMPOIJ(VPROG,MPO)

310 CONTINUE

PRBSUM = PROBPG(1)+PROBPG(2)+PROBPG(3)

IF (PRBSUM.GT.TESL) GO TO 311

IF (PRBSUM.LT.TESL) GO TO 311.

GO TO 315

311 DO 312 I=1,3

ISCHG(I) = 0

IF ((PROBPG(I).LT.0.90).AND.(PROBPG(I).GT.0.05))

1 ISCHG(I) = 1

312 CONTINUE

DTEMP = ISCHG(1)+ISCHG(2)+ISCHG(3)

IF (DTEMP.LT.TESL) GO TO 313

DTEMP = (1.00-PRBSUM)/DTEMP

DO 313 I=1,3

IF (ISCHG(I).EQ.1) PROBPG(I) = PROBPG(I) + DTEMP

313 CONTINUE

315 CALL CNPR(IPGTYP, SIZENV, PROBPG)

DO 320 I=1,3

320 DIFFGP(I) = IPGTYP(I) - NUMPRG(I)

DO 325 I=1,3

325 KINADD(I) = 0

IF (SIZENV.GT.OLDSIZ) GO TO 330

NUMADD = 0

GO TO 360

330 IMIN = OLDSIZ + 1

IMAX = SIZENV

DO 325 I=IMIN,IMAX

CALL IRANU(SEED,1,3,RAN)

VPROG(I) = RAN

KINADD(RAN) = KINADD(RAN) + 1

335 CONTINUE

NUMADD = SIZENV - OLDSIZ

I = 0

DO 340 J=IMIN,IMAX

1 = 1 + 1

PRGADD(I) = J

340 CONTINUE
CONTINUE
DO 345 I=1,3
345 DIFFPG(I) = DIFFPG(I) - KINALD(I)
360 CALL RANCHG(SEEED10,SIZENV,VPRG,DIFFPG,K,PRGCHG)
IF (NUMADD.EQ.0) GO TO 370
DO 365 I=1MIN,IMAX
     CALL SETMPO(I,VPRG,MPO)
365 CONTINUE
IF (K.EQ.0) GO TO 380
DO 375 I=1,K
     J = PRGCHG(I)
     CALL SETMPO(J,VPRG,MPO)
375 CONTINUE
380 GO TO 500
500 IF (OUTCD(I).EQ.1) GO TO 502
GO TO 600
502 CALL OUTENV(SUBID)
WRITE(PRTOUT,2040) (DIFFPG(I),I=1,3),NUMADD,NUMDEL
WRITE(PRTOUT,2045) K, (PRGCHG(I),I=1,K)
WRITE(PRTOUT,2050) (PRGADD(I),I=1,3),
(PKGDFL(I),I=1,3)
600 CALL ADDELT(NUMADD,PRGADD,NUMDEL,PKGDFL,MPFC,
1 MPF,ORGSFC,OUTCD(I),PRTOUT,SIZENV,1
2 ID,TCYCL)
RETURN
999 CALL ERROUT (1,ORGSFC(1),PRTOUT)
2040 FORMAT(23X,6HDIFFPG,314,12H NUMADD,13,
1 12H NUMDEL,13,62X)
2045 FORMAT(20X,2H K,12,10H PRGCHG,1014,19X)
2050 FORMAT(23X,6HPRGADD,314,12H PRGDEL,314,68X)
END
SUBROUTINE ADDDEL(NUMADD,PRGADD,NUMDEL,PRGDEL,MPERC,
1 MPO,ORGSPEC,OUTCD,PRTOUT,SIZENV,
2 ID,TCYCL)
INTEGER ORGSPEC(20),OUTCD,PRTOUT,SIZENV,ID,TCYCL
INTEGER NUMADD,NUMDEL,PRGADD(3),PRGDEL(3),I,J,K
INTEGER STRUC(5),SUBID,PRG1,PRG2
REAL MPERC(300 ,4), MPO(300,3)
COMMON /SEEDS/ SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,
1 SEED7,SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,
2 SEED14,SEED15
REAL SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,SEED7,
1 SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,SEED14,
2 SEED15
DATA SUBID /9/
   IF (NUMADD.EQ.0) GO TO 200
   CALL CKVSP (STRUC, ORGSPEC, PRTOUT)
   DO 110 I=1,NUMADD
      J = PRGADD(I)
      CALL GNPERC(J, STRUC, MPERC, MPC)
   CONTINUE
   GO TO 300
200   IF (NUMDEL.EQ.0) GO TO 300
   DO 210 I=1,NUMDEL
      J = PRGDEL(I)
      DO 205 K=1,4
         MPERC(J,K) = 0.00
      CONTINUE
   GO TO 310
210   CONTINUE
300   IF (OUTCD .NE.1) GO TO 400
   WRITE(PRTOUT,2000) ID, TCYCL, SUBID
   WRITE(PRTOUT,2005) TCYCL
   PRG1 = -1
   PRG2 = 0
310   PKG1 = PRG1 + 2
   PRG2 = PKG2 + 2
   IF (PRG1.GT.SIZENV) GO TO 400
   IF (PRG2.GT.SIZENV) PRG2 = SIZENV
   WRITE(PRTOUT,2010) PRG1,PRG2,((MPERC(1,J),J=1,4),
1 =PRG1,PRG2)
   GO TO 310
400 RETURN
2000 FORMAT(16X,14,3X,11HTASK CYCLE 13,
1 14H SUBROUTINE 12,60X)
2005 FORMAT(23X,11HTASK CYCLE 13,3X,
1 25MPERCeptions AT THIS POINT,68X)
2010 FORMAT(20X,13,1H,,13,2X,4F5.3,3X,4F5.3,61X)
END
SUBROUTINE IRANDU(SEED, MIN, MAX, I)
X=RANDL(SEED)
SEED=X+(1.0E+6)
X=(MAX-MIN+1)*X+MIN
I=X
IF(1.GT.MAX) I=MAX
RETURN
END
SUBROUTINE GAUSS(SEED, RMEAN, STDX, X)
    SUM = 0.0
    DO 5 I = 1, 12
    R = RANDL(SEED)
    SEED = R * (1.0E+8)
    5 SUM = SUM + R
    X = STDX * (SUM - 6.0) + RMEAN
RETURN
END
FUNCTION RANDL(S)
PROD = S*22.0
BIG = 1.0E+8
I = PROD/BIG
DIFF = PROD - I
I = DIFF/BIG
XI = I*BIG
S = DIFF - XI
RANDL = S/BIG
RETURN
END
SUBROUTINE CNFR(PRTYP, SIZENV, PROBPG)
    INTEGER PRTYP(3), SIZENV, 1
    REAL PRTYP(3), RTEMP1, PROBPG(3)
    RTEMP1 = SIZENV
    DO 70 I=1,3
        PRTYP(I) = RTEMP1 * PROBPG(I)
    70 I = SIZENV - (PRTYP(1) + PRTYP(2) + PRTYP(3))
    RETURN
END
SUBROUTINE RANVEC(IRVEC,N,ISEED)
DIMENSION IRVEC(N)
INTEGER WKVEC(200)
REAL ISEED
DO 100 12 = 1,N
100 WKVEC(12) = I2
I3MAX = N
DO 150 INDEX = 1,N
CALL IRANU(ISEED,1,I3MAX,IRAND)
IRVEC(INDEX) = WKVEC(IRAND)
IF (I3MAX.EQ.1) GO TO 160
150 I3MAX = I3MAX - 1
DO 140 L=IRAND,I3MAX
140 WKVEC(L) = WKVEC(L+1)
150 CONTINUE
160 RETURN
END
SUBROUTINE SFlMPOd, VPROG, MPO
INTEGER VPROG(300)
REAL MPO(300,3)
COMMON /SEEDS/ SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,
  1 SEED7,SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,
  2 SEED14,SEED15
REAL SEED1,SEED2,SEED3,SEED4,SEED5,SEED6,SEED7,
  1 SEED8,SEED9,SEED10,SEED11,SEED12,SEED13,SEED14,
  2 SEED15
INTEGER I, J, RANDCR, INDCTR
REAL PCOMB(6,3), RANDC, MEAN(3)
DATA PCOMB(1,1),PCOMB(1,2),PCOMB(1,3)/.75,.75,.25/
DATA PCOMB(2,1),PCOMB(2,2),PCOMB(2,3)/.75,.25,.75/
DATA PCOMB(3,1),PCOMB(3,2),PCOMB(3,3)/.25,.75,.75/
DATA PCOMB(4,1),PCOMB(4,2),PCOMB(4,3)/.25,.25,.75/
DATA PCOMB(5,1),PCOMB(5,2),PCOMB(5,3)/.75,.25,.25/
DATA PCOMB(6,1),PCOMB(6,2),PCOMB(6,3)/.25,.75,.25/
INDCTR = VPROG(J)
GO TO (100,200,300),INDCTR
100 DO 105 J=1,3
    MEAN(J) = .75
    GO TO 400
105 DO 105 J=1,3
200 CALL IRRANU(SEEDS,1,6, RANDC R)
   DO 205 J=1,3
205 MEAN(J) = PCOMB(RANDX,J)
   GO TO 400
300 DO 305 J=1,3
305 MEAN(J) = .25
   GO TO 400
400 DO 405 J=1,3
    CALL GAUSS(SEED4,MEAN(J),OE,RANDX)
    MPO(1,J) = RANDX
    IF (MPO(1,J).LT.0.00) MPO(1,J) = 0.00
    IF (MPO(1,J).GT.1.00) MPO(1,J) = 1.00
405 CONTINUE
RETURN
END
SUBROUTINE QUTENV(SUBID)
INTEGER ORGSPC, TCYCL, OUTCD, VPROG, SIZENV, PRFSCP
INTEGER EVOKEO, PCOSEO, PROGT, LTFECM, ID
INTEGER NUMSRC, SWITCH, PRTOUT
REAL MPO, PROBPG, CONASP, GOALWT, MPEVC, MOUTCM
REAL MPEVAL, LCM8PO
COMMON ORGSPC(20), TCYCL, OUTCD(51), VPROG(300), MPO(300,3)
COMMON SIZENV, PROBPG(3), CONASP(3,2), GOALWT(3),
1 MPEVC(300,4), PROG, EVOKEO(7), PCOSEO(720), PROGT,
2 MOUTCM(720,3), MPEVAL(720,3), LCM8PO(720), LTFECM(7), ID,
3 NUMSRC(720), SWITCH(720), PRTOUT
INTEGER SUBID, I, J
INTEGER PKG1, PKG3, PKG9
510 WRITE(PRTOUT,2000) IC, TCYCL, SUBID
WRITE(PRTOUT,2005) SIZENV, (PROBPG(I),I=1,3)
PRG1 = -8
PRG9 = 0
520 PKG1 = PKG1 + 9
PRG9 = PRG9 + 9
IF (PRG1.GT.SIZENV) GO TO 530
IF (PRG9.GT.SIZENV) PKG9 = SIZENV
WRITE(PRTOUT,2015) PKG1, PKG9, (MPO(I,J),J=1,3),
      1 PKG9
      GO TO 520
530 WRITE(PRTOUT,2020) TCYCL
PRG1 = -2
PRG3 = 0
540 PKG1 = PKG1 + 3
PRG3 = PRG3 + 3
IF (PRG1.GT.SIZENV) GO TO 600
IF (PRG3.GT.SIZENV) PKG3 = SIZENV
WRITE(PRTOUT,2025) PKG1, PKG3, (MPO(I,J),J=1,3),
      1 PKG3
      GO TO 540
600 RETURN
2000 FORMAT(16X,14,H TASK CYCLE,13,
      1 14H SUBROUTINE,12,60X)
2005 FORMAT(23X,7HSIZE NV ,13,7H PROBPG,3F8.5,9H; VPROG',
      1 60X)
2015 FORMAT(20X,13,1H=,13,2X,915,59X)
2020 FORMAT(23X,11HTASK CYCLE,13,13H POTENTIAL ,
      1 22HOUTCOMES AT THIS POINT,61X)
2025 FORMAT(20X,13,1H=,13,3(1X,3F5.3),58X)
END
SUBROUTINE ERROUT(I, ORGSPC, PRTOUT)
INTEGER ORGSPC, I, PRTOUT
999 WRITE(PRTOUT,2999) I, ORGSPC
2999 FORMAT(1H1,15X,29H***ERROR*** INCORRECT ORG.
118Hspecification NO.,12, 4H (:14,1H),5X)
STOP
END
SUBROUTINE CKVSP(STRUC, ORGSPC, PRTOUT)
INTEGER STRUC(5), ORGSPC(20), I, PRTOUT
IF ((ORGSPC(4).GE.0).AND.(ORGSPC(4).LE.2)) GO TO 5
   I = 4
   GO TO 999
5  STRUC(1) = ORGSPC(4)
   IF (STRUC(1).EQ.2) GO TO 50
20 IF ((ORGSPC(10).GE.1).AND.(ORGSPC(10).LE.3))
   1   GO TO 22
      1 = 10
      GO TO 999
22 STRUC(2) = ORGSPC(10)
   IF (((ORGSPC(3).EQ.1).OR.(ORGSPC(3).EQ.2))GO TO 24
      1 = 3
      GO TO 999
24 STRUC(3) = ORGSPC(3)
   IF (((ORGSPC(11).EQ.1).OR.(ORGSPC(11).EQ.2))) GO TO 26
      1 = 11
      GO TO 999
26 STRUC(4) = ORGSPC(11)
   IF (ORGSPC(9).EQ.0) GO TO 28
      1 = 9
      GO TO 999
28 STRUC(5) = ORGSPC(9)
   GO TO 100
50 IF ((ORGSPC(7).GE.1).AND.(ORGSPC(7).LE.3))
   1   GO TO 52
      1 = 7
      GO TO 999
52 STRUC(2) = ORGSPC(7)
   IF (((ORGSPC(3).EQ.1).OR.(ORGSPC(3).EQ.2)) GO TO 54
      1 = 3
      GO TO 999
54 STRUC(3) = ORGSPC(3)
   IF (((ORGSPC(8).EQ.1).OR.(ORGSPC(8).EQ.2)) GO TO 56
      1 = 8
      GO TO 999
56 STRUC(4) = ORGSPC(8)
   IF ((ORGSPC(9).GE.1).AND.(ORGSPC(9).LE.5))
      1 = 9
      GO TO 999
58 STRUC(5) = ORGSPC(9)
100 RETURN
999 CALL ERROUT(I, ORGSPC(I), PRTOUT)
END
SUBROUTINE GMPERC(T, STRUC, MPERC, MP(I))
INTEGER STRUC(5), T, J
REAL MPERC(300, 4), MP(300, 3)
REAL STDDEV(2), RSD, MEAN, RANDX
COMMON /SEEDS/ SEED1, SEED2, SEED3, SEED4, SEED5, SEED6,
1 SEED7, SEED8, SEED9, SEED10, SEED11, SEED12, SEED13,
2 SEED14, SEED15
REAL SEED1, SEED2, SEED3, SEED4, SEED5, SEED6, SEED7,
1 SEED8, SEED9, SEED10, SEED11, SEED12, SEED13, SEED14,
2 SEED15
DATA STDDEV(1), STDDEV(2) / .08, .16/ J = STRUC(3)
MPERC(1, 4) = STDDEV(J)
RSD = MPERC(1, 4)
DO 193 J = 1, 3
  IF (STRUC(4) .EQ. 1) GO TO 110
  IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 120
  IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 130
  IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 150
  IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 170
  IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 180
  MEAN = .75
  GO TO 190
  MEAN = .25
  GO TO 190
110 IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 120
  MEAN = .25
  GO TO 190
120 MEAN = .25
  GO TO 190
130 MEAN = .75
  GO TO 190
150 IF ((MP(1, J) .GE. 0.00) .AND. (MP(1, J) .LE. 0.50)) GO TO 170
  MEAN = .75
  GO TO 190
170 MEAN = .75
  GO TO 190
180 MEAN = .25
  GO TO 190
190 CALL GAUSS(SEED6, MEAN, RSD, RANDX)
  MPERC(1, J) = RANDX
  IF (MPERC(1, J) .LT. 0.00) MPERC(1, J) = 0.00
  IF (MPERC(1, J) .GT. 1.00) MPERC(1, J) = 1.00
CONTINUE
RETURN
END
SUBROUTINE RANCHG(SEED10, SIZEEN, VPRG, DIFFPG, K, PRGCHG)
INTEGER VPRG(300)
INTEGER SIZEEN, DIFFPG(3), PRGCHG(10), I, J, K, L, RAN
REAL SEED10

130   K = 0
       GO TO 147
135   CALL IRANU(SEED10, 1, SIZEEN, RAN)
       J = VPRG(RAN)
       IF (DIFFPG(J) .GT. 0) GO TO 135
140   L = 1
141   IF (DIFFPG(L) .GT. 0) GO TO 145
       L = L + 1
       GO TO 141
145   VPRG(RAN) = L
       DIFFPG(J) = DIFFPG(J) + 1
       DIFFPG(L) = DIFFPG(L) - 1
       K = K + 1
       PRGCHG(K) = RAN
147   I = 1
148   IF (DIFFPG(I) .NE. 0) GO TO 135
       IF (I .EQ. 3) GO TO 150
       I = I + 1
       GO TO 148
150   RETURN
END
APPENDIX B

EXAMPLES OF THE SIMULATION MODEL'S OPERATION

TWO PATTERNS OF FACTORS ARE USED AS EXAMPLES TO

ILLUSTRATE THE FUNCTIONING OF THE SIMULATION MODEL. THE TWO

 PATTERNS USED ARE REFERRED TO AS "LOW STRUCTURE" AND

"HIGH STRUCTURE." THESE LABELS ARE CONVENIENT TO USE

SINCE THE MAJOR DIFFERENCE BETWEEN THE TWO PATTERNS IN EACH

OF THE 6 PAIRS OF PATTERNS INVESTIGATED IN THIS STUDY IS

THAT ONE HAS LOW STRUCTURE AND THE OTHER HAS HIGH STRUCTURE.

LIKEWISE, IN THE 2 EXAMPLES ONE ORGANIZATION HAS LOW

STRUCTURE AND THE OTHER HAS HIGH STRUCTURE. EACH SET OF

SPECIFIED FACTOR LEVELS DEFINES AN ORGANIZATION. GIVEN THE

KIND OF ORGANIZATION INITIALLY SPECIFIED, THE SIMULATION

METHODOLOGY ALLOWS THE RESEARCHER TO OBSERVE THE BEHAVIOR OF

THE ORGANIZATION OVER TIME.

FOR EACH EXAMPLE INFORMATION IS PRESENTED BY TASK CYCLE

AND SUBROUTINE. TASK CYCLE 0 INDICATES INITIALIZING

PROCESSES (SEE APPENDIX A). THE SWITCH FROM ONE TASK CYCLE

TO THE NEXT OCCURS IN SUBROUTINE B, THE ENVIRONMENTAL CHANGE

PROCESS. THE SUBROUTINES ASSOCIATED WITH THE NUMERIC CODES

ARE AS FOLLOWS (SEE APPENDIX A FOR A LISTING OF THE

PROGRAMS):

<table>
<thead>
<tr>
<th>SUBROUTINE</th>
<th>IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MAIN PROGRAM--PRIOR TO ANY INITIALIZING</td>
</tr>
<tr>
<td>1</td>
<td>INITIALIZE THE ENVIRONMENT</td>
</tr>
<tr>
<td>2</td>
<td>INITIALIZE STRUCTURE AND PERCEPTIONS</td>
</tr>
<tr>
<td>3</td>
<td>INITIALIZE THE EVOKED SET</td>
</tr>
</tbody>
</table>

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STARCH AND CHOICE BEHAVIOR - PERFORMANCE EVALUATION PROCESS - LEARNING BEHAVIOR - ENVIRONMENTAL CHANGE PROCESS - ADD AND DELETE PERCEPTIONS - MAIN PROGRAM--AFTER ALL TASK CYCLES ARE FINISHED

THE INFORMATION PROVIDED BY EACH SUBROUTINE IS PRESENTED BELOW:

SUBROUTINE 0

THE 18 FACTOR LEVELS AS SPECIFIED BY THE RESEARCHER

(SEE APPENDIX C FOR A LISTING OF THE 18 FACTORS AND THEIR ASSOCIATED LEVELS.)

SUBROUTINE 1

1. SIZE OF THE ENVIRONMENT

2. PROBABILITIES OF THE 3 PROGRAM TYPES (ALL HIGH, MIXED, ALL LOW)

3. VECTOR OF PROGRAM TYPES WHERE 1 MEANS ALL HIGH, 2 MEANS MIXED, AND 3 MEANS ALL LOW PROGRAM TYPE.

THIS VECTOR IDENTIFIES WHAT KIND OF PROGRAM EACH SPECIFIC PROGRAM OF TASK BEHAVIOR IS. IT IS GENERATED RANDOMLY ACCORDING TO THE SIZE OF THE ENVIRONMENT AND THE PROBABILITIES OF PROGRAM TYPES.

4. POTENTIAL OUTCOMES ASSOCIATED WITH EACH PROGRAM.

EACH OF THE 3 POTENTIAL OUTCOMES ASSOCIATED WITH A PROGRAM ARE DETERMINED ACCORDING TO THE TYPE OF PROGRAM THAT PARTICULAR PROGRAM IS.

SUBROUTINE 2
1. LOWER AND UPPER ASPIRATIONS FOR GOALS 1, 2, AND 3

2. WEIGHTS ASSOCIATED WITH GOALS 1, 2, AND 3, INDICATING RELATIVE IMPORTANCE

3. THE PRESCRIBED PROGRAM OF TASK BEHAVIOR, IF STRUCTURE IS HIGH.

4. PERCEPTIONS FOR EACH PROGRAM. THE FIRST 3 PERCEPTIONS FOR EACH PROGRAM INDICATE THE ESTIMATED OUTCOME LEVEL FOR EACH OF THE 3 OUTCOMES. THE FOURTH PERCEPTION INDICATES THE DEGREE OF UNCERTAINTY. IT IS THE STANDARD ERROR OF THE ESTIMATED LEVEL.

SUBROUTINE 3

1. PROGRAMS IN THE EVOKED SET, IF ANY

2. THE NUMBER OF TIMES ASPIRATIONS LOWERED, IF ANY, AND THE NUMBER OF PROGRAMS IN THE EVOKED SET AT THE TIME OF LOWERING; ALSO, THE KIND OF SEARCH STRATEGY USED TO OBTAIN AN INITIAL EVOKED SET.

SUBROUTINE 4

1. THE NUMBER OF SEARCHES TO FIND A PROGRAM AND OTHER INFORMATION ASSOCIATED WITH THE SELECTION:
   A. WHETHER A SWITCH WAS MADE FROM THE PREVIOUS TASK CYCLE
   B. THE NUMBER OF EXPANDED SEARCHES AND ASPIRATION LOWERINGS AS WELL AS THE NUMBER OF PROGRAMS IN THE EVALUATION SET AT THE TIME OF LOWERING.

2. THE PROGRAM CHOSEN

3. THE VALUES USED TO RANK THE PROGRAMS IN THE SET OF PROGRAMS EVALUATED
4. Programs searched beyond the evoked set, if any

5. The set of programs evaluated

6. Programs in the evoked set before search and choice

7. Programs in the evoked set after search and choice

Subroutine 5

1. The outcomes and deviations for determining the three performance outcomes

2. The three performance outcomes

Subroutine 6

1. The number of task cycles evaluated and the specific ones evaluated

2. The frequency of review and the information delay for review

3. Performance evaluation bias (mean value)

4. The weighted combination of performance outcomes
   (uses goal weights)

5. Performance evaluations, if any

Subroutine 7

1. Programs for which learning occurs, if any

2. Revised perceptions for those programs

Subroutine 8

1. Same information as in subroutine 1 with additions, including the following.

2. The number of programs added or deleted
3. THE NUMBER OF PROGRAMS CHANGED AND THE SPECIFIC
PROGRAMS CHANGED

4. THE SPECIFIC PROGRAMS ADDED OR DELETED

SUBROUTINE 9

PERCEPTIONS FOR ALL CURRENT PROGRAMS

SUBROUTINE 10

1. POTENTIAL OUTCOMES FOR ALL PROGRAMS AFTER THE LAST
TASK CYCLE

2. PERCEPTIONS FOR ALL PROGRAMS AFTER THE LAST TASK
CYCLE

3. PROGRAMS CHOSEN BY TASK CYCLE

4. PROGRAM SWITCHES BY TASK CYCLE

5. NUMBER OF SEARCHES EACH CYCLE

6. WEIGHTED COMBINATION OF OUTCOMES BY CYCLE

7. PERFORMANCE OUTCOMES BY CYCLE

8. PERFORMANCE EVALUATIONS FOR EACH CYCLE

9. SUMMARY DATA
   A. ORGANIZATIONAL SPECIFICATIONS (REPEAT OF
      FACTOR LEVELS SPECIFIED IN SUBROUTINE 0)
   B. INITIAL SEEDS FOR THE RANDOM NUMBERS
   C. THE NUMBER OF SEARCHES IN EACH THIRD OF THE
      TIME HORIZON AND THE TOTAL TIME HORIZON
   D. THE NUMBER OF SWITCHES IN EACH THIRD OF THE
      TIME HORIZON AND THE TOTAL TIME HORIZON
   E. THE MEAN OF THE WEIGHTED COMBINATION OF
      OUTCOMES OBTAINED IN EACH OF THE TASK CYCLES
      FOR EACH THIRD OF THE TIME HORIZON AND THE
      TOTAL TIME HORIZON
   F. THE STANDARD DEVIATIONS ASSOCIATED WITH THE
MEAN VALUES OF THE WEIGHTED COMBINATION OF OUTCOMES.

EXAMPLES

INFORMATION GENERATED FOR EACH OF THE 2 EXAMPLE PATTERNS IS PRESENTED NOW. THE MODEL WAS RUN FOR 180 TASK CYCLES. INITIAL INFORMATION AND ENDING INFORMATION IS PRESENTED TO INDICATE THE FUNCTIONING OF THE MODEL.
SIMULATION RUN EXAMPLES (HIGH AND LOW STRUCTURE)

**CONTROL PARAMETERS**

**TASK CYCLES 160; TOTAL RUNS 2; START CODE 0**

OUTCD(1-5) 1 1 0 0 1; TP1OUT 0; TP2OUT 0; PR1OUT 12

IN 5; TCMPGP 0; NUMDBG 2; PUNCH 0

DBGTC 0 2 180 180

GENV1 0; NUMVW1 0; GENV2 0; NUMVW2 0

IDVW1 0

IDVW2 0

CARPC1 0; CARPC2 0; PCOUNT 0

SEEDS 45045666 25854326 84293526 34568928 72849184

SEEDS 41423472 23563584 94230752 17283968 19495328

SEEDS 31312316 69423712 34665280 74726912 15618728

1 TASK CYCLE 0 SUBROUTINE 0

3 1 2 1 2 0 0 0 3 1 5 1 1 1 0 0 1

1 TASK CYCLE 0 SUBROUTINE 1

SIZENV 27 PRBPG 0.20000 0.20000 0.60000; VPRDG

1-9 2 3 2 2 1 3 3 3
10-18 3 3 3 3 3 3 3 3
19-27 3 3 3 1 3 2 1 3

1 TASK CYCLE 0 POTENTIAL OUTCOMES AT THIS POINT

1-3 0.2640.7080.202 0.1410.2080.273 0.3590.8850.777
4-6 0.2680.3640.784 0.0780.8220.685 0.1050.1710.367
7-9 0.1370.1800.260 0.2840.3940.309 0.2750.1970.340
10-12 0.2180.2420.302 0.1800.2210.297 0.2640.2760.123
13-15 0.2550.2020.109 0.2000.2470.404 0.2360.3210.145
16-18 0.3400.8330.241 0.2070.2690.317 0.8440.3490.360
19-21 0.3070.1710.284 0.7630.7890.676 0.2690.3300.431
22-24 0.7030.8060.729 0.0740.0170.181 0.8650.1780.187
25-27 0.8760.8780.766 0.3230.2570.322 0.7140.7410.964

1 TASK CYCLE 0 SUBROUTINE 2

ASP. GL 1 0.147 1.000 GL 2 0.246 1.000 GL 3 0.261 1.000

WEIGHTS GL 1 0.600 GL 2 0.200 GL 3 0.200 PRESCP 0

1 TASK CYCLE 0 PERCEPTIONS AT THIS POINT

1, 2 0.2820.7760.3130.160 0.2350.3810.4010.160
3, 4 0.1770.6900.7260.160 0.3150.0550.6300.160
5, 6 0.5660.7150.9880.160 0.4000.2160.0790.160
7, 8 0.1150.2970.0880.160 0.3510.0580.2980.160
9, 10 0.2740.5340.1620.160 0.2890.4660.4110.160
11, 12 0.1900.5000.0 0.160 0.2480.2660.0 0.160
13, 14 0.2930.0310.1190.160 0.2650.1210.0970.160
15, 16 0.4620.1290.4390.160 0.4170.4780.0 0.160
17, 18 0.4010.3590.0450.160 0.6190.2410.5350.160
19, 20 0.4390.4730.0880.160 0.8040.6870.8370.160
21, 22 0.1220.4070.2430.160 0.7300.6710.9320.160
23, 24 0.0150.0490.2620.160 0.7480.5770.0 0.160
25, 26 1.0000.7320.7940.160 0.2440.2540.3240.160
27, 27 0.7790.9980.5090.160

0=ORSCP16

1 TASK CYCLE 0 SUBROUTINE 3

PROGRAMS IN EVOKED SET 6 18 24 27 10 13 3

LOWASP 0 COUNTV 0 0 0 0 COUNT 0 SERCHS 2
1 TASK CYCLE 1 SUBROUTINE 4
NUMSRC 1 SWITCH 0 NUMCAL 0 EXPSCh 0 LOWASP 0
COUNTV 0
PROGT 6
1- 1 3762.32
PROGRAMS SEARCHED 0 0 0 0 0 0 0
PROGFVL 6 0 0 JMAX 1 JMIN 1 PROGT 6
PROGRAMS IN EVOKED SET 6, 18, 24, 27, 10, 13, 3
MOUTCM(1, 1) = -0.06370 DEVN = 0.01105
MOUTCM(1, 2) = 0.10452 DEVN = 0.04939
MOUTCM(1, 3) = 0.34063 DEVN = 0.03696
1 TASK CYCLE 1 SUBROUTINE 5
OUTCOMES 0.0
OUTCOMES 0.15391
OUTCOMES 0.37759
1 TASK CYCLE 1 SUBROUTINE 6
LTCEVL 1 1 0 0 0 0 FRQCY 1 DELAY 0
PBIAS 0.06 LCMBPO 0.1063
MPEVAL 0.0511 0.2064 0.4272
1 TASK CYCLE 1 SUBROUTINE 7
LEARNING FOR PROGRAMS 6
PERCEPTIONS FOR PROGRAMS 6, 6, 0.4000, 0.3160, 0.0790, 0.160
1 TASK CYCLE 2 SUBROUTINE 8
SIZENV 30 PROEPG 0.20300 0.19850 0.59850; VPROG
1- 9 0.2640, 0.7980, 0.2020 0.1410, 0.2080, 0.273 0.3990, 0.8850, 0.777
4- 6 0.2680, 0.3640, 0.784 0.7870, 0.2220, 0.885 0.1050, 0.1710, 0.367
7- 9 0.1370, 1.000, 0.260 0.2840, 0.3940, 0.309 0.2750, 0.1970, 0.340
10- 12 0.2180, 0.2420, 0.302 0.1800, 0.2210, 0.297 0.2640, 0.2760, 0.123
13- 15 0.2550, 0.2020, 0.109 0.2000, 0.2470, 0.404 0.2360, 0.3210, 0.145
16- 18 0.3400, 0.8330, 0.741 0.2070, 0.2690, 0.317 0.8440, 0.3490, 0.360
19- 21 0.3070, 0.1710, 0.784 0.7630, 0.7890, 0.676 0.2690, 0.3300, 0.431
22- 24 0.7030, 0.8060, 0.729 0.0740, 0.0170, 0.181 0.8650, 0.7890, 0.187
25- 27 0.8760, 0.8770, 0.766 0.3230, 0.2570, 0.322 0.7140, 0.7410, 0.946
28- 30 0.7590, 0.2650, 0.697 0.6460, 0.6730, 0.806 0.3020, 0.3140, 0.221
DIFFPG 0 0 0 NUMADD 3 NUMDEL 0
K 0 PRGCHG 0
PRGADD 28 29 30 PRGDEL 0 0 0
1 TASK CYCLE 2 SUBROUTINE 9
1 TASK CYCLE 2 PERCEPTIONS AT THIS POINT
1, 2 0.2820, 0.8760, 0.3130, 0.160 0.2350, 0.3810, 0.4010, 0.160
3, 4 0.1770, 0.6900, 0.7360, 0.160 0.3150, 0.0550, 0.6300, 0.160
5, 6 0.5660, 0.7150, 0.9800, 0.160 0.4000, 0.3160, 0.0790, 0.160
7, 8 0.1150, 0.2970, 0.0680, 0.160 0.2510, 0.0580, 0.2960, 0.160
9, 10 0.2740, 0.5340, 0.1620, 0.160 0.2890, 0.4660, 0.4110, 0.160
1. TASK CYCLE 2 SUBROUTINE 4
   NUMSRC 1 SWITCH 0 NUMCAL 0 EXPSCH 0 LOWASP 0
   COUNTER 0
   PROGTV 6
   1-0 0.3762.32
   PROGRAMS SEARCHED 0
   PROGFLV 0 0 0 JMAX 1 JMIN 1 PPROGT 6
   PROGRAMS IN EVOKED SET 6 18 24 27 10 13 3
   MOUTCM( 2, 1)= -0.03243DEVN= 0.03331
   MOUTCM( 2, 2)= 0.22143DEVN= 0.02066
   MOUTCM( 2, 3)= 0.31199DEVN= 0.08978

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   OUTCOMES 0.00088
   OUTCOMES 0.24208
   OUTCOMES 0.22821

1. TASK CYCLE 2 SUBROUTINE 6
   LICEVL 1 2 0 0 0 0 0 0 0 FRQCY 1 DELAY 0
   PBIAS 0.06 LCMPEL 0.9934
   MPEVL 0.0666 0.3393 0.3161

1. TASK CYCLE 2 SUBROUTINE 7
   LEARNING FOR PROGRAMS 6
   PERCEPTIONS FOR PROGRAMS 6, 6 0.0590 0.2760 0.3550 0.035

1. TASK CYCLE 2 SUBROUTINE 8
   SZENV 33 PROBPG 0.20600 0.19700 0.59700; VPROM
   1-9 2 2 2 2 1 3 3 3 3
   10-18 3 3 3 3 3 3 2 3 2
   19-27 3 1 3 1 3 2 1 3 1
   28-33 2 1 3 3 3 3 2
   TASKCYCLE 3 POTENTIAL OUTCOMES AT THIS POINT
   1-3 0.2640 0.2980 0.202 0.1410 0.2080 0.273 0.3990 0.8850 0.777
   4-6 0.2680 0.2640 0.784 0.7870 0.2200 0.685 0.1050 0.1710 0.367
   7-9 0.1370 0.1800 0.260 0.2840 0.3940 0.309 0.2750 0.1970 0.340
   10-12 0.2180 0.2420 0.302 0.1800 0.2210 0.297 0.2640 0.2760 0.123
   13-15 0.2550 0.2020 0.109 0.2000 0.2470 0.404 0.2360 0.3210 0.145
   16-18 0.2400 0.8230 0.241 0.2070 0.2690 0.317 0.8440 0.3490 0.260
   19-21 0.3070 0.1710 0.284 0.7630 0.7890 0.676 0.2690 0.3300 0.431
   22-24 0.7030 0.8060 0.729 0.0740 0.0170 0.181 0.8650 0.7890 0.187
   25-27 0.8760 0.8770 0.760 0.3230 0.2570 0.322 0.7140 0.7410 0.946
   28-30 0.7590 0.2650 0.697 0.6460 0.6730 0.808 0.3020 0.3140 0.221
   31-33 0.1940 0.1890 0.190 0.3760 0.0930 0.101 0.6550 0.6460 0.132
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- 0.77300

1 TASK CYCLE 180 SUBROUTINE 6

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1 TASK CYCLE 180 SUBROUTINE 7

LEARNING FOR PROGRAMS 18

PERCEPTIONS FOR PROGRAMS
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OUTCOMES AT THIS POINT
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1 TASK CYCLE 181 SUBROUTINE 10

OUTCOMES AT THIS POINT
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180 TOTAL TASK CYCLES

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**180 TOTAL TASK CYCLES**

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**180 TOTAL TASK CYCLES**

**NO. OF SEARCHES EACH CYCLE**

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**180 TOTAL TASK CYCLES**

**WEIGHTED COMB. OF OUTCOMES**

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PROGRAMS IN EVOKED SET 8, 11, 6, 9, 5, 19
LOWASP 0 COUNTV 0, 0, 0, 0 COUNT 0 SARCHS 2
ASP, GL 1 0.091 0.251 GL 2 0.097 0.257 GL 3 0.250 0.410

2 TASK CYCLE 0 SUBROUTINE 4
NUMSRC 10 SWITCH 0 NUMCAL 1 EXPSCB 1 LOWASP 0
COUTV 0
PROGT 22
1- 1 73.17
PROGRAMS SEARCHED 20, 21, 22, 0, 0, 0, 0
PREGVL 22 0, 0, JMAX 3, JMIN 1, PROGT 22
PROGRAMS IN EVOKED SET 8, 1, 11, 6, 9, 5, 19
EVOKED SET 8, 1, 11, 6, 22, 5, 19

2 TASK CYCLE 0 SUBROUTINE 2
ASP, GL 1 0.091 0.251 GL 2 0.097 0.257 GL 3 0.250 0.410
WEIGHTS GL 1 0.333 GL 2 0.333 GL 3 0.333 PRESCP 22

2 TASK CYCLE 0 SUBROUTINE 4
NUMSRC 10 SWITCH 0 NUMCAL 0 EXPSCB 0 LOWASP 0
COUNTV 0
PROGT 22
1- 0 73.17
PROGRAMS SEARCHED 0
PREGVL 0, 0, 0, JMAX 0, JMIN 0, PROGT 22
PROGRAMS IN EVOKED SET 8, 1, 11, 6, 22, 5, 19
MOUTCM(1, 1) = 0.18678 DEVN = -0.00934
MOUTCM(1, 2) = 0.46385 DEVN = -0.04903
MOUTCM(1, 3) = 0.16814 DEVN = 0.00829
2 TASK CYCLE 1 SUBROUTINE 5
OUTCOMES 0.17744
OUTCOMES 0.41462
OUTCOMES 0.17643
2 TASK CYCLE 1 SUBROUTINE 6
LICEL 0 0 0 0 0 0 0 FROGY 1 DELAY 0
PBASS 0.0 LCMPE 0.2562
2 TASK CYCLE 1 SUBROUTINE 7
LEARNING FOR PROGRAMS
PERCEPTIONS FOR PROGRAMS
2 TASK CYCLE 2 SUBROUTINE 8
SIZENV 30 PREEPG 0.20300 0.19850 0.59850; VPRG1
1- 9 3 3 3 3 3 2 1 3 2 1
10- 18 3 1 2 3 3 3 3 2 1
19- 27 3 2 3 3 3 3 3 2 3 1
28- 30 3 1 2
2 TASK CYCLE 2 POTENTIAL OUTCOMES AT THIS POINT
1- 3 0.2060.1770.181 0.2730.2350.175 0.2870.2090.173
4- 6 0.1030.3650.149 0.1840.6090.151 0.6630.7110.717
7- 9 0.2400.2490.158 0.1770.7590.771 0.8330.7990.757
10- 12 0.2310.1970.428 0.2610.7000.833 0.7940.8240.262
13- 15 0.1840.1760.187 0.1050.1660.310 0.4110.1000.279
16- 18 0.2290.1130.354 0.1900.3560.636 0.7260.7630.666
19- 21 0.1960.2200.164 0.7890.1610.300 0.2890.1670.216
22- 24 0.1450.3600.157 0.0960.1210.147 0.1070.2420.265
25- 27 0.7000.8280.075 0.2500.2590.331 0.8030.7340.702
28- 30 0.3110.3190.234 0.6240.7750.860 0.2380.8220.197
DIFFPG 0 0 NUMADD 3 NUMDEL 0
K 0 PRGCHG 0
PRGADD 28 29 30 PRGDEL 0 0 0
2 TASK CYCLE 2 SUBROUTINE 9
TASK CYCLE 2 PERCEPTIONS AT THIS POINT
1, 2 0.0430.1530.1400.160 0.0360.1950.0480.2620.160
3, 4 0.6260.0 0.3360.160 0.1990.0 0.5580.160
5, 6 0.1060.4960.1220.160 0.6990.7370.6110.160
7, 8 0.0990.2210.0820.160 0.2670.6380.2750.160
9, 10 0.3840.6520.7190.160 0.0 0.6030.0610.160
11, 12 0.3610.5930.5110.160 0.4730.7210.2230.160
13, 14 0.1970.3260.0 0.160 0.2500.2650.3060.160
15, 16 0.3450.2900.2110.160 0.3110.3460.2970.160
17, 18 0.0240.1901.0000.160 0.7280.7980.7590.160
19, 20 0.1330.0180.1770.160 0.3600.2780.4570.160
21, 22 0.3230.0 0.3610.160 0.1150.1180.3570.160
23, 24 0.3610.2810.0600.160 0.1630.1920.3140.160
25, 26 0.4950.7430.1510.160 0.2780.1020.3130.160
27, 28 0.8070.7040.4610.160 0.2900.3260.0 0.160
29, 30 0.4200.5280.5770.160 0.2380.6370.3430.160
2 TASK CYCLE 2 SUBROUTINE 4
NUMSRC 1 SWITCH 0 NUMCAL 0 EXPSCH 0 LOWASP 0
COUNTV 0
PROGT 22
1- 0 73.17
PROGRAMS SEARCHED 0
PRCEVL 0 0 0 JMAX 0 JMIN 0 PROGT 22
PROGRAMS IN EVOKED SET 8 1 11 6 22 5 19
MOUTCM(2, 1) = 0.07678 DEVN = -0.03954
MOUTCM(2, 2) = 0.31797 DEVN = -0.03824
MOUTCM(2, 3) = 0.09370 DEVN = 0.02443

2 TASK CYCLE 2 SUBROUTINE 5
OUTCOMES 0.03724
OUTCOMES 0.27973
OUTCOMES 0.11812

2 TASK CYCLE 2 SUBROUTINE 6
LTCEVL 0 0 0 0 0 0 FRGCY 1 DELAY 0
PBIAS 0.0 LCMBPD 0.1450

2 TASK CYCLE 2 SUBROUTINE 7
LEARNING FOR PROGRAMS 0
PERCEPTIONS FOR PROGRAMS 0

2 TASK CYCLE 3 SUBROUTINE 8
SIZENV 33 FRDBPG 0.20600 0.19700 0.58700; VPROC:
1 - 9 3 3 3 2 1 3 2 1
10-18 3 1 2 3 3 3 3 2 1
19-27 3 2 3 3 3 3 3 2 1
28-33 2 1 2 3 2 3

2 TASK CYCLE 3 SUBROUTINE 9
LEARNING FOR PROGRAMS 0
PERCEPTIONS AT THIS POINT 0

K 2 PRGCYG 33 31
PRGADD 31 32 33 PRGDEL 0 0 0

2 TASK CYCLE 3 SUBROUTINE 9
LEARNING FOR PROGRAMS 0
PERCEPTIONS AT THIS POINT 0

1, 2 0.0430.1530.1400.1600 0.0260.0480.2620.160
3, 4 0.6260.0 0.3360.1600 0.1900.0 0.5580.160
5, 6 0.0640.3680.1220.1600 0.6990.7370.6110.160
7, 8 0.0990.2210.0820.1600 0.2670.6380.2750.160
9, 10 0.8440.6520.7190.1600 0.0 0.6030.6010.160
11, 12 0.3610.5930.5110.1600 0.4730.7210.2230.160
13, 14 0.1970.3760.0 0.1600 0.2500.2650.3060.160
15, 16 0.3450.2900.2110.1600 0.3110.3460.2970.160
17, 18 0.0240.1401.0060.1600 0.7280.7980.7590.160
19, 20 0.1330.0180.1770.1600 0.3600.2760.4570.160
21, 22 0.3230.0 0.3610.1600 0.1150.1180.3570.160
23, 24 0.2610.2610.0600.1600 0.1630.1920.3140.160
25, 26 0.4550.7430.1510.1600 0.2780.1020.3130.160
### Task Cycle 181: Potential Outcomes at This Point

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0.17

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0.16

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0.9 5 0.40

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0.30

0.14

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0.18

0.16

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0.77

0. 16

0.59

0.34

0.56

0.16

0.77

0.61

0.16

0.77

0.74

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0.16

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0.8 6

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0.06

0.16

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**160 TOTAL TASK CYCLES**

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APPENDIX C

PATTERNS OF FACTOR LEVELS

In this study there are 12 major patterns of factors. Within each of the 12 major patterns a number of factors, specifically the critical factors identified by the propositions from the historical perspectives, have the same specified levels. Other factors, specifically the non-critical factors within each major pattern, have levels that are determined randomly for each simulated organization within the major pattern. Since there are 30 organizations simulated for each major pattern, there are 30 different patterns for the non-critical factor levels within each major pattern.

Identification of the factors and their associated levels are listed first. Following that is the listing of all 360 patterns of factors used in this study.

FACTOR IDENTIFICATION AND ASSOCIATED LEVELS

1 KIND OF ENVIRONMENT
   1. MUNIFICENT
   2. MIXED
   3. POOR

2 DEGREE OF INTERNAL CONTROL
   1. HIGH
   2. LOW

3 PERCEPTIONS—DEGREE OF CERTAINTY
   1. CERTAIN
   2. UNCERTAIN

4 STRUCTURE
   1. LOW

268
2. **HIGH**

5 **ENVIRONMENTAL CHANGE PROCESS**
   1. STABLE
   2. GROWING
   3. DECLINING

6 **ENVIRONMENT—INITIAL SIZE**
   1. LARGE
   2. SMALL

7 **ASPIRATIONS—DESIGNERS**
   0. NOT USED
   1. ALL HIGH
   2. MIXED
   3. ALL LOW

8 **PERCEPTIONS—DESIGNERS BELIEFS RELATIVE TO ACTUAL**
   0. NOT USED
   1. SAME
   2. DIFFERENT

9 **SEARCH AND CHOICE BEHAVIOR—DESIGNERS**
   0. NOT USED
   1. MAXIMIZING
   2. RATIONAL, WITH SATISFICING EVOKED SET
   3. RATIONAL, WITH RANDOM EVOKED SET
   4. SATISFICING, WITH SATISFICING EVOKED SET
   5. SATISFICING, WITH RANDOM EVOKED SET

10 **ASPIRATIONS—PERFORMERS**
   0. NOT USED
   1. ALL HIGH
   2. MIXED
   3. ALL LOW

11 **PERCEPTIONS—PERFORMERS BELIEFS RELATIVE TO ACTUAL**
   0. NOT USED
   1. SAME
   2. DIFFERENT

12 **SEARCH AND CHOICE BEHAVIOR—PERFORMERS**
   0. NOT USED
   1. MAXIMIZING
   2. RATIONAL, WITH SATISFICING EVOKED SET
   3. RATIONAL, WITH RANDOM EVOKED SET
   4. SATISFICING, WITH SATISFICING EVOKED SET
   5. SATISFICING, WITH RANDOM EVOKED SET

13 **PERFORMANCE EVALUATION PROCESS**
   0. NOT USED
   1. BIASED HIGH
2. BIASED LOW

14 FREQUENCY OF EVALUATION
   0. NOT USED
   1. FREQUENT
   2. INFREQUENT

15 LEARNING BEHAVIOR
   0. NOT USED
   1. BAYESIAN
   2. NON-BAYESIAN

16 NOT USED

17 ENVIRONMENTAL CHANGE PROCESS (OVERRIDES FACTOR 5
   IF THIS HAS A LEVEL OTHER THAN 0 AND FACTOR 5
   HAS A LEVEL OTHER THAN 1)
   0. NOT USED
   1. GROWING
   2. DECLINING

18 INFORMATION DELAY IN REVIEW
   0. NOT USED
   1. SHORT
   2. LONG

NOTE—ALTHOUGH LEVELS FOR FACTORS 10, 11, 12, 13, 14, 15, AND 18
MAY BE SPECIFIED, THEY ARE IRRELEVANT IN THE MODEL
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</tr>
</tbody>
</table>
APPENDIX D

CONTROL PARAMETERS FOR REPLICATING THE EXPERIMENTS

SIMULATION RUN DISSERTATION DATA FOR 360 ORGANIZATIONS

***CONTROL PARAMETERS***

TASK CYCLES 180; TOTAL RUNS 360; START CODE 0
OUTCD(1-5) 0 0 1 1 1; TP1OUT 8; TP2OUT 9; PRTOUT 6
LIN 5; TCMP0P 60; NUMDBG 0; PUNCH 7
DBGTC 0 0
GENVW1 0; NUMVW1 5; GENVW2 0; NUMVW2 30
IDVW1 160 169 255 94 356
IDVW2 341 281 343 345 350 123 299 30 314 2
IDVW2 32 13 294 266 347 50 69 145 82 66
IDVW2 58 241 127 31 337 177 93 233 90 248
CAPRC1 0; CAPRC2 0; PCCPUNT 0
SEEDS 45645644 . 25856432 . 64295528 . 34568928 . 72849184 .
SEEDS 41423472 . 23563584 . 94230752 . 17283968 . 19495328 .
SEEDS 3123136 . 69423712 . 34685280 . 74726912 . 15817628 .

283
Because of the complexity of the theoretical model and the resulting plan of presentation, details on the various segments of the model are spread throughout the dissertation. This appendix provides a summary, in one place, of the theoretical model, the possible factor levels for the factors in the various segments of the model and the operational values of the factor levels used in this study. (Appendix C contains the specific levels used for the factors in each of the 360 experiments.) The summary provided in this appendix consists of copies of Figure 4 and Tables 1-10.
Fig. 4.—Five segments of the theoretical model.
TABLE 1
POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 1

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
</table>
| A. Organizational Unit Design Process | 1. stable  
2. changing |
| B. Structure of the Organizational Unit | RANGE OF POSSIBLE VALUES |
| 1. Goals | ONE EXTREME | OTHER EXTREME |
| a. number | none | many |
| b. specification of aspiration levels | none specified | levels exactly specified (may range from low levels to high levels) |
| c. importance of each goal | no goals important (a hierarchy of goals with all being at the bottom) | all goals most important (a hierarchy of goals with all being at the top) |
| 2. Means for achieving goals | | |
| a. prescription of task behavior | low | high |
| b. prescription of communication channels | low | high |
| c. specification of a control system | | |
| 1) what is reviewed | goal achievement behavior | |
| 2) frequency of review | infrequent | frequent |
| 3) delay in review | large | none |
4) congruence with goals | high | low 

d. specification of a reward system 

1) what is rewarded | goal achievement | behavior 

2) frequency of reward | infrequent | frequent 

3) delay in reward | large | none 

4) congruence with control system | high | low 

5) congruence with goals | high | low 

e. configuration of the organizational unit | simple | complex 

f. authority to change structure | high | low 

C. Performance Outcomes | RANGE OF POSSIBLE VALUES | 

<table>
<thead>
<tr>
<th>ONE EXTREME</th>
<th>OTHER EXTREME</th>
</tr>
</thead>
</table>

1. Number | few | many |

2. Levels of Achievement | low | high |
4) congruence with goals high low

d. specification of a reward system

1) what is rewarded goal achievement behavior

2) frequency of reward infrequent frequent

3) delay in reward large none

4) congruence with control system high low

5) congruence with goals high low

e. configuration of the organizational unit simple complex

f. authority to change structure high low

C. Performance Outcomes

<table>
<thead>
<tr>
<th>ONE EXTREME</th>
<th>OTHER EXTREME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>few</td>
</tr>
<tr>
<td>Levels of Achievement</td>
<td>low</td>
</tr>
</tbody>
</table>
### TABLE 6

OPERATIONAL VALUES FOR FACTORS IN SEGMENT 1

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Organizational Unit Design Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Over time</td>
<td>1. stable: ( \text{Structure}_t = \text{Structure}_1 )</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>2. changing: not operationalized</td>
<td></td>
</tr>
<tr>
<td>2. Search and choice behavior under high structure</td>
<td>1. maximizing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. rational</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. satisficing</td>
<td></td>
</tr>
<tr>
<td>B. Structure of the Organizational Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>As a whole</td>
<td>1. low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. high</td>
<td></td>
</tr>
<tr>
<td>Values of sub-variables for low and high structure</td>
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<td></td>
</tr>
<tr>
<td>1. Goals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. number</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>b. specification of aspiration levels</td>
<td>minimum</td>
<td>small, acceptable range</td>
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<td>1) specificity of levels</td>
<td>desired</td>
<td>levels</td>
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<tr>
<td></td>
<td>levels specified</td>
<td>around exact levels specified (from 0 to 1)</td>
</tr>
<tr>
<td></td>
<td>(from 0 to 1)</td>
<td></td>
</tr>
<tr>
<td>2) levels specified</td>
<td>1. all low</td>
<td>1. all low</td>
</tr>
<tr>
<td></td>
<td>2. mixed</td>
<td>2. mixed</td>
</tr>
<tr>
<td></td>
<td>3. all high</td>
<td>3. all high</td>
</tr>
<tr>
<td>c. importance of each</td>
<td>1 most</td>
<td>all 3</td>
</tr>
<tr>
<td></td>
<td>important</td>
<td>important</td>
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</tbody>
</table>
2. Means for achieving goals

a. prescription of task behavior
   - low (no program specified)
   - high (a program specified)

b. prescription of communications channels
   - low (no program specified)
   - high (a program specified)

c. specification of a control system
   - what is reviewed
     1) goal achievement behavior
     2) frequency of review
        1. every cycle
        2. every 6 cycles
     3) delay in review
        1. zero cycles
        2. 6 cycles
     4) congruence with goals
        1. congruent
           (incongruent control system not operationalized)

   - specification of a reward system
     ignored because of assumptions

Assumptions:

1. Rewards are distributed according to the control system
2. Reward system is congruent with goals
3. Members of the organizational unit desire the rewards provided by the reward system

e. configuration of the organizational unit
   ignored because of assumptions

Assumptions:

1. The organizational unit is capable of behaving as a single entity
2. The degree of complexity does not affect the level of the organizational unit's ability to act as a single entity, or
Alternate 2
   The effect of the degree of complexity is reflected
2. Means for achieving goals

| a. prescription of task behavior | low (no program specified) | high (a program specified) |
| b. prescription of communications channels | low (no program specified) | high (a program specified) |
| c. specification of a control system |
| 1) what is reviewed | goal achievement behavior |
| 2) frequency of review | 1. every cycle 1. every cycle |
| | 2. every 6 cycles 2. every 6 cycles |
| 3) delay in review | 1. zero cycles 1. zero cycles |
| | 2. 6 cycles 2. 6 cycles |
| 4) congruence with goals | 1. congruent (incongruent control system not operationalized) |

| d. specification of a reward system | ignored because of assumptions |

Assumptions:

1. Rewards are distributed according to the control system
2. Reward system is congruent with goals
3. Members of the organizational unit desire the rewards provided by the reward system

| e. configuration of the organizational unit | ignored because of assumptions |

Assumptions:

1. The organizational unit is capable of behaving as a single entity
2. The degree of complexity does not affect the level of the organizational unit's ability to act as a single entity, or

Alternate 2

The effect of the degree of complexity is reflected
in the degree of internal control.

f. authority to change structure 

<table>
<thead>
<tr>
<th>low</th>
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<tr>
<td>(high authority not operationalized)</td>
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C. Performance outcomes

<table>
<thead>
<tr>
<th>POSSIBLE VALUES</th>
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<tbody>
<tr>
<td>1. Number</td>
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<tr>
<td>2. Levels of achievement</td>
</tr>
<tr>
<td>from 0 to 1 on all 3 outcomes</td>
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### TABLE 2

POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 2

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<th>FACTOR</th>
<th>RANGE OF POSSIBLE VALUES</th>
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<td><strong>A. Environment</strong></td>
<td><strong>ONE EXTREME</strong></td>
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<tr>
<td>1. Aggregate characteristics</td>
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</tr>
<tr>
<td>a. size</td>
<td>small</td>
</tr>
<tr>
<td>b. distribution of characteristics</td>
<td>heterogeneous/low</td>
</tr>
<tr>
<td>2. Characteristics of components</td>
<td></td>
</tr>
<tr>
<td>a. number of potential outcomes</td>
<td>few</td>
</tr>
<tr>
<td>b. levels of outcome dimensions</td>
<td>low</td>
</tr>
<tr>
<td><strong>B. Environmental Change Process</strong></td>
<td><strong>SET OF ALTERNATIVE FORMS</strong></td>
</tr>
<tr>
<td>1. stable</td>
<td></td>
</tr>
<tr>
<td>2. changing with growth</td>
<td></td>
</tr>
<tr>
<td>3. changing with decline</td>
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<tr>
<td><strong>C. Organizational Unit's Perceptions of the Environment</strong></td>
<td><strong>RANGE OF POSSIBLE VALUES</strong></td>
</tr>
<tr>
<td>1. Perceived environmental components</td>
<td><strong>ONE EXTREME</strong></td>
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<tr>
<td></td>
<td>few</td>
</tr>
<tr>
<td>2. Beliefs about cause and effect relationships</td>
<td></td>
</tr>
<tr>
<td>a. number of outcome dimensions</td>
<td>few</td>
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**D. Designers’ Perceptions of the Environment**

<table>
<thead>
<tr>
<th>1. Perceived environmental components</th>
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<tr>
<td>few</td>
<td>many</td>
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<table>
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<tr>
<th>2. Beliefs about cause and effect relationships</th>
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<th></th>
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</thead>
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<tr>
<td>a. number of outcome dimensions</td>
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<td>many</td>
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<tr>
<td>b. estimated level on each outcome</td>
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<td>high</td>
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**E. Internal control of outcomes**

<table>
<thead>
<tr>
<th></th>
<th>RANGE OF POSSIBLE VALUES</th>
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<tr>
<td>ONE EXTREME</td>
<td>OTHER EXTREME</td>
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<td>high</td>
<td>low</td>
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### TABLE 7

**OPERATIONAL VALUES FOR FACTORS IN SEGMENT 2**

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<tr>
<th>FACTOR</th>
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<tbody>
<tr>
<td>A. Environment</td>
<td></td>
</tr>
<tr>
<td>1. Aggregate characteristics</td>
<td></td>
</tr>
<tr>
<td>a. size (operationalized as number of programs of task behavior)</td>
<td>1. small = 27</td>
</tr>
<tr>
<td>b. distribution of characteristics</td>
<td>2. large = 125</td>
</tr>
<tr>
<td>1) general probability distribution</td>
<td>Probability of predominant kind of program = .60</td>
</tr>
<tr>
<td>2) kinds of environments (predominant program type)</td>
<td>Probability of other two kinds of programs = .20 each</td>
</tr>
<tr>
<td>2. Individual characteristics</td>
<td></td>
</tr>
<tr>
<td>a. number of potential outcomes</td>
<td></td>
</tr>
<tr>
<td>b. levels on outcome dimensions</td>
<td>1. all low: random normal variates with $\mu=.25$, $\sigma=.08$</td>
</tr>
<tr>
<td>(within the constraints of aggregate characteristics)</td>
<td>2. all high: random normal variates with $\mu=.75$, $\sigma=.08$</td>
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<tr>
<td></td>
<td>3. mixed: some low values as above; some high values as above</td>
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</table>
B. Environmental Change Process

C. Organizational Unit's Perceptions of the Environment

1. Number of perceived components (operationalized as number of programs of task behavior)

2. Beliefs about cause and effect relationships (for each program)
   a. number of outcomes
   b. estimated level on each (can be the same as or the reverse of individual characteristics for the programs defined in the environment)

3. Uncertainty

D. Designers' Perceptions of the Environment

1. Number of perceived components (operationalized as number of programs of task behavior)

   SET OF ALTERNATIVE FORMS
   1. stable
   2. changing with gradual growth
   3. changing with gradual decline

   POSSIBLE VALUES
   1. few = 27
   2. many = 125
2. Beliefs about cause and effect relationships (for each program)

a. number of outcomes

b. estimated level on each (can be the same as or the reverse of individual characteristics for the programs defined in the environment)

3. Uncertainty

E. Degree of Internal Control

POSSIBLE VALUES

1. high: random variable from normal distribution having \( \mu = 0 \) and \( \sigma = .04 \)

2. low: random variable from normal distribution having \( \mu = 0 \) and \( \sigma = .16 \)
<table>
<thead>
<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td>POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 3</td>
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**FACTOR**

<table>
<thead>
<tr>
<th>A. Program of Task Behavior</th>
<th>RANGE OF POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The chosen set of environmental components to supply inputs, receive outputs, and transform inputs into outputs</td>
<td>All possible combinations of input, output, and transformation components perceived by organizational unit</td>
</tr>
<tr>
<td>2. Potential outcomes associated with a program</td>
<td>All high, mixed, or all low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Search and Choice Behavior</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relative to structural constraints</td>
<td></td>
</tr>
<tr>
<td>a. compliant</td>
<td></td>
</tr>
<tr>
<td>b. non-compliant</td>
<td></td>
</tr>
<tr>
<td>2. Search and choice strategies</td>
<td></td>
</tr>
<tr>
<td>a. no search, trivial choice</td>
<td></td>
</tr>
<tr>
<td>b. satisficing search and choice</td>
<td></td>
</tr>
<tr>
<td>c. rational search and choice</td>
<td></td>
</tr>
<tr>
<td>d. maximizing search and choice</td>
<td></td>
</tr>
<tr>
<td>e. random search and choice</td>
<td></td>
</tr>
<tr>
<td>3. Over time</td>
<td></td>
</tr>
<tr>
<td>a. consistent</td>
<td></td>
</tr>
<tr>
<td>b. inconsistent</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Task Behavior</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relative to structural constraints</td>
<td></td>
</tr>
<tr>
<td>a. compliant</td>
<td></td>
</tr>
<tr>
<td>b. non-compliant</td>
<td></td>
</tr>
<tr>
<td>2. Over time</td>
<td></td>
</tr>
<tr>
<td>a. consistent</td>
<td></td>
</tr>
<tr>
<td>b. inconsistent</td>
<td></td>
</tr>
</tbody>
</table>
# TABLE 8

**OPERATIONAL VALUES FOR FACTORS IN SEGMENT 3**

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Program of Task Behavior</strong></td>
<td>Vector of programs represented by numbers 1 to N, where N = size of the environment. A program can have all high, mixed, or all low outcomes.</td>
</tr>
<tr>
<td><strong>B. Search and Choice Behavior Process</strong></td>
<td></td>
</tr>
<tr>
<td>1. Relative to structural constraints</td>
<td></td>
</tr>
<tr>
<td>2. Search and choice strategies</td>
<td></td>
</tr>
<tr>
<td>a. under high structure</td>
<td></td>
</tr>
<tr>
<td>b. under low structure</td>
<td></td>
</tr>
<tr>
<td>2. Over time</td>
<td></td>
</tr>
<tr>
<td>a. consistent</td>
<td></td>
</tr>
<tr>
<td>b. inconsistent not operationalized</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 4

**POSSIBLE FACTOR LEVELS FOR THE FACTORS OF SEGMENT 4**

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Performance Evaluation Process</strong></td>
<td>1. Based on correspondence with the specified control system</td>
</tr>
<tr>
<td></td>
<td>a. orientation</td>
</tr>
<tr>
<td></td>
<td>1) behavior</td>
</tr>
<tr>
<td></td>
<td>2) goal achievement</td>
</tr>
<tr>
<td></td>
<td>b. frequency of review</td>
</tr>
<tr>
<td></td>
<td>1) frequent</td>
</tr>
<tr>
<td></td>
<td>2) infrequent</td>
</tr>
<tr>
<td></td>
<td>c. delay in review</td>
</tr>
<tr>
<td></td>
<td>1) small</td>
</tr>
<tr>
<td></td>
<td>2) large</td>
</tr>
<tr>
<td></td>
<td>d. relationship to remaining structural demands</td>
</tr>
<tr>
<td></td>
<td>1) congruent</td>
</tr>
<tr>
<td></td>
<td>2) incongruent</td>
</tr>
<tr>
<td></td>
<td>2. Based on validity of evaluations</td>
</tr>
<tr>
<td></td>
<td>a. biased low</td>
</tr>
<tr>
<td></td>
<td>b. unbiased</td>
</tr>
<tr>
<td></td>
<td>c. biased high</td>
</tr>
<tr>
<td><strong>B. Structure of the Organizational Unit</strong></td>
<td>(See Table 1)</td>
</tr>
<tr>
<td></td>
<td><strong>C. Performance Evaluations</strong></td>
</tr>
<tr>
<td></td>
<td>1. Relative to performance outcomes</td>
</tr>
<tr>
<td></td>
<td>2. Absolutely</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 9

OPERATIONAL VALUES FOR FACTORS IN SEGMENT 4

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Performance Evaluation Process</td>
<td>1. Relative to high and low structure</td>
</tr>
<tr>
<td></td>
<td>a. what is evaluated (i.e., orientation)</td>
</tr>
<tr>
<td></td>
<td>1) behavior (under high structure)</td>
</tr>
<tr>
<td></td>
<td>2) performance outcomes (under low structure)</td>
</tr>
<tr>
<td></td>
<td>b. frequency of evaluation (under either high or low structure)</td>
</tr>
<tr>
<td></td>
<td>1) every task cycle</td>
</tr>
<tr>
<td></td>
<td>2) every 6 task cycles</td>
</tr>
<tr>
<td></td>
<td>c. delay in evaluation (under either high or low structure)</td>
</tr>
<tr>
<td></td>
<td>1) no delay</td>
</tr>
<tr>
<td></td>
<td>2) delay of 6 task cycles</td>
</tr>
<tr>
<td></td>
<td>2. Relative to validity of evaluation</td>
</tr>
<tr>
<td></td>
<td>a. biased low</td>
</tr>
<tr>
<td></td>
<td>b. biased high</td>
</tr>
</tbody>
</table>

B. Structure of the Organization Unit

(See Table 6)
C. Performance evaluations

POSSIBLE VALUES

1. Relative to actual performance outcomes
   a. lower than or equal to
   b. greater than or equal to

2. In absolute terms:
   range from 0 to 1
### TABLE 5

POSSIBLE FACTOR LEVELS FOR THE FACTOR OF SEGMENT 5

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Behavior Process</td>
<td>1. Bayesian (use of all past information)</td>
</tr>
<tr>
<td></td>
<td>2. Non-Bayesian (use of recent information only)</td>
</tr>
</tbody>
</table>
TABLE 10

OPERATIONAL VALUES FOR THE FACTOR IN SEGMENT 5

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SET OF ALTERNATIVE FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Behavior Process</td>
<td>1. Bayesian learning, using all past evaluations to update the most recent perceptions regarding a program of task behavior</td>
</tr>
<tr>
<td></td>
<td>2. Non-Bayesian learning using only the four most recent evaluations of a program of task behavior to revise perceptions regarding the program.</td>
</tr>
<tr>
<td></td>
<td>3. No learning, when structure is high.</td>
</tr>
<tr>
<td></td>
<td>Not operationalized</td>
</tr>
</tbody>
</table>

1. By the organizational unit

2. By the designers
BIBLIOGRAPHY


Ferratt, Thomas W., "Environment: Clarification of a Concept." The Ohio State University, Columbus, Ohio, 1973. (Typewritten.)


