THE IMPACT OF A CONVERSATIONAL
MAN-MACHINE DECISION SYSTEM
ON THE PORTFOLIO SELECTION
PROCESS

by

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A.B., Wesleyan University
(1963)

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE

at the

MASSACHUSETTS INSTITUTE OF
TECHNOLOGY

December, 1972 (i.e. Feb. 1973)

Signature of Author

Alfred P. Sloan School of Management, December 18, 1972

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MAR 27 1973
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Submitted to the Alfred P. Sloan School of Management on December 18, 1972 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

The purpose of this thesis is to show how a conversational computer-driven graphical display system can aid a decision maker in a situation where the information processing requirements are complex. The portfolio selection process within the Trust Department of a large bank was chosen as the focus of the decision support system, primarily because (1) the information processing requirements of the job exceed the capacity of the unaided human, (2) key elements of the decision process are judgmental and thus the process cannot be completely automated, (3) the decision process is repetitive in nature so that the informational requirements are stable over time and (4) the financial magnitude of the decisions is such as to justify the cost of systems support.

The first chapter of the thesis discusses the theory of man-machine decision systems, reviews previous experimental work in this area, and cites relevant considerations from the experimental psychology literature. The second chapter briefly reviews the financial theory of portfolio management and explores the implications of the theory for the organizational design of a bank Trust Department. Discrepancies between the assumptions of the theory and conditions which exist in the real world are discussed in order to assess the applicability of the theory to real decision contexts and discover the additional assumptions necessary to bring the theory into line with empirical data. The possible role of an interactive computing system as an aid to operationalizing the theoretical model is discussed. The purpose of discussing the theoretical or normative model before a descriptive model of the portfolio selection process is presented is to aid in the process of \textit{problem finding}, in which discrepancies between actual and desired behavior may be observed.

The third and fourth chapters are devoted to a descrip-
tion of a real world Trust Department and a series of experiments designed to capture some understanding of the process and structure of portfolio selection within that environment. The third chapter describes the Trust Department from an organizational standpoint. A short history of the department is provided and interviews with key personnel are presented in an effort to portray the background of the personnel, major job functions, communication flows, job frustrations, and attitudes toward the computer system soon to be installed. The fourth chapter discusses the design of experiments and interviews designed to elicit information regarding the construct space within which managers consider portfolios and the process by which managers revise their portfolios. Two psychological instruments designed to elicit managerial conceptual structure are described and sample data from the administration of each are presented. Hypotheses regarding expected changes in managerial conceptual structure following the introduction of the computerized decision support system are presented. Decision protocols, in which the manager presents his own reasoning for making portfolio revisions as they occur or shortly after they have occurred, are also provided. Some of the theoretical and empirical problems in obtaining and using these protocols are discussed. Finally, differences in the decision style of portfolio managers within each of the three functional areas of portfolio management within the Trust Department are described.

From the interplay of theoretical models and empirical data which constitutes the problem finding process, several hypotheses are generated which may explain why portfolio manager behavior doesn't always conform to the analytical model. Relevant data and theoretical formulations from the psychology literature are included.

In conclusion, the implications of managerial conceptual style for quality of job performance are explored. In particular, it is hypothesized that one kind of cognitive style is appropriate to well-structured jobs while another kind is well suited to jobs involving a great deal of judgment and estimation.

Finally, the hypotheses regarding the potential impact of the conversational computer system on individual decision processes and portfolio management are summarized. A monitor trace facility is described which is designed to provide data for psychological research as well as provide an objective basis for the performance evaluation of portfolio managers.

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ACKNOWLEDGEMENTS

Many individuals have been helpful to me in the preparation of this thesis. To all who offered ideas, suggestions, and criticisms, I am grateful.

I particularly wish to thank my thesis advisor, Professor Michael Scott Morton for his continuing assistance and encouragement during this effort. I also wish to thank Dr. Milton L. Lavin and Charles Stabell for contributing so heavily to the design and implementation of this research project. Dr. Thomas P. Gerrity, Jr. was an invaluable source of assistance regarding research materials and hypotheses.

Professors Stewart C. Ayers and Robert C. Merton were especially helpful in explaining financial concepts and answering my questions regarding the normative theory of portfolio management. Some of the psychological ideas came to my attention during seminars with Professors John Steinbruner and Jeremy Anglin of Harvard University and Jerome Bruner, now of Oxford University.

Finally, my special thanks to James P. Baxter, John Wagner and everyone at the Bank for giving so unstintingly of their time and thought and to Meimei Pan for an excellent typing job.
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CHAPTER I

THEORY OF MAN-MACHINE DECISION SYSTEMS

The research to be discussed in this report is based on the "assumption that a combination of man and computer elements performs better on certain problem-solving tasks than either man or computer alone." (Newman and Rogers, 1966) The goal of this section of the report is to indicate some of the specific conditions and ways in which this assumption holds.

The technique utilized in this research follows the pattern of Newman and Rogers (1966) in that "some of the processes that humans are supposed to use in thinking and problem-solving are made directly available to experimental subjects in the form of computer and display "aids", and the subjects may use them as they see fit." The emphasis here is on strategies employed in the decision-making process on the assumption that the quality of decisions in an unstructured situation may be enhanced by an improved capability to retrieve, process and store relevant information.

Ackoff (1967) distinguishes three major classes of management decisions. These are:

"A. Decisions for which adequate models are available, or can be constructed, from
which optimal (or near optimal) solutions can be derived.

B. Decisions for which adequate models can be constructed but from which optimal solutions cannot be extracted. . . The model specifies what information is required.

C. Decisions for which adequate models cannot be constructed."

It is clear that Class A decisions are best made by man alone or a batch computer program alone, depending upon the complexity of the problem and the amount of symbol manipulation required for solution. Decisions in classes B. and C. may profitably be supported by interactive man-machine systems when (1) the decision is sufficiently complex so that a tool which augments human intellectual capacity is desirable and (2) the decision occurs often enough and is important enough to justify the cost of systems support.

With regard to the first criterion, recent psychological research, as well as everyday observation, indicates that the biological constraints on human information processing capabilities are rather severe. Herbert Simon (1968) in his Karl Taylor Compton lectures points out "the evidence is overwhelming that the system is basically serial in its operation that it can process only a few symbols at a time and that the symbols being processed must be held in special, limited memory structures whose content can be changed rap-
idly. The most striking limits on subjects' capacities to employ efficient strategies arise from the very small capacity of the short-term memory structure (seven chunks) and from the relatively long time (five seconds) required to transfer a chunk of information from short-term to long-term memory."

Gerrity (1970) points out that "this relatively long transfer rate forces heavy reliance on short-term memory for rapid problem solving; and the limited short-term memory capacity places extremely tight constraints on the complexity or globality of problem solving strategies the human can effectively employ."

Given these constraints on human memory, aids such as computer-driven graphical display terminals may greatly extend the subject's capability to employ complex information processing strategies by effectively acting as an extension of short-term memory. In addition, the interactive computing system permits the use of more sophisticated operators to scan, search, and manipulate the data base. Gerrity (1970) defines operators as "primitive functions for retrieving, manipulating, transforming, and displaying information structures relevant to the decision system." Graphical displays, which would require many man-hours of manual labor to construct, may be created by the computerized decision support system almost instantaneously. By allocating the complex clerical work to the computer,
the manager may concentrate on thinking out his problem and on evaluating the results of the calculations. Many more calculations are possible with the computer-driven support system and, as a result, the manager may aim for an "optimal" rather than a "satisfactory" solution (see Scott Morton, 1971).

The normative goal of such man-machine interaction is to insure that "the computer's enormous manipulative and computational powers will be fully melded with the imagination, intuition, and evaluative capabilities of man. Under such circumstances, the computer will become a powerful intelligence amplifier, multiplying by orders of magnitude the capabilities of the man's mind and giving him the freedom to explore in depth the most complex ramifications of his hunches." (Parkhill, 1966)

We expect this "intelligence amplification" effect to be greatest for problems in which the data base may be arranged along many dimensions, or attributes. Psychological research on conservation learning (recognition of constancy along one dimension while other dimensions vary) indicates that performance on conservation tasks is highly dependent upon the amount of external "noise" which is present in the task environment. This is often called the "decalage" effect by psychologists (see Flavell, 1963). Therefore, transformation or "recoding" operators, which make relevant
attributes more salient should permit more complicated decision making strategies. Miller, Galanter, and Pri-bram (1960) claim that recoding is the normal method of information processing. The recoding process is seen as a memory aid in that it helps to relieve the burden on short-term memory. Thus, computerized recoding operators should help to reduce "cognitive strain" (Bruner et al. 1956) by facilitating and amplifying the normal recoding process.

Newman and Rogers (1966) point out that "another common operation in problem solving is the elimination, temporarily at least, of information not considered pertinent or relevant at the moment. This filtering process is so common and pervasive in human behavior that we sometimes forget how powerful it is." The filtering process relieves strain on short-term memory by allowing one to ignore certain data for a while but then return to them when one is ready to assimilate them. This function is an aid to what Posner (1964) has galled "gating"--the process of ignoring certain aspects of the stimulus. Posner demonstrates that this is a useful process in solving concept formation problems defined over multivariate stimuli.

Results of the Newman and Rogers (1966) experiment indicated that the computer aided group solved problems faster, made fewer errors, and solved more problems in total than did the non-aided group. In addition, the dis-
parity in performance was greater on the more difficult, relational tasks.

Models of the Decision Process

It is useful to examine the problem solving or decision process in greater detail in order to identify those subproblems which might be most effectively allocated to an unaided human, to an automated system, or to a human decision maker with an appropriate degree of computational support. Gorry and Scott Morton (1971) point out that

"Regardless of the resulting division of labor, however, it is essential that a model of the decision process be constructed prior to the system design. It is only in this way that a good perspective on the potential application of systems support can be ascertained."

Most descriptions of problem solving and decision processes have identified three distinct phases which Simon (1960) has called intelligence, design, and choice. These categories correspond to a series of questions which John Dewey (1910) posed for any potential decision maker:

What is the problem?
What are the alternatives?
Which alternative is best?

Similarly, most policy decisions involve the synthesis of the following steps: the statement of problems, the formulation of objectives, the generation and evaluation of alternative plans and policies, the implementation and
management of programs, and the monitoring and evaluation of feedback.

As stated earlier, a key variable is the degree to which aspects of the decision process may be programmed. In particular, can we go directly from a statement of objectives to a plan with the highest probability of meeting these objectives? Can a programmed procedure be generated which represents an optimization for this particular objective function? Can the objectives themselves be stated in such a way as to make clear the criteria by which potential solutions are to be judged?

If the answer to these questions is "yes" and the problem is quantitatively complex, operations research techniques such as mathematical programming may be appropriate. In fact, it is possible to develop formal scientific models only for problems which may be structured in this way.

In the animal kingdom, organisms which have evolved optimal or at least very satisfactory solutions to particular environmental problems survive and often proliferate. When the environment changes suddenly, the cybernetic mechanism which has been slowly evolved may quickly become inappropriate to the new situation, and the organism may die off. Similarly, a mechanical decision maker in business may look very "intelligent" in situation with which he is familiar but may be helpless or wildly wrong in an
unstructured or novel situation. Two distinct kinds of traits seem to be relevant in coping with the two different kinds of situations—one to deal with well-structured situations and the other to deal with novel or unstructured situations.

Raymond B. Cattell (1971) in an interesting study of *Abilities: Their Structure, Growth and Action* has isolated two distinct factors which contribute to general intelligence test scores. These factors are "crystallized abilities" and "general ideational fluency" or "fluid intelligence." "Fluid intelligence" refers to the capability of adapting to new situations by producing "insightful relations." Cattell cites as an example of a person with high fluid intelligence the physician Harvey, who perceived an intriguing relation, the resemblance of structures in veins to valves in the common pump, and decided that blood circulated.

A person who is high in "fluid intelligence" should perform well in unstructured situations in which "inductive reasoning" is required. Another kind of skill, "crystallized ability," is required for optimal performance in well-structured situations in which "deductive reasoning" is required. It is clear that "crystallized abilities" may be directly transferred to a computer (or robot) when it is desirable to do so whereas "fluid intelligence" seems to be uniquely human. Thus, for purposes of man-
machine symbiosis, it seems desirable to allocate routine, "habitual" functions to the computer while leaving the flexible, creative, hypothesis generating activities to the human.

It is interesting that "fluid intelligence" seems to be composed of an intelligence variable known as "general ideational fluency" and a personality variable designated as "ideational flexibility." According to Cattell (1971) the flexible person in demonstrating a high capacity to "solve riddles and restructure visual patterns" shows that he can see things in new groupings, can perceive possibilities of constructing new words by dissolving the rigid forms and obstinate debris of the old, and has ability to escape from habitual approaches to problems.

With regard to the other side of the flexibility-rigidity dichotomy, Cattell theorizes that "An appreciable fraction of what the casual psychologist calls 'rigidity' is due to low fluid intelligence, either innate or through brain injury. The mental defective goes on doing the same thing inappropriately because he does not have the relation-perceiving capacity to see that a more effective alternative presents itself."

Much of the literature on conceptual and personality development indicates that development proceeds from the rigid to the flexible. For example, Harvey, Hunt and Schroder (1961) postulate four stages of conceptual develop-
ment. Stage I is characterized by rigid adherence to "symbols, rules, or opinions whose origin is external to the individual" (description of theory from Riesing, 1972). In Stage I

"Aspects of the world are viewed as absolute categories (black-white, either-or, good-bad, etc.) and situations are approached in terms of fixed roles and role expectations. There is an overriding need to conform and to find specific absolutely correct solutions to problems."

In Stage IV, on the other hand,

"Behavior is extremely flexible, neither overly dependent as in stage three, nor overly independent as in stage two. The greater flexibility of response which results from the highly abstract structure reduces the impact of incongruous or conflicting observations and gives the individual much greater resistance to stress and anxiety. Behavior is marked by an informational or task orientation."

"Flexibility" and "abstractness", then, are usually considered to be characteristic of relatively advanced levels of intellectual functioning among humans. Furthermore, it would seem reasonable that conceptual structures and processes characterized by a high degree of abstractness and flexibility might be highly correlated with managerial success in dealing with unstructured situations. As Riesing (1972) suggests,

(1) if it is possible to measure the abstractness of managerial conceptual structure and
(2) if it can be shown that managerial conceptual structure is related to managerial performance, then

(3) it may be possible to improve managerial performance by increasing the abstractness of managerial conceptual structure.

The objective of the research to be described in this paper is to demonstrate that managerial performance may be improved by enhancing a manager's ability to think flexibly and abstractly about an unstructured problem. In a situation where a manager does not currently possess complex discrimination capabilities with regard to a set of objects or events, enhancing his discrimination and information processing capabilities should result in a more complex and abstract conceptual structure. This new conceptual structure should in turn lead to improved performance in an unstructured situation calling for flexibility of response.

The sorts of objects under consideration in this study are portfolios of common stocks and other financial assets. The variables of interest in our study are the number of attributes or dimensions which a manager can associate with portfolio structure and the abstractness of the manager's conceptual structure with regard to portfolios. Two measures of conceptual structure with regard to portfolios were used. These measures, and the rationale behind using them, are discussed in detail in the section on experimental design.
In addition to improving a manager's performance in an unstructured situation by enriching his conceptual structure with regard to the decision context, the decision support system was also designed to improve a manager's ability to make decisions by improving his ability to plan. That is, decision processes, as well as decision structures, should become more agile and flexible. Evidence for the expected shift in decision process comes from a previous study by Scott Morton (1967) who found a significant increase in the degree of iteration through problem solving phases. With the aid of the decision support system, the manager may explore the ramifications of several trial solutions before deciding on the best one. Without the system, the information processing costs may be so high that the manager will accept the first solution which meets certain specified criteria, without first checking to see whether other possible solutions might be even better. He may perform one set of analyses in order to reach a decision, and then a different set of analyses to reach a similar decision in another context. With the support system, on the other hand, the manager may develop a more sophisticated set of standard procedures, or "macros", by which he scans the data base for possible discrepancies between observed and desired status.

The current study places a great deal of emphasis on
a study of the decision processes prior to system implementation. The experimental design section describes in detail the technique which was used for modelling the decision process. In particular, several distinct models of the decision process are elaborated. These are positive models which attempt to describe the manner in which decisions are made and predict behavior in situations not directly observed.

Prior to a discussion of the descriptive modelling procedure, we present a brief discussion of the normative theory of portfolio management. The purpose in discussing the theoretical or normative before a descriptive model of the portfolio selection process is presented is to aid in the process of problem finding, in which discrepancies between actual and desired behavior may be observed.

According to Gerrity (1970),

"Construction of or search for normative models is aimed at uncovering desirable standards for comparison with the current system. It involves the specification of characteristics and behavior of an ideal system. These characteristics may be derived from a number of sources in direct elaboration of system goals, search of the literature, similar systems elsewhere, abstract optimizing models, people in the system, etc."

In the same vein, Rockart (1969) points out that an explicit discussion of normative models is advantageous
"The problem-finding aspect of model-based studies, it is suggested, tends to identify problems not before recognized -- or given full credence -- and to reveal those areas which need additional operations research. Through the use of this technique, insights are gained into further existing operational control problems and therefore into the information system necessary to support operational decision-making. The technique helps to ensure that (1) no important areas of the system are overlooked, (2) that deficiencies in the current process are identified, and (3) that the information system is designed to be able to take advantage of improvements in the basic process as they are developed. In addition, there are subsidiary benefits from the process in terms of providing the analysts prior to the study with a better understanding of the area, better communication potential with people employed in the area, and a better base from which to plan the study itself."
CHAPTER II

PORTFOLIO MANAGEMENT - A NORMATIVE VIEW

A keystone of the normative approach to decision making has been stated by Ackoff (1967):

"Each (or at least each important) type of managerial decision required by the organization under study should be identified and the relationships between them should be determined and flow-charted."

A brief analysis of the logical decision flow within a Trust Department discloses that basically three kinds of decisions comprise the process of portfolio management. These are:

(1) An estimate and forecast of overall market conditions.

(2) Estimates on the expected performance of particular securities and industries relative to the market.

(3) Estimates regarding which particular combination of securities is optimal for portfolios with predefined goals.

Turning to organizational aspects of the normative approach, Ackoff (1967) states:

"Decision-flow analyses are usually self-justifying. They often reveal important decisions that are being made by default and they disclose interdependent decisions that are being made independently. Decision-flow charts frequently suggest changes in managerial responsibility, organizational structure, and measure of performance which can correct the types of deficiencies cited."
Ackoff's primary contention here is that the division of labor within the organization should reflect the logical structure of the decision flow chart. Managerial planning and control systems within the organization should be set up to maximize performance within these divisions of labor.

A key requirement of a good control system is that responsibility, authority, and rewards should all be pinpointed. For example, an analyst's estimate of a future stock price may be deviant for two reasons. These are, (1) an error in the estimate of overall market conditions and (2) an error in predicting stock performance relative to the market. This suggests a revision in managerial responsibility so that analysts would be asked to make specific predictions about stock prices given a prediction about overall market performance. In this way, the performance of the analyst could be more accurately monitored by partialling out the effects of market discrepancies. The additional assumption that the error of the analyst's estimate is independent of the market level seems to be reasonable in this context.

According to modern portfolio theory (e.g. Sharpe [1970]), the overall estimate of market conditions appears to be a key decision upon which all other decisions hinge. The forecasts of the analyst, as well as portfolio strate-
gy decisions, are contingent upon the overall market forecast. This key forecast, then, should be the responsibility of a blue ribbon committee within the Trust Department. A senior economist, reporting directly to the Trust Department head, should be the key man. Market forecasts, which should be made frequently enough to keep abreast of shifting conditions, should then be explained to the analysts and portfolio managers.

As previously mentioned, the analysts' forecast should then be made contingent on the market forecast. Of particular interest are stocks which deviate from predicted overall rates of return for a given risk class. Most current portfolio theory (e.g., Markowitz [1959], Sharpe [1970]) views portfolio decision-making as a tradeoff between risk and return. The rate of return on a security is defined as

\[ \frac{\text{Capital Gains & Dividends}}{\text{Present Market Value}} \]

Rates of return are usually expressed in yearly percentages.

The risk of a stock or portfolio is defined as the "standard deviation of rate of return, based on the probabilities that various deviations from the expected value will occur." (Sharpe, 1970)

Risk may further be subdivided into two categories, systematic risk and unsystematic risk. Systematic risk is
a measure of "the volatility of the security's rate of return relative to changes in the market rate of return."

(Sharpe, 1970) The value of the \textit{systematic risk} of a security (symbolized as beta) is the slope of the line relating shifts in the stock's rate of return to shifts in the market's rate of return. Sharpe notes that,

"A security with a value of beta below 1 is said to be defensive. A 1 percent increase in the market rate of return is likely to be accompanied by a less than 1 percent increase in the security's rate of return. On the other hand, a 1 percent decrease in the market rate of return is likely to be accompanied by a less than 1 percent decrease in the security's rate of return. The investor is thus "defended" to some extent against the occurrence of a major disaster. The smaller the value of beta, the greater his defense.

A security with a value of beta above 1 is said to be aggressive. A 1 percent decrease in the market rate of return is likely to be accompanied by an even greater decrease in the security's rate of return. On the other hand, in the event of a rise in the market rate of return, the security's rate of return is likely to rise by an even larger amount. The larger the value of beta, the more aggressive the security."

Unsystematic risk is defined in terms of variances as the difference between total risk and systematic risk. With regard to portfolios, a relevant fact is that only the systematic portion of the risk need be considered; the rest can be diversified away.

According to Francis and Archer (1971), this is possible because
"Sharpe has designated that portion of assets' variability of returns which is attributable to a common source as systematic risk. Systematic risk is the minimum level of risk that may be achieved via diversification across a large group of randomly selected assets. The independent variations in the returns of the individual assets in such a portfolio average out to zero, and only systematic variability of return is left."

A study by Evans (1968) indicates that approximately 34 percent of the variance in a typical security's rate of return is attributable to its relationship with the market as a whole. However, a typical (randomly selected) portfolio with equal dollar amounts of 10 securities will have only 7 percent more risk than the minimum possible (risk due to systematic factors alone). A typical portfolio with equal amounts of 20 securities will have only 3 percent more than the minimum. In summary, a little diversification can go a long way. Another study by King (1966) produced the gratifying result that a procedure designed to group securities solely on the basis of comovement in their returns during the period studied produced results conforming almost perfectly to those implied by traditional industrial classifications. Diversification by industry group remains a wholly acceptable procedure.

The significance of Sharpe's beta coefficient as a measure of systematic risk has been succinctly stated by
Francis and Archer (1971):

"In equilibrium an asset's expected return is a positive linear function of its covariance of returns with the market. That is, the expected return from a security is an increasing function of its systematic risk as measured by its covariance with the market. Since systematic risk is the portion of a security's total risk that hinders rather than helps diversification, this relationship is intuitively appealing. The more risk a security has that cannot be eliminated by diversification, the more return investors will require to induce them to hold that security in their portfolios."

It should be pointed out that Sharpe's beta coefficient is technically defined as

\[ b(i/M) = \frac{\text{Cov} (r_i, r_M)}{S_M^2} = \frac{r_i S_M}{S_i} \]

where \( r_i \) is the correlation coefficient of \( r_i \) and \( r_M \), and \( S_i \) and \( S_M \) are the standard deviations of returns for asset \( i \) and the market portfolio, respectively. The beta coefficient, then, is an accurate measure of a security's responsiveness to changes in market conditions. It is interesting in terms of the discussion of psychological processes in Chapters 1 and 4 that such a key attribute of a security or portfolio is such an abstract, mathematically defined concept. It should be remembered that the beta coefficient is an accurate measure of a security's
"riskiness" only when unsystematic risk has been eliminated by diversification.

Francis and Archer (1971) point out that

"The essence of effective diversification is to combine securities with either low or negative covariances. Therefore, demand for securities that have low or negative covariance of returns with most other securities will be high. Those securities whose returns covary inversely or are independent of the returns from the market portfolio will have their prices bid up. And, securities that have high covariance with M - that is, high systematic risk - will experience low demand. As a result, the prices of securities with high systematic risk will fall, and securities with low systematic risk will have their prices bid up. Since equilibrium rates of return move inversely with the price of the security, securities with high covariance with the market will have relatively low prices and high average or expected returns. Conversely, securities with low or negative covariances will have relatively high prices and, therefore, experience low expected rates of return in equilibrium."

The definition of "defensive security" in terms of low or negative covariance with the market is similar but not identical to the definition usually given by security salesmen, financial analysts, and others. Francis and Archer note that

"Traditionally, when speaking of defensive securities, financial analysts give examples of firms that are unlikely to experience decreases in earning power. Since these people tend to define risk am-
biguously - if at all - their definitions of a defensive security are hard to pin down."

Since it is the function of the portfolio manager to assure adequate diversification, the analyst need only concern himself with the rate of return and volatility characteristics of individual securities. The central purpose of portfolio management is to obtain an average differential return over and above that obtainable from a market-based portfolio of comparable volatility. A positive differential return indicates that performance was superior to that of a market-based portfolio of comparable volatility; a negative differential return indicates that it was inferior to market levels.

The primary function of the investment analyst, then, is to pick out stocks that have a favorable differential return, or reward to volatility ratio, given a predicted state of the economy. Such seeking of marginal advantage is only possible in a world of disagreement. In a world of perfect agreement, all securities would plot along a single line, called the "security market line." In such a world, the "price of risk" (Sharpe, 1970) would be the slope of the security market line.

In a world of disagreement, the slope of the "security market line" would be dependent on the overall market
estimate. Thus, the "price of risk" or "risk premium" is a function of the market estimate. This explains the critical nature of the market estimate and the reason why we have suggested it be done as competently as possible. Once the "security market line" is established, it is the task of the analyst to determine which stocks will lie above, on, and below the line. Since the "beta" or volatility estimates are usually supplied exogenously (by a "beta supplier" who keeps track of volatility data on each security), the analyst's main task is to construct a predicted rate of return for each security, given the current predicted market estimate.

The task of the portfolio manager is threefold:

(1) to insure adequate diversification so that unsystematic risk is eliminated. Systematic risk is that portion of total risk which cannot be diversified away.

(2) To select securities so that a desired average systematic risk level is achieved.

(3) To select those securities within the constraints set by (1) and (2) which will achieve the highest overall rate of return.

In the normative theory, it is not the portfolio manager's job to second guess the analyst's market forecast. His is an optimization problem within fairly limited constraints. According to the normative theory, the investment researchers set portfolio strategy by high-
lighting those securities which are likely to be quantitatively most favorable in a given phase of the market. In fact, an algorithmic mathematical programming procedure for portfolio selections (see Cohen and Pogue, 1967) may be superior to the manual techniques. As we shall see, man-machine decision techniques may be most desirable.

In any case, it is important to do a cost-benefit analysis on the services of the portfolio manager in order to determine whether his services are worth the amount he is paid. In order to do this, a benchmark portfolio might be established. Merton (1972) has suggested that, as a basis for comparison, such a benchmark portfolio might consist of an active portfolio and a passive portfolio. The passive portfolio would contain a sizeable number of representative securities in about the same proportions as prevail under actual market conditions. The active portfolio would contain the same stocks, but in unrepresentative proportions according to the analyst's valuation of each security. Underpriced securities would be overrepresented in the active portfolio while overpriced securities would be underrepresented by some percentage.

The benchmark portfolio could also monitor analyst's performance and use this data as feedback to subsequent buy-sell decisions. This could be done by a self-regulating device which rewards the accurate analyst by giving his
recommendations more weight than before, while the analyst whose performance was more variable would be given less weight in his recommendations ("less weight" here would mean a smaller percentage deviation from the passive portfolio holdings for the security in question). The size of the percentage deviation would also be a function of the degree to which the security is said to be over or underpriced.

If benchmark portfolio performance proved superior to that of some portfolio managers, the affected portfolios could be made a part of a "group fund" which would be managed according to the principles of the benchmark portfolio. The benchmark portfolio would contain such a large number of securities that legal problems caused by large percentage holdings of individual companies probably would not arise (as they often do in large bank trust departments).

A cost-benefit analysis could be performed on the analyst's performance as well as on the portfolio manager's performance. The benchmark portfolio system is a means of monitoring analyst's performance while correcting for market discrepancies. The benefit of the analyst's recommendations should be represented by differential returns on the benchmark portfolio (assuming the hypothetical benchmark portfolio contains assets of comparable value to those managed by the Trust Department).
cost to the bank of the analyst's services, is, of course, the total budget for the research department. If cost exceeds benefit for a significant period of time, the Trust Department management might consider using brokerage house research reports or other sources of information rather than its own research department.

It cannot be over-emphasized that major organizational changes require a great deal of careful planning in order to insure their success. It is infinitely easier to suggest a normative organization design and division of labor for a new Trust Department than to change one which already exists. Considerable expertise has been accumulated in each of the existing job functions, however ill defined. In addition, strong vested interests within the organization act to maintain the present organization with its well-defined set of standard operating procedures, communication channels, job privileges, and promotional opportunities. Transitional costs in terms of morale, retraining of personnel, and underutilization of existing personnel must be carefully weighed in considering an organizational change. Major organizational changes should promise significant, rather than just marginal, performance improvements. The simplest organizational change is often the best change.

Returning to our normative discussion of the port-
folio management function, we find that the risk-return model of portfolio analysis has important implications for traditional concepts of portfolio goals. A "growth fund" differs from an "income fund" primarily on the basis of risk. Since most "growth" companies reinvest large percentages of their retained earnings, return from the investment in "growth companies" comes largely from capital gains. Capital gains income is obviously more variable than dividend income, since it is dependent to such a great extent on market fluctuations. Companies which have stopped growing rapidly tend to be a more stable source of return since a greater proportion of retained earnings is paid out in the form of dividends. The key variable then is "high risk" versus "low risk" rather than "growth" versus "income". It doesn't really matter, aside from considerations of transaction costs and realized versus unrealized capital gains, whether a "high risk" fund contains growth stocks only, or cyclical stocks of comparable volatility. "Balanced" funds are, of course, intermediate risk funds.

In this context, Ackoff (1967) points out that:

"For a manager to know what information he needs he must be aware of each type of decision he should make (as well as he does) and he must have an adequate model of each. These conditions are seldom satisfied. Most
managers have some conception of at least some of the types of decisions they must make. Their conceptions, however, are likely to be deficient in a very critical way, a way that follows from an important principle of scientific economy: the less we understand a phenomenon, the more variables we require to explain it."

Since we have seen that "risk" and "return" are the key concepts in portfolio management, it is important to see how the "price of risk" or "risk premium" changes with market conditions. Under favorable market conditions, the slope becomes steeper and each additional unit of risk buys a greater amount of return. Under these conditions, the "risk premium" goes up. In less favorable market circumstances, each additional unit of risk buys less return than in the former case. In these conditions, the "risk premium" goes down. Given the assumption that the purchasing power of risk varies with the market, one would tend to choose a more aggressive portfolio during a market upswing. In a market downswing, the purchasing power of risk is lower so one buys more defensive stocks.

The average risk level which a portfolio manager is willing to accept is also a function of the accuracy of the market estimate. Total portfolio risk is comprised of (1) the variance between actual portfolio return and predicted return based on the average risk level and the estimated security marketline and (2) the variance bet-
ween the market estimate and actual market performance. The average risk level which the manager is willing to accept should vary directly with the record for accuracy of the market forecasts.

The Sharpe asset pricing model (1964, 1970), along with others based on the original Markowitz (1959) mean-variance model, involves the following assumptions (from Jensen, 1971):

(a) All investors are single period expected utility of terminal wealth maximizers and can choose among alternative portfolios on the basis of mean and variance (or standard deviation) of return.

(b) All investors can borrow or lend an unlimited amount at an exogenously given risk free rate of interest $R_f$, and there are no restrictions on short sales of any asset.

(c) All investors have identical subjective estimates of the means, variances, and covariances of return among all assets.

(d) All assets are perfectly divisible and perfectly liquid, i.e. all assets are marketable and there are no transactions costs.

(e) There are no taxes.

(f) All investors are price takers.

(g) The quantities of all assets are given.

Empirical tests of the model must take place in the real world where many of these assumptions are not valid. Such tests serve two purposes: (1) Some evi-
dence may be gathered as to whether the model shows promise as a description of the process generating the returns on assets and (2) an indication may be obtained as to the "robustness" of the model and its potential usefulness in aiding real-world decision makers.

The Sharpe asset pricing model may be described by the equation

\[ E(R_j) = R_F + [E(R_M) - R_F]B_j \]

where \( E(R_j) \) is the equilibrium expected return on any asset \( j \), \( R_F \) is the riskless rate of interest, \( E(R_M) \) is the expected return on the market portfolio, and \( B_j \) is the systematic or covariance risk of the \( j \)'th asset.

An empirical test of the Sharpe asset pricing model has been performed by Black, Jensen, and Scholes (1971). Their findings, based on time series data, indicate that the relationship between risk and before tax rate of return is "amazingly linear" but the \( y \)-intercept is positive and the slope is significantly less than predicted by the model. Low risk securities earn significantly more on average than predicted by the Sharpe model and high risk securities earn significantly less than predicted by the Sharpe model.

A possible explanation of this phenomenon is proposed
in a doctoral thesis by Brennan (1970). Brennan notes that real world conditions differ from those assumed by the Sharpe model in that differential tax rates exist for income derived from capital gains and dividend income. He notes that "the introduction of taxes changes the intercept and slope of the risk-return relationship and introduces a new variable, the dividend yield, into the determination of expected returns." Brennan notes that there is a strong negative correlation (−.59) between dividend yield and risk (as measured by beta). High dividend yield (low beta) stocks are priced artificially low because of the higher tax rate on dividends. Since the price is lower than expected, the before tax rate of return is higher. Similarly, low yield (high beta) stocks are priced artificially high since the differential tax rates favor such stocks. This causes the before tax rate of return to be lower than expected. Hence the positive intercept and flattened slope observed by Black, Jensen, and Scholes (1971).

It should be noted that Brennan's two factor model is designed to predict the equilibrium structure of asset prices across the whole range of the market. Hence, Brennan's model uses complicated averages of the marginal tax rates on dividends and capital gains for all investors. Thus a security may not be at an equilibrium price in terms of the special tax situation of an individual investor.
For example, there are no taxes on income from pension fund portfolios. Therefore, stocks with high dividend yields are underpriced for the pension funds while high risk stocks are overpriced for these portfolios. Conversely, for the Personal Trust whose owner is in a very high tax bracket, high dividend stocks are overpriced while high risk stocks are underpriced. The slope of the security market line for these investors is different from that of the hypothetical average investor and thus the position of each stock vis-a-vis the security market line must be reevaluated.

The Portfolio Composition System, the man-machine decision aid described in other chapters, might prove especially useful in making these individualized conversions to "after tax rate of return," especially for Personal Trust portfolios. The PCS has the capability of displaying visual scatter diagrams of all the securities in a portfolio along two dimensions such as volatility and rate of return. The data base supplied by the analysts could show each stock's value on such dimensions as volatility (beta), rate of return, rate of capital gains, and dividend rates. Appropriate conversions could be applied to the capital gains and dividends data to yield an "after tax rate of return" attribute for each stock as it belongs to a particular portfolio. The portfolio manager
would then be in a position to make appropriate tradeoffs between risk and return and determine which securities are over and underpriced in terms of the portfolio's tax structure. The system could also help him tradeoff the benefit gained from making a trade with the loss incurred in going from an unrealized capital gain to a realized gain.

The Portfolio Composition System might also be able to take account of other costs, such as transactions costs, so that a more realistic cost-benefit calculation may be made on each alternative trade. In a variety of ways, a system such as PCS can build into an idealized model, those constraints which are so much a part of the work-a-day world. In so doing, we are able to move from a strictly normative approach to an intermediate level against which current practice might profitably be compared.

In support of the approach taken here, Gerrity (1970) states:

"It is proposed that the normative model be developed early in the process relative to the descriptive model. The hypothesis here is that one will be more effective and efficient in descriptive modeling, if one begins with some normative constructs to guide analytic attention. A related hypothesis is that, on balance, one will arrive at a more creative and more effective normative model if one builds it before engaging in the bulk of the descriptive modeling effort; i.e. one will be overly
biased toward suggesting suboptimal, incremental modifications of the current system after having modeled it in some detail. On the other hand, it must be recognized that the danger of normative modeling with too much insulation from the real system is that the result will prove naive and infeasible in light of characteristics of the real process."
CHAPTER THREE

DESCRIPTION OF THE EXPERIMENTAL SETTING

The final two chapters of this paper are devoted to a descriptive modelling effort and a discussion of the experimental design used in this research. Chapter Three presents a description of the experimental setting for our study. Chapter Four presents techniques for modelling decision processes and assessing cognitive structure with regard to a particular problem domain. Sample data which utilize these instruments are presented. Gerrity (1970) points out the importance of keeping in mind the normative model when constructing the descriptive model:

"The process of problem definition involves a continuing comparison between the normative and descriptive models. The comparison process reveals differences between "what is" and "what should be" that constitute potential problems recognized and eventually diagnosed. The list of problems thus identified should be assigned priorities for design attention."

The setting for the study is the Trust Department of a large Midwestern Bank. As of January 1, 1970, the market value of accounts for which the bank had investment responsibility totalled $6,200,000,000. In the 1970 American Banker survey, the Trust Department ranked ninth in the nation in terms of investment responsibility and tenth in terms of gross operating revenues. Of the $6.2
billion total assets, 4.0 billion were in the Retirement and Endowment area as Pension, Profit Sharing, and Endowment Funds. The remaining 2.2 billion were in the Personal Trust area with $1.7 billion in Personal Trust Funds, $130 million in Probate, and $400 million in Investment Advisory accounts.

The Asset Management section of the bank is broken down by product and by function. This matrix organization is a recent innovation, and was designed to promote both professional development and customer service. As previously mentioned, the three product lines within the Asset Management area are Personal Trust, Retirement Trust, and Investment Advisory and Custody. The three functional job specialties are Investment, Legal, and Administration/Operations. The Investment staff includes an Investment Research group composed of security analysts, the three groups of portfolio managers each headed by a Senior Portfolio Manager, and a Trust Investment Committee composed of the senior portfolio managers, the product managers, and the manager of the Asset Management Section. The legal staff handles the Estate Planning, Document Review, and Legal Audit functions. The Administration/Operations staff has responsibility for security operations, accounting, tax and customer reports.

In a recent planning report, the chief officer of the trust department stated:
It is generally conceded that the quality of our services has deteriorated, particularly within the last few years. Increased volume has over-taxed current resources but new computer systems promise future relief. However, such promise is dependent upon our capacity to develop and maintain Trust Department personnel who, with the information Management Systems Division, can help design and police innovative computer systems.

In an attempt to solve this difficult problem of designing effective computer support for trust department activities, the Trust Department chief hired a management professor who specializes in Management Information Systems and Management Planning and Control Systems. The professor, in turn, helped to set in motion a long range planning mechanism within the Trust Department so that, among other things, the antiquated accounting system could be brought up to date and hopefully, on line. One of the outcomes of this planning process was the development of the Portfolio Composition System which forms the basis of the decision support system research described in this paper. Another outcome was the reorganization along both product and functional lines which we have just described. Additionally, long range planning was established as a standard operating procedure within the department and a planning report was scheduled to be presented on an annual basis.

In an interview with the head of the Trust Department, the history of the Trust Department's involvement with
computer technology was traced. The discussion focused
on the Trust Department's relationship with the Informa-
tion Management Systems Division (IMSD), which is res-
sponsible for all computer systems development within the
bank. The Trust Department chief felt that the switch
from clerical systems to computerized accounting systems
had created a "human tragedy" within IMSD. This was
because the military authoritarian structure which char-
acterized the department in pre-computer days was no
longer appropriate to a complex, systems development en-
vironment. As a consequence, there is now a great need
for managers with technical skills who are also good at
working with people. The changing requirements of sys-
tems jobs requires human relations experts as managers
to ensure that appropriate people are chosen and coordi-
nate effectively on development projects.

The Trust Department chief commented that late, in-
accurate statements from an old, magnetic tape based
accounting system have been the source of many customer
complaints. He stated that the Trust Department is work-
ing with IMSD and an independent software firm on a new,
direct access Trust Accounting System, currently slated
for completion in mid-1973. He expressed the hope that
TAS will remove much of the clerical load from portfolio
managers and administrative personnel, and also greatly
reduce the number of customer complaints.
The independent software firm, which was financed by the Trust Department and was composed of a team of management and computer experts, is also responsible for the implementation of the Portfolio Composition System (PCS). PCS was designed to interface directly with the new accounting system to provide greatly augmented systems aid to the Portfolio Manager. Together the TAS and PCS systems provide the capability for (1) up-to-date pricing information, (2) removing most present clerical work, and (3) a greatly improved capability for retrieving, processing, and storing relevant stock or portfolio related information. The present work overload on portfolio managers should be accordingly reduced since (1) he may spend a greater percentage of his time on actual portfolio decisions and (2) he may perform the analyses necessary to reach these decisions much more quickly and accurately.

In addition to problems involving the computer system, the Trust Department chief noted that the Department had been plagued by a history of difficulties involving the relationship between the portfolio managers and the Investment Research Department. The portfolio managers were often critical of Investment Research's recommendations and often felt that research staffing of outside brokerage houses provided more accurate information. The research group, on the other hand, was often critical of portfolio managers who refused to implement the research
recommendations. Personal Trust managers, in particular, often held onto stocks long after Research had recommended selling. This was done partly to avoid tax losses on realized capital gains and partly because many of the personal trust managers were so overloaded that they could only review each account once or twice per year.

Interviews were conducted with many of the officers within the Asset Management Section as a means of forming a better picture of the working environment. Each of the officers were asked questions designed to elicit information regarding each of the following areas:

1. Personal Background

2. Major Functions
   - Time allocated to each
   - Relations with other units
   - Bases of evaluation

3. Attitudes Toward Computer Systems
   - Portfolio Composition System
   - Trust Accounting System
   - Other systems and/or IMSD

4. Attitudes Toward Job and Job Environment

5. Description of Investment Decisions
   - Group Portfolio Reviews
   - Individual Portfolio Reviews

* Questions addressed to Portfolio Managers only

Questions were not asked in a rigid order, but the interviews tried to touch on each functional area during the course of each interview. Most interviews lasted about one hour.

The first interview was conducted with the Senior Port-
folio Manager in the Personal Trust division. A personable
youngish man, he is nevertheless a 10 year veteran of the
Trust Department. The portfolio manager joined the bank
immediately after receiving an MBA from Harvard's Graduate
School of Business Administration.

The Senior Portfolio Manager listed two major and
one minor function:

a) see that the Portfolio Managers follow
   investment policy
b) handle personnel matters for Trust, es-
   pecially planning
c) spend a modest amount of time generating
   new business

Most of our discussion focused on the portfolio re-
view function. The Senior Portfolio Manager noted that
the senior investment staff officer, who is in charge of
the research staff, is also in charge of setting up general
guidelines and parameters for each of the three investment
management groups. The Senior Portfolio Manager's role,
then, is to refine these guidelines and make sure that they
are carried out within his department.

The Senior Portfolio Manager participates in the week-
ly Trust Investment Committee meeting in which stock rec-
ommendations are made and stocks are added to or removed
from the Approved List (a list which comprises the universe
of stocks from which Portfolio Managers may choose). The
Senior Portfolio Manager noted that the Personal Trust area has a more diverse set of customers than the Pension Fund area. He noted that his area has many more "current income" accounts than does the Pension Fund area. The portfolio manager noted that portfolios are classified in two ways--according to goals and risk. Goals are classified as:

1) Current income
2) Balance: average current income plus acceptable appreciation
3) High quality growth
4) Rapid growth: capitalizing on special situations; we have very few of these in Personal Trust.

Portfolio risk is categorized as Low, Average, and High. Currently, the evaluation of risk is by gut-feel although the Management Science group is exploring the use of formal mathematical procedures, such as those developed by Markowitz.

The Senior Portfolio Manager expressed some skepticism about the potential value of the new computer systems. He noted that past computer systems efforts within the bank had been marred by failure. He felt that the proposed system design seemed superior to past efforts, and emphasized the need for a more modern and up-to-date accounting system within the Department.
An interview with another portfolio manager in Personal Trust helped to clarify the typical work situation in this area. This portfolio manager is a twelve-year veteran of the Trust Department. After graduating with a B.A. in History from an Eastern college, he served a hitch in the Army. He spent two years in an MBA program at a Midwestern university before joining the Trust Department. The portfolio manager noted that his educational background was typical of the Portfolio Managers—all of whom are college graduates (mostly in Liberal Arts) and many of whom have completed one or two years of graduate work in business.

The portfolio manager is directly responsible for 300 accounts and about $250,000,000 of assets. Currently, the manager estimates that he spends about 65% of his time on clerical activity such as tracking down errors, changing addresses, and seeing that securities are delivered on time. As a result, only 25% of the portfolio manager's time is spent on Investment Management and 10% on customer relations. He noted that there is a very heavy flow of written material coming from Investment Research, probably more than a portfolio manager can read. He stated that he shared a cup of coffee a few times a day with some senior analysts from Investment Research and that personal lines of communication are very open.

The portfolio manager noted that the Personal Trust
area is organized into three groups, each group having 5 to 6 administrative officers and 4 investment officers. He felt that the administrative officers are under-utilized in terms of their education. Do you really need a J.D. degree to handle trust investments?

The portfolio manager feels that the supply of current, accurate portfolio status information is very poor. He stated that

We just don't know where we stand. We don't know the current market value of our assets or the industry representation in a portfolio. We have no ability to analyze individual stocks in an industry.

The portfolio manager discussed a recent trade in which he switched oil holdings within a portfolio to two stocks which the Research Department is currently recommending.

The portfolio manager was asked: "How did this portfolio come to your attention?" He stated that

Typically it happens two ways:

a) It comes to my attention as a result of a formal review (as was the case here)
b) My attention was drawn to the account because of a bond maturing, a rights offering, a stock dividend, the correction of a ledger error, or because the customer called me about some other matter.

It is interesting that the Portfolio Manager did not at this time examine all his portfolios to make the same
switch wherever possible. He noted that "I just don't have the time to make all the switches." Apparently most of the portfolio manager's buy-sell decisions are triggered by need or random factors. Time limitations do not permit opportunity triggers to function.

The Portfolio Manager was hopeful that the new computer system would alleviate many of his present difficulties. He stated that the Portfolio Composition System would provide "a clear, accurate analysis of the current makeup and value of my trusts; in particular, costs, current prices, current P/E rates, and comparisons. It will really help me in giving customers good information about their accounts."

The Portfolio Manager felt the Trust Accounting System would prove equally valuable. He pointed out that

"TAS will free up time to use PCS. I am not spending nearly enough investment time on each account. Ideally, I would like to spend 70% on investment, 20% on customer contact, and 10% on administrative matters. I think most portfolio managers would agree with me."

An interview with another Personal Trust portfolio manager clarified further the multiple roles that such a manager must play. This manager has been with the Bank 13 years of which 12 1/2 were with the Trust Department. He came directly to the Bank from an Ivy League college where he obtained an Industrial Administration degree after beginning as a metallurgy major. Upon reflecting about his
goals in college, the portfolio manager confessed that he never thought he'd enjoy selling.

The portfolio manager started out in the Commercial end of the Bank and then was loaned to Trust about six months later. He never went back to Commercial. Beginning his work in Trust with the Tax Department, he moved to Closely Held Trusts, did a lot of work in Probate, and then became a Portfolio Manager in Personal Trust.

The portfolio manager told us that he handles about 320 accounts. He noted that at least 3/4 of his accounts are non-discretionary (which means that all decisions to buy or sell securities have to be approved by the customer). One of the basic jobs of a portfolio manager, then, is to know his customers. The portfolio manager noted that

"I spend a large part of my time on the phone -- usually 1/2 to 1 hour each day. If there's a crisis, I can spend much of the day on the phone -- perhaps as much as 5 hours."

He further emphasized the centrality of good customer relations by stating that

"My definition of a good portfolio manager is someone who keeps his customers happy. I'm constantly talking with my customers -- I talk about their family, about whatever interests them. Others are very active in investments. You have to take a different approach with them."

The portfolio manager states that he follows the buy
and sell recommendations of Investment Research rather closely. When Investment Research and the Trust Investment Committee decide that a stock should be sold, the accounting system produces a "stock run" of all accounts holding that stock. The manager then sells the stock from all accounts where it is possible. With regard to stock purchases, the portfolio manager noted that

"Usually I have 2-3 stocks in mind which I currently favor. . . Most of our portfolios are diversified enough so that any given switch will change the diversification very little. . . I'm not on an industry track. I feel that when making a change, you should pick the best stock at this point in time . . . There's another reason for having a few (on my own short list): (If I follow only a few), I have the figures and stories in my mind -- when a customer inquires, I sound as if I'm knowledgeable."

When asked how he felt the new computer system would be helpful, the Portfolio Manager stated

"I'm really looking for cost information -- especially if I must sell something. I hope that the system will provide it. Presently, I can get a simple list of holdings in an account in 1-2 days. With the Portfolio Composition System I can flash the account on the terminal and tell the customer what he has, including current prices."

The third personal trust manager interviewed was a much younger man, with four years of trust department experience and 2 1/2 years as a portfolio manager. This manager came directly to the Bank from an MBA program. His
thesis is yet to be done.

The portfolio manager handles about 300 accounts, divided as follows:

"-50 Commingled Funds: These tend to be very static; a lot of them go back to the time when we were involved drawing up the trust document; you tend to have a close association with the beneficiary; many of the clients are little old ladies who would get shook up if a new man were given her portfolio.

"-10 Dynamic or Performance Oriented Accounts.

"-240 Non Performance Oriented Accounts: These are average accounts, with average activity; everything is o.k. if the income check arrives on time; the client is generally quiet unless the account falls out of bed."

With regard to the relationship with Investment Research, the portfolio manager pointed out that

"There used to be a barrier between the portfolio managers and research. You know, a fellow gets burned on XYZ stock and then may never buy that stock for 5 years. Part of the problem is that many of the portfolio managers have no research background, they have no appreciation for what goes on in Research. But people have recognized the problem and are trying to do something about it by rotating personnel between the areas."

In moving to the Retirement and Endowment (Pension Fund) section, a distinct change in atmosphere was observed. Whereas a great deal of autonomy and independence seemed to prevail in the Personal Trust area, the Pension Fund group gave the impression of greater unity and commonality of effort. In order to verify these impressions, we interviewed
the Senior Portfolio Manager in the Pension Fund Area.

The Senior Portfolio Manager has been in the Trust Investment business for twenty years. He was one of the first two Portfolio Managers in the Retirement and Endowment division. A vital and energetic man, he enjoys a good game of golf, particularly with someone else from the Investment Banking field.

The Senior Portfolio Manager cited four major functional areas which comprise his job. The first and "most important" of these is customer relations. He noted that

"We do a pretty good investment job, but so do a lot of people. . . (Thus), how you market your product is very important over the long run. . . no one can hope to win all the time. As far as I'm concerned, the customer is buying the bank. He's dealing with the bank, not a Portfolio Manager. We try to make him feel that the bank is making the best possible decisions for him."

The Senior Portfolio manager carries this philosophy into his second major functional area of responsibility, that of developing investment policy for the Retirement and Endowment area. He described this process as follows:

"We start with Investment Research's economic outlook. . . I pretty much subscribe to it. It represents a consensus judgment of the bank. . . Investment Research, Economic Research and the Trust Investment Committee. . . Within that economic outlook there is an obvious industry focus. It's less obvious as to which companies are good and bad within an industry."
[While we were sitting there, the Portfolio Manager received a call from a trader who was offering him 40,000 shares of "U.S. Plywood". The Portfolio Manager explained that "we like building materials. The price is two points cheaper than our last purchase so we'll buy it... It's the kind of stock that fits our current expectations)].

Since the Retirement and Endowment group controls $4 billion in assets, many large block trades are offered to the group. The hour-long interview with the Senior Portfolio Manager was interrupted at least half a dozen times by traders offering large blocks of shares for sale. These block purchases, which are the Senior Portfolio Manager's third major responsibility, shape the content of the portfolios to a very large extent. Although decisions within the group have some of the trappings of democracy, the role of the Senior Portfolio Manager in making buy and sell decisions looms very large. The Senior Portfolio Manager noted that

"We have frequent group meetings (normally once a week). We come in with a list of questionable stocks -- which have to be classed as either "buys" or "sells". These decisions are made by majority vote."

However, we received the impression from several sources that the Senior Portfolio Manager is very influential at these meetings. In fact, the Senior Portfolio Manager does seem to see his second and third functions, those of
block trading, making buy and sell decisions, and worrying, as being the most important. The manager told us that he has "a broad base of input" for these block trades. He's been in this business a long time and knows many stocks very well. He characterized himself as having "a longer time frame of reference" than the younger fellows. When we inquired as to which inputs went into his decision process, he stated:

"You can't follow all the stocks on the Common Stock List. You must depend upon Research and what you read. I depend mostly upon Research but read some of the services too -- like United Business Service, and Standard and Poor's -- also brokerage house reports. . .I try to be selective -- read material about stocks I'm following or stocks my Portfolio Managers are interested in."

It is quite clear that this Senior Portfolio Manager takes everyone's advice, including his own research department, with more than a few grains of salt. He notes that

"If there's a discrepancy between Research and my own knowledge, I try to check it out. . .We don't always believe what Research says. Like International Nickel. We sold it at 36 1/2. They had it on the list as a buy. . .Here's a great old company. . .It was apparently attractive on a price basis. . .I questioned the analyst. He went back, reread the research reports and changed his mind. . .it went from a "buy"to a "hold". That was a red flag for me. . .a credibility gap. We looked at all our portfolios and sold out of it. Now it's at 33 and under real pressure. . .Fortunately we didn't have too much. Most of the holdings were in Personal Trust [He showed us an IBM stock run]. Our
holdings are just the last page. . . Another flag is earnings estimate. I try to remember changes in earnings estimate. Changes indicate that a man is getting a better grasp of the situation. A downward change (or series of downward changes) is a good sell. Similarly, an upward revision is constructive."

It is interesting that, from long experience, this portfolio manager has learned that changes in indicators may indicate more than the level of the indicators. Another trap for the unwary, according to the Senior Portfolio Manager, are brokerage house reports.

"How many recommend selling? I would guess 90% recommend buying, 10% selling. Why? In a sense every analyst is a salesman. A sell recommendation's market is limited to those who hold that issue, whereas, a buy recommendation is addressed to the whole market."

The Senior Portfolio Manager pointed to another problem which is specific to large trust departments, that of bigness. In some cases, the Bank holds the legal limit of shares -- 5% of a utility or 10% of another corporation. The portfolio manager noted that

"In such a case Trust has to find an equivalent stock -- a stock in the same industry or market and of the same quality. IBM or Xerox present no problem; Sunbeam does. Ideally we'd like to make all our portfolios look alike. We can't, so we're forced to find equivalents."

The Senior Portfolio Manager felt that the Portfolio Composition System might be an aid in finding stocks with
similar attributes. Alarm was expressed, however, that the Portfolio Composition System would become operational before the Trust Accounting System. He felt that "it would be especially helpful to know my cash position; free cash position, who holds what security, etc. Now it takes a day to get a list of holdings."

The Senior Portfolio Manager stated that his fourth major area of responsibility was managing the guide portfolios. These are the ten portfolios which are considered to be the most important -- either because of their size or because the client sits on the Board of Directors of the bank. He noted that the General Motors fund alone contains $400,000,000 in common stock. He pointed out that in recent years some of the larger companies had been breaking up their Pension Funds among several banks and then applying performance yardsticks to compare fund management. The yardstick in most frequent use is the rate of return index as defined by the Bank Administration Institute. Often, the Bank with the lowest performance record for the year would be dropped by the client and the funds moved to another bank. He stated that this practice leads to distortions -- attempts to make the account look good at the end of the year -- which may detract from effective long range decisions.

One of the younger portfolio managers in the Pension Fund area also complained about administrative problems in
managing his portfolios. This portfolio manager has been with Retirement and Endowment just one year. Prior to that, he spent a year in Investment Research. His education includes an MBA in Finance from a Midwestern university. One of the members of the legal staff told us that this Portfolio Manager is an extremely conscientious individual and is very concerned about doing a good job for the portfolios he manages.

The Portfolio Manager told us that

"I spend 80% of my time on investment analysis, including customer contact, and 20% on administration. In fact, customer contact amounts to about 25-30% of the working day. This allocation of time is governed by my own personal preference. I'm not too diligent about administrative details. Some people just can't rest until everything is tied down -- but not me!"

The Portfolio Manager noted that he is currently one of the few account managers that has a list of his holdings. This capability allows him to examine all of the accounts that hold a particular stock so that all shares may be sold at once.

The Portfolio Manager told us that when he inherited his accounts the previous year, he found 225 stocks spread over 45 portfolios. He stated that

"I am now trying to reduce the number of stocks. I would like to have 25 or maybe 30 stocks at the outside. Of course, this is a
time consuming, difficult process."

The Portfolio Manager noted that this information overload problem had forced portfolio managers to manage accounts one by one instead of as a group. He felt generally that bank personnel are spread too thin. He informed us that

"It disturbs me to know that a guy (an analyst) is following 30 companies. They tend to take short cuts -- they have to! (On the other hand), a fellow could follow ten even if they were in different industries."

The Portfolio Manager felt that the Trust Department must choose between fewer accounts and more personnel in order to solve this problem. He placed a great deal of emphasis on judgment as an important factor in investment decisions. He stated that

"You just can't express all these factors as one compound annual rate (of growth). It's the assumptions behind that rate that are really important."

In order to facilitate the use of good judgment in making trades, the Portfolio Manager suggested that "an ideal situation is a small group of people (portfolio managers and analysts) -- say 5 -- exchanging ideas often." The Portfolio Manager also expressed skepticism that management will view the new computer system as a source of greater productivity and significantly raise the account
load for each portfolio manager.

The manager also gave us his theory of the market cycle. He feels that high quality growth stocks are bought at the beginning of a market upswing, the lower quality issues are purchased in the latter phases of the upswing. He states that

"If you're nimble you try to keep ahead of the game. The trick is to know when the game is over. (How do you do this?) You look at the New High List. Has quality gone down? Look at the trading volume. Lots of trading indicates a difference of opinion... The public always bails out the professional investor... The ASE/NYSE volume ratio is another measure of speculation."

The Portfolio Manager told us that

"I often talk to the analysts -- e.g., I have three drug stocks; which one do I sell? The amount of contact varies from once to three-four times per day. Usually I make a sweep. I gather up all my problems and then go over to see them.

I often go to the citywide Analysts Society meetings and to brokers' luncheons -- perhaps twice a month. Next week I go to Paine Webber's luncheon report on the drilling industry. These luncheons usually coincide with a written industry report.

You're always trying to evaluate the quality of these people. If impressed, you'll read what he has written, and use it as a backstop against what our own research department has said."

Moving from the Pension Fund area to the Investment Advisory and Custody area, we found an even less restrict-
ive atmosphere and a more free-wheeling trading philosophy.

One of the young, alert Portfolio Managers told us that

"Investment Advisory is more aggressive (than the other product areas). We're not constrained by trust documents. And we deal more with individuals. We also have some trust accounts, but these typically belong to people related to our I.A. clients."

This Portfolio Manager showed a great deal of interest in performance and expressed the opinion that compensation should be tied to performance by an incentive scheme. This was the first time we had heard such a view expressed. This manager also told us that investments had been a hobby since childhood and that he had always planned a career in investment banking. This interest in substantive matters also led this portfolio manager to suggest changes in the organization structure -- in particular, a closer relationship with Investment Research. In particular, he felt that an analyst should be assigned full-time to work with the Investment Advisory Group. The portfolio manager pointed out that Investment Advisory portfolio managers were able (with the customer's approval) to purchase "special situations" stocks -- small growth-oriented companies not on the Common Stock List or the NYSE. The analyst most often consulted by the Investment Advisory portfolio managers was, in fact, a special situations analyst.
It should be noted that information regarding these "special situations" securities will not appear on the Portfolio Composition System displays since the system will only have data on securities listed on the Common Stock List. The Sharpe risk-return model is also not applicable to these securities, since a stock must have a proven track record in order to be assigned a "beta" factor measuring covariance with market averages.

The Portfolio Manager estimated that 20-25% of his accounts are very active. He pointed out that

"These tend to be aggressive accounts. In aggressive accounts, half of the contacts are initiated by them and half by me -- well, maybe more of them by me. In the less aggressive accounts, flags (administrative triggers, suggestions from the customer) initiate contact. . . Periodic reviews also play a part."

It is in the more aggressive portfolios that the special situations stocks play a significant role. The portfolio manager stated that the department keeps its own special situations list. Factors such as industry, company management, good growth, and price are all considered.

The portfolio manager also noted that

"The people in our group work well together. We (like to) bounce ideas off one another. For example, the opportunity to buy a large block of stock would precipitate a lot of discussion. We have a good mix of fellows -- some are younger, and some are older and more experienced. . . . There's
(always) lots of discussion. There's a pretty good awareness of what's going on -- who's doing what. A couple of guys from Personal Trust get together with us for lunch fairly frequently."

Another portfolio manager in the Investment Advisory area described his job in similar terms. Like the first portfolio manager we spoke to in the Investment Advisory area, he is a young man with a recent MBA from a Midwestern university. Like the first manager, he expressed a great deal of enthusiasm for the decision-making aspects of his job.

The Portfolio Manager told us that out of a total of 120-130 accounts, 1/3 to 1/2 are discretionary. 35 to 40 of the accounts are aggressively oriented and the portfolio manager tries to review these at least once a week. The general procedure which this portfolio manager follows is to find an attractive stock, decide for which kinds of accounts the stock is appropriate, and then buy the requisite amount of stock. The stock usually comes to his attention by means of either an industry review by an Investment Research analyst, the special situations analyst, or an investment advisory or brokerage house report.

The Investment Advisory and Custody Product Manager told us that his primary responsibilities lay in the areas of setting fees and marketing activities with regard
to prospects for new accounts. Despite his limited involvement with portfolio management on day-to-day basis, he seemed very interested in discussing ways to improve the process of portfolio decision-making. He noted that many potential customers were very performance-conscious and sophisticated in financial matters. Many potential customers have expressed concern that current account loads on portfolio manager might inhibit effective performance.

Another ten year veteran of the Bank, the Product Manager received the bachelor's and MBA degrees from an Ivy League university. Very well-spoken, the Manager was quite conversant with the normative approaches to portfolio management discussed in the previous chapter.

The Product Manager sees the new Portfolio Composition System both as an effective marketing tool and as a means of facilitating portfolio performance by providing the capability for more intensive management of the portfolios. He felt that PCS provides the capability for much more flexibility and varied handling of accounts. He also pointed out that PCS (with the Trust Accounting System) would virtually eliminate the current manual data gathering and massaging activities which take 20 to 25 per cent of the portfolio managers' time. He felt that PCS will facilitate greater consistency in the handling of accounts and thus place even greater emphasis on the accuracy of
price and earnings estimates from investment research.

The Product Manager felt that a weakness in the current Investment Research procedure is that the analysts resist making quantitative rate of return estimates and placing quantitative boundaries or confidence intervals on their estimates. He felt it might be useful to trade off risk estimates with expected rates of return. The standard management science approach to portfolio management (see the section on normative models) is to pick those stocks which have the most favorable return to risk ratios within a certain risk class. The Product Manager felt that the PCS might place further pressure on the analysts to quantify their return and risk estimates so that scatter diagrams of return versus risk for a given portfolio might be produced. A hypothetical portfolio might then be created by mathematical programming techniques. Hypothetical portfolio performance might then be used as a benchmark against which to compare actual portfolio performance. It is interesting in terms of our descriptive discussion of the bank that a Product Manager, rather than any of the working portfolio managers or analysts, raised these issues with us. Perhaps the reason was that the Product Manager had the opportunity for more contact with the academic business school community and thus was more familiar with the specialized language.

Moving to the Investment Research Department, we
spoke first with the Assistant Manager. A relatively young man, the Assistant Manager had been with the bank for about eight years. The Assistant Manager briefly described to us his three major job functions:

(1) Investment strategy and Policy Making
(2) General Management - Personal
(3) Investment Decision Making

The Assistant Manager showed us a sample strategy summary and stock recommendation list for the bi-weekly period just ended. The stock recommendation list is divided into five categories.

A stocks - High Quality Growth Issues
B stocks - Higher Earnings Growth/Higher Risk Issues
C stocks - Balanced Earnings/Growth
D stocks - Cyclical and Turnaround
Income List - High Yield Stocks and Convertibles

The Manager explained that A stocks are distinguished from B stocks primarily on the basis of a company history of stability and quality management. The B stocks tend to be more aggressive and show more volatility with market changes. B stocks include many growth-oriented conglomerates, building trades, and consumer-related companies that vary quite markedly with fluctuations in the economy. A stocks tend to be quality growth companies with established positions in their industries -- such as IBM, Xerox, and Minnesota Mining -- or drug and hospital supply companies
with market leadership and research and development strength. C stocks tend to be established companies which are no longer growing at a rapid rate and whose prices tend to vary in cyclical fashion. Examples are banks, oils, food companies and utilities (some utilities appear on the straight income list as well). D stocks include those cyclical stocks which show drastic fluctuations with the economy. Examples are the hotel/motel industry and the airline industry because occupancy rates determine whether these companies operate at a profit or loss. This "critical mass" effect also applies to certain companies in the building trades and chemical industries. Some stocks are placed on a restricted list because the bank is close to the legal limits for percentage ownership in a company.

Within each stock category, a stock is classified as a buy, dollar average, hold, fully priced, or sell, in order of attractiveness. When a stock is listed as a buy or a sell, the research department is stating its strong disagreement with the market's valuation of the stock. "Buy" recommendations, of course, indicate that the stock is "underpriced" in the bank's opinion, while a sell recommendation indicates that the stock is "overpriced". A hold recommendation indicates that the bank is in agreement with the market's valuation of a stock.

The Research representative also described the organization of personnel within the Research Department. He
explained that the research analysts are divided into seven industry groupings with a senior analyst at the head of each group. The seven industry groupings are:

1. High Technology
2. Building Materials, Autos, Metals
3. Banks, Finance Companies
4. Beverages, Paper, Hospitals
5. Oils, Chemicals, Drugs, Tire and Rubber
6. Transportation, Utilities
7. Special Situations and Insurance

Changes to the recommendation list are made each week. These changes are discussed and ratified by the Trust Investment Committee meeting each Tuesday morning. Changes to the Recommendation List are then presented by Investment Research to the Portfolio Managers at a meeting on Wednesday morning. Another feature of this weekly meeting is the presentation by an analyst of a particular industry -- the economic outlook for the industry and the relative merits of particular companies within the industry.

The Research Assistant Manager felt that the new Portfolio composition System would improve portfolio management by providing more quantitative information about portfolios to the portfolio managers. This would enable the portfolio manager to test his qualitative assumptions about a portfolio against the quantitative data. For example, the portfolio manager might perceive two of his portfolios as
"growth" portfolios yet they might differ quite markedly on a histogram showing predicted earnings growth rates.

The Manager explained that the Investment Research Department also served as a training ground for new portfolio managers. When a new person is hired by the Trust Department, his first assignment is as an Assistant to a Senior Analyst. This assignment usually lasts for about a year, after which the analyst is either transferred to one of the portfolio groups or promoted within the Research group.

The next interview was with the Senior Staff Officer of the Research Department. A bank veteran, the Senior Staff Officer was previously a Portfolio Manager in the Retirement and Endowment area. His present assignment, made about two years ago, was widely viewed as an attempt to improve the communication process between Investment Research and the portfolio managers. Cognizant of the informational requirements of the Portfolio Managers, he has attempted to make the research reports directly applicable to the managers' decisions.

The Officer told us that he was responsible both for overall investment policy and strategy and for the research staff. The staff includes the Closely Held Trust, Tax Shelter, and Real Estate groups although these areas are largely autonomous from the Investment Research staff. The Officer noted that the bank maintains a separate
Business and Economic Research department and also retains several outside economic consultants.

The Research Senior Staff Officer is responsible for periodically drawing up a document on general economic trends and investment policy. The Senior Staff Officer talks to the in-house economists before he prepares this report. The present report stresses investment strategy during a cyclical recovery. The officer feels that the major focus of a strategy report is to highlight the most favored groups of stocks at the present phase of the economic cycle. He pointed out that there are several alternative ways in which one can look at a portfolio. One of these breakdowns is the following:

- Interest rate Sensitive
- Cyclical Industries
- Major growth

Portfolios may also be analyzed in terms of the distribution of Price/earnings multiples. Portfolios with many high P/E stocks are very exposed in terms of downside risk. The officer, who was one of those responsible for initiating the new Portfolio Composition System, noted that PCS will help the portfolio managers make these multiple analyses of security attributes set forth by the research group, since this information will form the data base to be employed by the Portfolio Composition System.

The Senior Staff Officer also briefly reviewed the
Bank's performance over the past several years. The Bank clearly outperformed both the Dow-Jones and Standard and Poor's averages in both bull and bear markets. Relative to other banks, the Bank performed somewhat less well during the bull market of 1968-69, but much better during the bear market of 1969-70. This was to be expected, the Research staff officer pointed out, because the Bank's investment strategy during these periods was clearly on the conservative side. He noted, however, that when the market bottomed out during the summer of 1970, "we ransomed everything we had" to buy stocks. Performance since that time had been very gratifying, he stated.

The next interview was with the Special Situations analyst who, we noted, was very much in demand by the Investment Advisory Group. A young, very alert and quick man, the analyst told us that he not only held an MBA in Finance, but was also a Certified Financial Analyst. His current assignment involved finding appropriate securities for the high risk portion of Pension Fund and Investment Advisory portfolios. The mechanism for accomplishing this was to have the portfolio managers purchase shares of a special situations fund -- known as Group Fund D. The Special Situations analyst was in charge of managing this "go-go" fund.

The analyst noted that the Fund was up 24% in the first six months of 1971 and up 70% since market bottom
during the summer of 1970. The stocks in the Special Situations Fund are all small, over the counter, securities. The ground rules for inclusion of stocks on the Special Situations List were quite stringent and include a required earnings growth rate of over 10%. The analyst told us that he was often tipped off as to which stocks were good and bad investments by firms which specialize in accounting practices. He also calls other analysts, looks carefully at company books himself, and either calls or visits the company. The analyst stated that he receives torrents of information from small companies all over the country. After an initial screening for those investments which look promising, he performs a very careful financial analysis of each one. The analyst looks at prospects for future earnings within the industry and for the specific company. Strength in sales, manufacturing, and marketing are all considered. The analysts also perform statistical regressions on how the particular industry and company have performed during economic cycles in the past. The historical record is considered very carefully in making a decision about whether to include a security on the special situations list. Conservative financing is also a major positive factor in the decision, he stated.

Moving from the trust department to the Administration/Operations area, we spoke with the Administration/Operations Function Manager. The manager, an attorney and twenty year
Trust Department veteran told us he doubled as Personal Trust Product Manager. He told us that he spent about 15% of his time on Personal Trust matters. Here he manages the sales staff and talks with dissatisfied customers. The manager does some new client contact and attends Bar Association meetings because he often finds other attorneys to be a good source of prospects. The manager also participates in some product planning within Personal Trust.

Putting on his Administration/Operations function manager hat, the manager told us that he divides his time about equally between the Administration managers for the various product line areas. The manager told us he spends about 60% of his time on the Administration/Operations Job and the time is divided as follows:

10% - Pension and Profit Sharing
15% - Investment Advisory
15% - Personal Trust
5% - Probate
15% - "educating myself" about operations

In the Personal Trust area, the manager handles many difficult areas such as customer relations, fees, legal problems, etc. This was a large part of his job prior to 12/28/70 but now these problems are filtered by the new Administration manager in the Personal Trust area. He noted that in the Investment Advisory and Retirement and En-
down areas, the portfolio manager is the primary customer contact, whereas, in Personal Trust, it's administration. Thus, in Investment Advisory and Retirement and Endowment, administration is really an operating kind of job -- as opposed to a human relations job. Examples of operating problems are customer requests not satisfied and system failures -- either computers or people.

The manager often gets involved in the Probate area because of his legal background. He stated that

"We confront some very difficult situations here - e.g. conflicts of interest where we can get into a lot of trouble. I must decide what to do and whether we should seek advice outside the Bank.

"For example, recently a decedent designated the Bank to be an executor and trustee of his estate. He owned controlling interest in a closely held business which owes money to the Bank. The estate may or may not be able to pay the decedent's debts. If we agree to be executor, we put the Bank at the end of the line of creditors. Is the Bank willing to take that risk?"

The other 20% of the Manager's time is spend as departmental liaison with the Information Management Systems Division (IMSD). Along with another Operations Manager, this manager is concerned with facilitating the development of the two new computer systems -- PCS and TAS. He noted that TAS, in particular, takes a lot of our time. The manager also told us that all computer systems in the bank -- including PCS and TAS -- are currently under review by a team which includes
-- An outside consulting company, a subsidiary of a major aerospace company

-- A representative of IMSD

-- A representative of Control

-- The interviewee and another manager representing the Trust Department

The Manager noted that TAS was currently under fire by the outside consulting company for being too expensive. There was some question about whether an on-line accounting system is justified at this point in time. Since PCS is predicated on TAS, both systems are in question. The present accounting system (a 2nd generation magnetic tape system) is obsolete and will have to be replaced very soon. The current reporting generating system is now nine years old.

Our final interview was with the head of the Asset Management Section, who reports directly to the Senior Vice President in charge of the Trust Department. Although he is presently in charge of all Asset Management within the bank, the officer has "never held down a basic job" in this area. In particular, he has never been a security analyst or a portfolio manager. His first job in the bank "many years ago" was in the Closely Held Trust area. He reported coming up "the Pension Trust route" and implied that his primary responsibilities have been marketing and new product development.

The Asset Management chief also has another hat --
serving as Investment Research function manager. He has spent most of the last year, however, on special assignment as one of the group concerned with the initial long range planning effort and which made the deliberations leading to the current matrix organization.

As manager of Asset Management, he divides his time between (1) Product Design and Marketing, and (2) Investment Management. Apparently most of his marketing effort is personal selling where contacts developed during his Pension Trust days are particularly useful. He "knows many of our big customers" and often hosts a luncheon for important clients or prospects.

The Manager works heavily with his three product managers (Personal Trust, Investment Advisory, and Retirement and Endowment) in

-- Product design
-- Profitability
-- Marketing
-- Ultimate customer satisfaction

(These four phases were recited by almost everyone in answering our query about his responsibilities. Obviously everyone interprets and performs these charges differently.)

Management of Investment Research "takes a lot of time -- probably close to half." The Manager is head of the Trust Investment Committee, an interim body which is
temporarily replacing the old committee composed of Senior Bank officers. This committee meets for half a day each week to review companies and industries, to set investment policy, and to examine the approved list of common stocks. Several hours of reading is spent preparing for each meeting.

The rest of this chunk of the manager's time is spent with the four senior portfolio managers and the senior investment staff officer. All five of these men sit on the Trust Investment Committee. The Manager reports spending about a day per week working with these five on customer contact and such personnel problems as staffing and raises.

The Manager is also concerned with finding new ways to monitor investment performance. He has assigned two staff men the job of answering the question:

"What kind of data do we want in an investment monitoring system?"

Regular performance reports would be very desirable, the manager stated. He was hopeful that the necessary performance recording and retrieval system could be incorporated into the design for the Portfolio Composition System.

**Summary and Conclusions**

Now that we have provided a description of the ex-
perimental setting, it is instructive to summarize the
information system-related problems reported in each of
the functional areas. In so doing, we will explore the
potential impact of the new Portfolio Composition System-
Trust Accounting System on each problem area which has
been cited. In order to make the basis for these assess-
ments clear, a brief functional description of the new
computer system is provided. A more complete description
is provided by Gerrity (1970, 1971).

Gerrity's design for the Portfolio Composition System
came largely from an earlier descriptive study of the same
Trust Department described here. Gerrity summarizes his
findings as follows:

"In summary, the current Portfolio Man-
ger decision process involves a great deal
of intelligence or problem-finding activity,
followed by a very local search for alter-
native solutions, considering potential
asset transactions one at a time. Throughout
the process, one is struck by the focus upon
individual securities with little apparent
perception of the status of a total portfolio
as an entity."

In order to facilitate consideration of structural
attributes of portfolios, Gerrity defined an initial set
of operators "by a consideration of specific problems or
requirements within the decision phases of intelligence,
design, and choice." For example, Gerrity notes that
"In the intelligence phase, a problem cited was the fragmentation of the data base into two separate files, one on portfolio holdings and the other on stock performance history and forecasts. This suggests the need for a TABLE operator that allows for the juxtaposition of portfolio holding information and investment research information in one tabular display. That is, the Portfolio Manager should see explicit values for such variables as earnings growth rate and price-earnings ratio associated with each stock in a portfolio, rather than trying to remember them or compute in his head their current value."

The TABLE operator has been included in the Portfolio Composition System design. HISTOGRAM and SCATTER operators provide a distribution of the values of one or two summary statistics (for example, Sharpe's beta coefficient and estimated total return) across all stocks in a portfolio, or all portfolios in a department. Another operator, called STOCK, produces a list of all portfolios which contain a given stock. The operator is very valuable when it is desired to sell quickly all holdings in a given security.

Gerrity (1970) cites another example of an operator designed to correct a deficiency:

"In the intelligence phase, one of the major problems identified was the fact that portfolio status reports were out of date and had to be updated by hand. This suggests the need for a STATUS operator which causes the display of the current status of a portfolio or other list."
The basis for the Portfolio Composition System, then, consists of a data base in which all relevant attributes of each security on the Common Stock List are stored, together with a set of operators which allow the user to manipulate the data base in various ways. The detailed system design for the Portfolio Composition calls for a highly complex interactive computing system in which information is presented to the user graphically by means of a cathode ray tube terminal. The graphical display terminals are connected to an IBM 360 computer by means of a highly customized minicomputer interface. Customized systems programming was performed in order to allow the minicomputer to operate as a remote terminal under the Time Sharing Option of Operating System/360. The application program design for the Portfolio Composition System allows for three distinct modes of conversational interaction: (1) Menu-selection, (2) Stacked selection and (3) Direct Command.

The Trust Accounting System is designed to interface with the Portfolio Composition System. It represents a complete rewrite of the current magnetic-tape based system and involves sophisticated third-generation random access data management techniques. The Trust Accounting System will allow the Portfolio Composition System to operate with current price information and also provide on-
line reports of security holdings and free cash positions to Senior Portfolio Managers and administrative personnel. Instead of shifting cash balances when trades are settled, the system makes the appropriate entries at the time when trades are actually put through. Also, instead of making accounting entries on a cash basis as in the old system, the new system records changes on an accrual basis. These changes should provide the Senior Portfolio Manager with much more timely information as to current status.

Descriptions of characteristic problems within each functional area of the Trust Department have now been presented. In addition, two new computer systems designed to alleviate some of these problems have been described. Each of the problems can be described in terms of whether they relate to system errors, lack of current status information, and lack of information regarding portfolio structure. The following table presents a breakdown of the problems in terms of functional area and problem type. An indication as to which of the two systems - the Portfolio Composition System (PCS) or Trust Accounting System (TAS) - will alleviate the problem is also given.
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CHAPTER FOUR

THE EXPERIMENTAL DESIGN

As we saw in the introductory theoretical chapter, the Interactive Portfolio Composition System was designed to have two major effects upon Portfolio Managers. These are:

(1) An improved ability to think flexibly and abstractly about portfolio structure.

(2) A greatly expanded capability to perform analyses of portfolio characteristics as an integral part of the decision process.

A full, functional description of the PCS may be found in Gerrity (1970) and (1971). Gerrity's hypotheses regarding the effects of PCS may also be found in these papers.

In this section, techniques for measuring these effects on concept structure and decision process are discussed. The focus throughout is on ways of observing shifts in concept structure and behavior as a result of the introduction of the Portfolio Composition System.

Two measures of concept structure have been used in this study. These measures are Kelly's (1955) Role Construct Repertory Test and a new instrument called the Portfolio Structure Interview. Kelly's test was originally designed as a clinical instrument which elicits interpersonal constructs. In Kelly's test, subjects are
given a list of role titles which are chosen to sample a wide range of experience. Sample categories for eliciting names of persons might be:

"A person you like or dislike"

"A person who likes you or dislikes you"

"The most intelligent person you know personally"

The subject is asked to nominate a person to fill each title. If he cannot think of a person to fill a given title, he is asked to nominate "some other person not yet named" and to describe that person's role vis-a-vis himself. Each name is written on a separate card until the required number of cards are obtained (usually 20).

The experimenter then picks out three cards and asks the subject to suggest some important way in which two are alike and different from the third. The experimenter then asks how the third person is different from the other two. This procedure continues until 10-25 sorts have been made. In a variation of the test, called the Repertory Grid Test, the subject is asked to look at all of the other cards after each sort or three cards. He then asked "Which of these would you call________ as opposed to________?" (The blanks refer to the poles of the dimension named for similarity and contrast, respective in the original three cards.)

Kelly's purpose in designing the Role Repertory Test
was based on the following fundamental postulate:

"A person's processes are psychologically channelized by the ways in which he anticipates events. We hope that the subject reveals, in taking the test, those channels through which new experiences, as well as old, may run. We assume that the constructs he verbalizes are ones which can be applied to people and interpersonal situations which he has not yet confronted. In other words, we assume that the constructs elicited by the tests are permeable."

Results of the Role Repertory Test can be subjected to both formal and clinical analyses. According to Kelly,

"From such an analysis, one can get some insight into the facets of the subject's role - what he sees himself called upon to do in certain types of situations: at home, at work, and so on. Some judgment of the extent and flexibility of the subject's constructs can be made; also of the difficulties the subject has in construing some figures within his construct system."

The procedure used in this research was adapted from Kelly's original research by Gerrity (1970) and Wilcox (1970). The major change is that the subject writes down the name of a stock or portfolio, rather than a person, on each card. Sample categories for eliciting stock objects are:

"The stock you know the best"

"A stock that most people are wrong in selling"
"The stock you are buying most heavily now"

Sample categories for eliciting account or portfolio objects are:

"The account you know the best"

"The account which has given you the most trouble"

"The account you most enjoy managing"

The purpose of using the Role Repertory Test in this context is to test a hypothesis proposed by Gerrity (1971). In Gerrity's study, it was found that five out of six portfolio managers possessed more complex discrimination capabilities when dealing with common stocks than with portfolios. Gerrity also found that

"the dimensions used to discriminate among portfolios in the test were naive (e.g. big vs. small portfolio) by comparison with the more goal-related dimensions applied to common stocks. (e.g., high expected earnings growth rate and high expected price volatility)."

Gerrity (1970) formulated the following hypotheses about the effects of the Portfolio composition System on the Portfolio Managers' conceptual structure:

The Portfolio Manager's complexity of discrimination among portfolios will increase with use of the Portfolio Composition System.

The dimensions used by the Portfolio Manager in discrimination among portfolios will be relatively more status-related (as opposed to goal-related) than before.
The goal in the current research is to validate Gerrity's (1970) finding with regard to unaided Portfolio Managers and to test his hypotheses with regard to the effects of the Portfolio Composition System. In Gerrity's original study, a prototype Portfolio Composition System was built, but operational problems prevented the sustained usage necessary to produce a measurable impact.

In the present study, as well as in Gerrity's original study, the Kelly Role Repertory Test was used to measure the content and complexity of Portfolio Manager perception of stocks and portfolios.

In this study, the grid form of the Role Repertory Test was used. In elaborating the rationale for the grid form of the test, Kelly notes that

"Lyle has proposed that the pole which represents the similarity of the two 'like' figures be called the emergent pole and the contrasting pole be called the implicit pole. He believes that emergence and implicitness have important implications for clinical diagnosis and for understanding the client's value system. We shall adopt Lyle's terminology and, when appropriate, refer to the poles of constructs produced on the Rep Test in these terms.

After the client has labeled the emergent pole of his construct and its contrast, the implicit pole, he is asked to consider each of the other figures and indicate, with an appropriate check mark, the individuals to whom the emergent pole is relatively applicable. Thus the construct, while selected for
its applicability to a prescribed trio of figures, is subsequently considered in relationship to all the remaining figures listed along the margin of the grid. When all the sorts are completed the client has produced a protocol in which he has labeled both the emergent and the implicit poles of each construct and has indicated the incidents, by means of check marks, where the emergent poles apply to figures."

It should be remembered that where Kelly refers to "figures" and "individuals", the frame of reference in our study is to "stocks" and "accounts." Crosses, rather than check marks, were used in our study. Members of the original triad contain identifying numbers within their boxes. Therefore, the two emergent objects in the original triad will appear as numbers which have been crossed out while the implicit object will appear as a number which is unmarked. The following is a sample score sheet from a Role Construct Repertory Test which was administered to one of the Portfolio Managers with reference to twenty of his own accounts:
ROLE REP TEST - PORTFOLIO ATTRIBUTES

Portfolio Manager:  3
Interviewer      :  M. L. Lavin
Date             :  8 October 1971

SORT:       COMMENTS:

1  3 and 14 are less aggressive portfolios than 15

\{most aggressive acct's:  6, 9, 10, 13, 16, 19, 1, 2
least aggressive acct's:  3, 5, 8, 14, 20

2  With 1 and 9 I have no communications problem, whereas with 16
I have a bad one--there's very low feedback from 16 on how I'm
doing.

\{low feedback:  5,7,8,12,17,16
high feedback:  4,6,13,15

3  17 and 20 are much larger than 5, which is inactive and dormant--
really much too small. [What does size mean to you?] Not that
much. . . I invest a $100,000 account just like a million dollar
account. Perhaps what I mean is that 5 is much less active.

\{inactive accounts:  3,5,8
active accounts:  the rest

4  7 and 13 are discretionary accounts, whereas, 4 is non-discretionary.
A discretionary account is one where you can move very quickly if
something comes up.

\{can move very quickly:  5,7,9,10,12,13,15,16,18,19,1
cannot move very quickly:  3,5,8,14,17

5  19 differs from 11 and 12 in that it is related to another larger
account. It's important to keep this account happy so it tends
to receive more attention. This is typical for accounts belonging
to important people.

\{receives preferential treatment:  8,11,12,14
does not receive preferential treatment:  the rest

6  In the case of 6, I am very close to the customer, whereas, in
2 and 10, I am not so close.
In the case of 17, I manage a person's entire wealth, whereas, in 7 and 8, I manage only a portion of the wealth. This means, that in the case of 17, I must strive for internal diversification of the portfolio. In this sense, 17 is very like an account in Personal Trust.

- internal diversification needed: 17,4,9,11,12,14,16,2
- internal diversification not needed: the rest

3 is a low risk account, while, 9 and 17 are high risk accounts.

- low risk: 3,5,14,20
- high risk: 6,10,13,15

12 differs from 5 and 6 in that 12 has a large concentration of its assets in one security, where large capital gains exist. For all practical purposes, these are untouchable securities.

- large proportion of untouchable securities: 8,12,13,14,15,18,2
- no significant proportion of untouchable securities: the rest

15 differs from 11 and 18 in that 15 has no income requirement. Here I can buy stock having no dividend. In contrast, 11 and 18 are balanced portfolios, having an income requirement.

- high current income requirement: 3,8,14,20
- low current income requirement: 15,6,9,10,13,19,1

4 differs from 2 and 16 in that 4 is solely oriented toward growth, whereas, 2 and 16 are "total return" portfolios--income and growth are equivalent.

- total return portfolios: 6,7,8,9,10,12,13,15,16,18,19,20,1,2
- non-total return portfolios: the rest

In the case of 14 I'm involved with an entire family. This means that it takes a long time to get a new program approved, in contrast to 8 and 13, where I'm not involved with an entire family.

- long time to get approval of program: 3,5,17,20,14
- speedy approval: see "can move very quickly".

For 13, I have a clear picture of the account's goals, whereas, for 8 and 14 I do not.

- very clear picture of goals: 6,9,10,11,12,15,16,18,19,1,2,13
- very unclear picture of goals: 3,4,7,8,14,17
13 19 is a younger client, more aggressive, much more interested in growth, and more risk prone than 1 and 10, where the clients are older and near retirement. Perhaps the novel contrast is stable objectives (1 & 10) compared with changing objectives (19).

- Changing objectives: 5,18,19,1
- stable objectives: the rest

14 Compared with 1 and 2, I have much more contact with the customer in account #20. I get much more feedback from 20 and have a clearer idea of his objectives.

(no new attributes)

15 In comparison with 2 and 15, 5 is much more diversified. In 2 and 15, I found the wealth concentrated in one place—one stock, a building, or a piece of land. I'm trying to diversify it.

- over concentration in a few assets: 3,13,15,2,18
- diversified assets: the rest

16 In comparison with 18 and 19, 3 places many restraints on the investment I make. In 3 the client retains a good deal of control, whereas, in 18 and 19, I move freely. In addition, 18 and 19 are growth oriented accounts while 3 is not.

- client retains a lot of control: 3,8,14,17,20,4
- client retains very little control: 6,7,9,10,13,15,19

17 11 and 13 are very large accounts while 6 is very small... I feel much more comfortable about 6 and 13 because I know the goals better.

(no new attributes)

18 I've been involved with 9 from the beginning, whereas, I inherited 4 and 14 from my predecessor. [What does this mean to you?]. In the case of 4 and 14 I have to realign the portfolio and re-educate the client. In addition, I don't have as clear a picture of the goals.

- have to re-educate client: 4,14
- do not have to re-educate client: the rest

- have to realign the portfolio: 4,8,14,15,16,20,1
- do not have to realign the portfolio: the rest

19 17 is very concerned with administrative problems—things like getting dividends on time—whereas, 7 and 10 are more investment-oriented. As a result, 17 probably receives less attention than 7 or 10.
SORT: COMMENTS:

- very concerned about administrative matters: 17, 3, 11, 14, 2
- not very concerned about administrative matters: the rest

20

16 has additional cash inflow continually, and so, I must review it periodically, in contrast to 8 and 20 which have no additional cash inflow.

- very frequent review: 16, 6, 9, 10, 13, 15, 1
- very infrequent review: 3, 5, 8, 17
From the data on the Role Construct Repertory Test score sheet, a List of Portfolio Attributes was compiled. The attributes were then classified as to whether they related to the client, goals, or structure. The number of attributes falling in each category were then tabulated. Although no formal criteria were established for classifying the attributes as relating to the client, goals, or structure, the inter-observer reliability of such classifications was almost perfect. These tabulations form the data necessary to test the two hypotheses proposed by Gerrity. The following is a sample list of Portfolio attributes.

The sort measure is to be understood in the following way: The number to the left of the decimal point simply refers to the order of the sort within the predetermined sequence. The number to the right of the decimal point refers to the order in which a particular construct was mentioned within a sort. A second construct might be elicited within a sort by the question "Can you think of another important way in which _____ and _________ are alike and different from _____?

The salience measure refers to the length of the larger of the two chains of objects which are described as being similar to either the emergent or the implicit pole. The count and frequency columns provide a frequen-
cy distribution for the salience measure. The frequen-
cy with which each larger chain length occurred in the
sample is shown by the frequency distribution. The
median larger chain length is also provided.
Subject: List of Portfolio Attributes
Portfolio Manager: 3
Analysis by: M. L. Lavin Date: 9 November 1971
Data Source: Role Rep Test Date: 8 October 1971

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Sort</th>
<th>Salience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLIENT:</strong> (8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Low) feedback</td>
<td>2.1</td>
<td>6</td>
</tr>
<tr>
<td>(Can) move very quickly</td>
<td>4.1</td>
<td>11 Hi</td>
</tr>
<tr>
<td>(Receives) preferential treatment</td>
<td>5.1</td>
<td>4</td>
</tr>
<tr>
<td>(Very) close to the customer</td>
<td>6.1</td>
<td>6</td>
</tr>
<tr>
<td>(Long time) to get approval of the program</td>
<td>12.1</td>
<td>5</td>
</tr>
<tr>
<td>Client retains (very little) control</td>
<td>16.1</td>
<td>7 Hi</td>
</tr>
<tr>
<td>(Have to) re-educate the client</td>
<td>18.1</td>
<td>2</td>
</tr>
<tr>
<td>Client (is) very concerned about administrative matters</td>
<td>19.1</td>
<td>5</td>
</tr>
<tr>
<td><strong>GOALS:</strong> (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Most) agressive accounts</td>
<td>1.1</td>
<td>8 Hi</td>
</tr>
<tr>
<td>(Low) risk</td>
<td>8.1</td>
<td>4</td>
</tr>
<tr>
<td>(Low) current income requirement</td>
<td>10.1</td>
<td>7 Hi</td>
</tr>
<tr>
<td>Total return portfolio</td>
<td>11.1</td>
<td>14 Hi</td>
</tr>
<tr>
<td>(Very clear) picture of goals</td>
<td>12.2</td>
<td>12 Hi</td>
</tr>
<tr>
<td>(Changing) objectives</td>
<td>13.1</td>
<td>4</td>
</tr>
<tr>
<td><strong>STRUCTURE:</strong> (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Inactive) account</td>
<td>3.1</td>
<td>3</td>
</tr>
<tr>
<td>Internal diversification (is) needed</td>
<td>7.1</td>
<td>8 Hi</td>
</tr>
<tr>
<td>Has a (large proportion) of untouchable securities</td>
<td>9.1</td>
<td>7 Hi</td>
</tr>
<tr>
<td>Over-concentration in a few assets</td>
<td>15.1</td>
<td>5</td>
</tr>
<tr>
<td>(Have to) realign portfolio</td>
<td>18.2</td>
<td>7 Hi</td>
</tr>
<tr>
<td>Very frequently reviewed:</td>
<td>20.1</td>
<td>7 Hi</td>
</tr>
</tbody>
</table>

**Attribute Breakdown:**

<table>
<thead>
<tr>
<th>Client</th>
<th>8</th>
<th>40%</th>
<th>14</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td>6</td>
<td>30%</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Structure</td>
<td>6</td>
<td>30%</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>100%</strong></td>
<td><strong>8</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Frequency**

*This measure is, in general, the largest number of portfolios mentioned in one category.*
In this sample, eight (40%) of the attributes referred to client characteristics. This is an indication that Gerrity's original descriptive model of the portfolio managers construct space is valid, at least for this particular sample. The remaining twelve attributes were evenly divided between portfolio goals and portfolio structure.

Another instrument used in the effort to examine the concept structure of portfolio managers was the Portfolio Structure Interview. Devised by M.L. Lavin, the Portfolio Structure Interview is an explicit attempt to elicit structural characteristics of portfolios. The manager is asked for the names of four of his portfolios according to the following criteria:

A: My most recent analysis
B: One I plan to analyze soon
C: The one I'm the most happy with
D: The one I'm the least happy with

Four pairings of the portfolios are then made; AB, BC, CD, and DA. For each pairing, the portfolio manager was asked to describe all of the similarities and differences he noticed between the two portfolios. For example, one of the similarities cited by a portfolio manager states "Both trusts have balanced objectives--maintenance of income level with some growth."
Another example of a similarity "In each case, the bonds held are municipal bonds. This tells me that the beneficiaries are in a high tax bracket, something I must keep in mind while taking capital gains."

A sample difference is "In B we have discretion while in A we do not." Another difference is "A produces high income in contrast to B which produces low income." When the portfolio manager stops speaking, he may be prompted for more distinctions by a statement such as "Are there any other important ways in which B and C differ?"

In the psychological literature, one of the most frequently used techniques to elicit conceptual structure involves the use of differences and similarities. These tasks usually ask the subject to indicate ways in which items are different from and similar to those preceding or alongside. In such a manner, the salient dimensions (aspects, properties) of the environment serving as a basis of discrimination are identified. A concept may be defined as a way of differentiating two or more things. Psychological instruments such as the Portfolio Structure Interview and Role Construct Repertory Test provide a means for eliciting the rules which identify the properties by which objects are differentiated. In such a way, the salient attributes or dimensions of
stocks and portfolios as perceived by the portfolio manager are identified.

The Portfolio Structure Interview may be used as both a longitudinal and cross-sectional instrument. As a longitudinal instrument, it will enable us to measure the impact of the Portfolio Composition System on managerial conceptual structure. In particular, a test of Gerrity's hypotheses regarding increased cognitive complexity and a shift toward perceiving portfolios in terms of structural attributes will be possible. In addition, data from the Portfolio Structure Interview will permit a cross-sectional comparison between groups within the Trust Department. This cross-sectional comparison may reveal interesting differences in the kinds of attributes considered to be salient by portfolio managers in each of the three functional groups. For example, we might expect Personal Trust portfolio managers to use more client-related attributes while Pension Fund managers should mention a greater proportion of structural attributes.

A sample Portfolio Structure Interview appears below:
March 7, 1972

M.I.T. Project on the Impact of Conversational Computer

Systems-Trust Dept.,

Portfolio Structure Interview:

Portfolio Manager: 2
Interviewed by: Milton Lavin
Date of Interview: 28 November 1971

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>I.D. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: My most recent analysis</td>
<td>40240</td>
</tr>
<tr>
<td>B: One I plan to analyze soon</td>
<td>43116</td>
</tr>
<tr>
<td>C: The one I'm the most happy with</td>
<td>53591</td>
</tr>
<tr>
<td>D: The one I'm the least happy with</td>
<td>55626</td>
</tr>
</tbody>
</table>

Pair AB:

Similarities:

Both are pension accounts.

Both have total return objectives.

Both are relatively aggressive.

In both cases, we have complete discretion. There is no outside interference other than a following by the company.

Both are actively invested.

Both accounts have good stock percentages:
B has 92% stock
A has 84%.

B is, in fact, fully invested. Less than 2% of B's assets are in demand notes...
A has had 5 purchases since 10/15 (the date of the holdings list PM was then using)....
Our goal for stock percent is 90 at the present time. Less than 80% would be seriously low. A portfolio in the range 80-90% would need attention, but its situation would not be seen as critical. A portfolio with a stock percent above 90 would be classified as o.k.

Payout requirements mean we must keep some cash reserve. However, there's no problem [with either A or B] because of a positive cash flow. A has 4% of its assets in demand notes. This is not too high. More than 5% would be excessive, however.

A has sufficient cash flow [even though] we have been selling some bonds here. We've taken the bonds down to the point where only private placements are left. Only recently have we been able to sell private placements at fair prices.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total bond holdings (10/31)</td>
<td>13%</td>
</tr>
<tr>
<td>demand notes</td>
<td>4</td>
</tr>
<tr>
<td>private placements</td>
<td>9</td>
</tr>
<tr>
<td>public placements</td>
<td>0</td>
</tr>
</tbody>
</table>

Thus, B is in a more flexible position than A.

[Could you explain what you mean by "aggressive?"]

A was not considered aggressive until 12-18 months ago. Up until then it had a much lower stock percent... So "aggressive" means two things:

1) the relative percentages of stocks and fixed income investments;
2) the proportion of growth stocks.

Generally, we try to split the stock up as follows:

1/3 in high grade growth stocks
1/3 in consumer-related stocks
1/3 in interest rate sensitive stocks (eg., oils... in fact, this one is the "residual category")

Within the consumer-related area we have recently shifted emphasis from consumer non-durables like radio, TV, home appliances, autos, etc. This shift is especially noticeable in our recent purchases.

Now there's more emphasis on interest-rate sensitive stock than on consumer durables... although we don't sell out the other group (consumer durables) entirely.

[Any other important ways in which the two are similar?]

Although A has become more aggressive in recent years, A still has more conservative names than B, even at the present time. e.g.,

A has 4% in utilities
B has 6 1/2% in utilities
In fact, the two accounts have many of the same names e.g.,

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building materials</td>
<td>3 1/2 - 4%</td>
<td>in both</td>
</tr>
<tr>
<td>Drugs (A is still a bit behind)</td>
<td>7%</td>
<td>8 1/2%</td>
</tr>
<tr>
<td>Consumer-related (A has less here, but A and B have much the same emphasis)</td>
<td>25 - 26%</td>
<td>31%</td>
</tr>
<tr>
<td>Interest-rate sensitive stocks (A has been adding issues here in recent months)</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Retail (A's most recent purchase here is more aggressive than B's most recent purchase)</td>
<td>6%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Differences:

A has a higher percentage in inflexible bonds (private placements). Crater was never so deeply into private placements.

The percentage of stock in an account is a limiting factor. In B we could potentially go up to 95% if we used up all our reserves and sold off one GM bond which is not selling at that big a discount. So far as A is concerned, we've sold off very few of the bonds. I don't think we could get to even 90% stock unless the private placement market improved. Even then there'd still be a 5% difference between A and B.

Despite our adding some more aggressive names to A recently, A still has a longer number of "behind-type" holdings than B.

Pair BC:

Similarities:

C also is a complete discretion account (like A and B).

However, the biggest similarity is the similarity of stock % and the breakdown of the holdings. (see below)

In addition, the two accounts have most of the same issues--same names.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock percentage</td>
<td>92%</td>
<td>95%</td>
</tr>
<tr>
<td>Consumer-related</td>
<td>32%</td>
<td>31%</td>
</tr>
<tr>
<td>Construction</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Beverages (we've done well here)</td>
<td>5 1/2 (3 issues)</td>
<td>4 (2 issues)</td>
</tr>
</tbody>
</table>

Differences:

The cost relationships for C seem to be a bit better than those for B. C has always been a fairly aggressive account and this [policy?] has worked well for them. . .B bought into construction and has had less of a turn there.

B has good representation in office equipment stocks--the higher quality ones
(with supposedly less risk). However, B's worst stock is Control Data. B has much more Control Data than C.

Continuing the above percentage comparison:

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banks</td>
<td>5%</td>
<td>2</td>
</tr>
<tr>
<td>Electric &amp; Utilities</td>
<td>5</td>
<td>5 1/2</td>
</tr>
</tbody>
</table>

[Are there any other important ways in which B and C differ?]

Nok they're really not that different. C has just been more fortunate in its timing. But this is not too uncommon. The accounts are (planned) the same way, they hold many of the same issues, the basic breakdowns are very similar. One account has done better as a result of better timing—taking advantage of more opportune prices.

Part of the difference between the two is a "history difference". C has always been an aggressive account—they never got into bonds and they have no bonds today. In contrast, B has 4% in locked-in, fixed income investments. C has virtually nothing in fixed income. They have one State of Israel bond (less than 0.1% of the portfolio) and 5% in demand notes. Thus, the stock potential for C is 99.9%.

There is another major difference. C is a split-funded account—the dollars are divided between ourselves and someone else. . . The only disbursement is our fee.

B has a positive cash flow. . . We have to set a maximum stock percentage and hold the rest of the assets as a payments reserve. Payments are no problem for C.

Pair CD:

Similarities:

Both are split-funded, however, D has the smaller portion of the assets.

Like C, D has virtually no cash requirement.

Both accounts have the same objective: total return.

In both accounts we have sole discretion, although D watches us rather closely. We have frequent meetings with D—much more contact than we have with C, who leave us pretty much alone.

Both have high stock percentages (see below) and both are invested in many of the same areas:

<table>
<thead>
<tr>
<th>Stock percentage (D is still a bit low)</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer-related</td>
<td>93%</td>
<td>85%</td>
</tr>
<tr>
<td>Drugs (half of D's holdings are a recent purchase)</td>
<td>27 - 28 in both</td>
<td>9</td>
</tr>
<tr>
<td>Confections and Beverages (C's position here was taken 1 1/2 years ago)</td>
<td>?</td>
<td>none</td>
</tr>
</tbody>
</table>
Moreover, many of the names are the same in these two accounts.

D has suffered from being transferred too often to a new P.M. . . . We should all handle an account the same way, but we don't.

D doesn't have its present investments in our past strengths. . . . D has generally had a lower stock percentage. Its cash flow is lower this year. However, its recent performance looks pretty good.

Dissatisfaction arose because of a few bad purchases in the past, plus the lack of a few good solid purchases to offset the bad ones. One is tempted to remedy the situation by making more aggressive purchases. But to do this, you generally have to "but in rich"—pay richer prices. This is how portfolio troubles compound themselves once a portfolio gets into trouble.

On the other hand, if a portfolio is in good shape, you're under no pressure to take unattractive risks—you can buy only attractive stuff—there's no pressure to diversify. Thus, a good record tends to perpetuate itself. C falls into this category. Its yield has been 7 1/2 to 8% over the past 15 years. C has generally avoided investment in bonds and in those cases where bonds were purchased. C has moved out of them easily. Thus, for C the stock percent has stayed high, moreover, there's no pressure to alter the stock percent of to make switches.

**Differences:**

Size is one: C has 8 million in assets while D has 2 million.

Effect of new money inflow is another. New money flowing into D (at about 10-12% growth/year) is unsettling—especially if it comes in when the market is not attractive. I'm not keen on investing it but feel I should.

For C, the new money inflow is approximately 300,000/year on an 8 million base or about 3 1/2% per year. By the fact of its size alone it's not unsettling. It's small enough not to need attention immediately. There's less pressure to do something with the money and so I tend to put it into demand notes and let it ride until the market becomes attractive. . . . With D I invest some of the new money right away; typical policy is to invest 60% now, 20% later and 15% much later (sic).

**Pair DA:**

**Similarities:**

Both have about the same stock percentage and both have about the same goals. A's goals have changed a bit, but D has always been rather aggressive and a total return account.

As to the breakdown of the accounts, it too is pretty similar. A has some carryover from its less aggressive days and so has a higher percentage in utilities, oils, financial stocks, and similar areas.

However, now both have a similar position in non-equity investments, D being somewhat heavier.
Differences:

D's portion in non-equities is all liquid--D has no long term bonds. In contrast, 2/3 of A's non-equity portion is non-liquid, being private placement bonds.

A is a much larger account. At a total asset value of 11 1/2 - 12 million, it is 5 or 6 times the size of D. Let me explain why this is important. With a small account, one buys only one stock in any given area. But for a large account, I tend to pick a more aggressive stock for no. two or no. three.

For example, take building construction. A has 5 issues here while D has only 2. Again, D's two make up two of A's holdings and again the two not held by D are A's best performers in this area.

This issue of size is a major difference. For a large number of issues is not a disadvantage. Added issues are added gravy so far as performance is concerned. Typically, you initiate a commitment to an area by buying one or two large, well funded companies, with good records. (c.f., the above drug example). If you add funds to this area, you're more likely to add another issue, a more aggressive issue; whereas, in the case of a smaller account, you'd just add more shares to the initial holdings--the stable companies.

It's true that you're taking more risks with the larger account. However, you're leveling the risk by investing in one aggressive stock in a number of areas--it's not likely that they'll all go sour at once! For example, if your only aggressive holding were Boise-Cascade, you'd be wiped out. But if you also held American Express, Datsun, and Southwest Industries, you'd be in better shape.

Finally, D has more potential then A. D has only 84-85% in stock with about 10% reserve buying power. The reserves are a bit high.
The Portfolio Structure interview also serves as an indication of the kind of construct space with which a manager views portfolios. Although we have not formally analyzed the Portfolio Structure interviews as of this date, several interesting approaches might be taken to such an analysis. For example, the attributes mentioned in the Portfolio Structure Interview might be compared to the List of Portfolio Attributes obtained from the Role Construct Repertory Test. A categorization of the attributes mentioned on the Portfolio Structure Interview might also provide an additional test of the hypotheses proposed by Gerrity. While we would expect a greater proportion of structural and goal-related attributes on the initial Portfolio Structure Interview than on the initial Role Construct Repertory Test, we would still expect a shift away from client-centered attributes and toward structural attributes after the Portfolio Composition System has been in use.

A brief analysis of the List of Portfolio Attributes obtained from the Role Construct Repertory Test shows an approximately equal breakdown between attributes related to client, goal, and structure. We expect this baseline to shift markedly in the direction of structure as the Portfolio Composition System comes into use. We
also expect an increase in the sheer number of portfolio attributes mentioned on the Portfolio Structure Interview to occur after the Portfolio Composition System has been in use.

While psychological testing procedures were used in an attempt to elicit decision structure, more field-oriented techniques were used to uncover decision processes. The need for naturalistic or field-oriented techniques may be inherent in the nature of the research. As Soelberg (1967) points out

"There is some doubt whether it is even possible to simulate critical decision problems in the laboratory, hence whether most of our knowledge about critical human choice behavior will not have to come from observations in less well controllable field settings."

The procedure used here to study portfolio decisions was the decision protocol, which involves a manager's verbal trace of his thoughts during the process of portfolio analysis and revision. Decision protocols were collected from six portfolio managers, two each in Personal Trust, Retirement and Endowment, and Investment Advisory. Each interview averaged about thirty minutes with the portfolio manager reviewing one or two portfolios and making buy-sell decisions. The procedure was explained to the portfolio manager as an
attempt to elicit the portfolio manager's own conception of his decision process. The portfolio manager was asked to verbalize all the reasoning involved in making a particular analysis or decision. Some of the interviews were conducted "live" as the portfolio review was actually taking place while others were retrospective in describing decisions which had been made in the recent past.

Gerrity (1970) points out that

"limitations of field research with responsible decision makers as subjects in their on-going work environment are that (1) subjects cannot be inconvenienced seriously in carrying on with their job; (2) subjects may have inhibitions in communicating freely to the researcher about their decision behavior, despite assurances of "privileged communication".

Subjects may be particularly wary about describing decisions they are unsure of or which have a high probability of being wrong. Necessarily, this approach to research is vulnerable to biases and sometimes produces information that is difficult to verify. Nevertheless, field studies have an important place in developing and supporting hypotheses which identify the "key variables" in a decision as perceived by the decision maker.

The approach taken here differs markedly from the approach taken by Clarkson (1961). Clarkson's study,
Portfolio Selection: A Simulation of Trust Investment, is premised on the belief that the portfolio decision process has enough structure and predictability so that it can be accurately simulated by a computer program. Clarkson states his guiding assumption in the following manner:

"Basic to these studies of decision-making behavior is the assumption that thinking processes can be isolated as well as identified, and that they can be represented by a series of straightforward mechanical operations. This is not to say that thought processes are simple or easy to represent, but rather that they can be broken down into their elemental parts that in turn consist of collections of simple mechanisms. When these operations are recorded as a set of statements and rules which describe the behavior under investigation that behavior is said to have been 'programmed.'"

In modelling the portfolio decision process, Clarkson states that

"The trust investment process can be divided into three parts: (a) the analysis and selection of a list of stocks suitable for current investment - the "A" List, (b) the formulation of an investment policy, and (c) the selection of a portfolio."

The primary difference between the present approach and the approach taken by Clarkson is that part (a) - the stock selection phase - is considered here to be
judgmental and largely unprogrammable. As we have seen in our discussion of the normative model, judgments regarding overall market, industry, and individual company performance are functionally separate from the portfolio decision process. In the normative model, these decisions and judgments are made by senior economists and security analysts and are inputs to the portfolio process. In our normative model, the portfolio decision process is equivalent to parts (b) and (c) of Clarkson's model and is considered in both cases to be largely structured. We consider part (a) to be more unstructured than does Clarkson. Clarkson does make allowances for judgmental variables in the formation of expectations or forecasts which serve as "input" to a "scanner-selector" mechanism which generates the "A" List. Our own view is that the entire analysis process, including the final evaluation stage, is a largely judgmental and unprogrammable process (This point, incidentally, was made by many of the portfolio managers who then, mistakenly, used it as an argument that the portfolio decision process would not be profitably supported by quantitative decision aids).

The normative approach described here differs from the descriptive approach taken by Clarkson in that analytic and judgmental processes aimed at producing the
best possible results rather than mechanical procedures aimed at producing "satisfactory" results are stressed. The interest in the normative model is in making quantitative predictions regarding risk and return characteristics of individual securities and portfolios. It is not enough to know that a given security or portfolio is acceptable in terms of a predefined criterion or decision rule. The "degree of acceptability" is a critical factor in the normative model, so that securities and portfolios may be quantitatively compared by the portfolio manager. The process of arriving at a precise quantitative estimate of predicted performance for an individual security is highly judgmental and non-programmable at present.

The process of arriving at a quantitative estimate of predicted portfolio performance, given the individual security predictions as input, is indeed more structured than the security analysis process. However, the emphasis here is on mathematical programming procedures aimed at optimization rather than "satisficing" procedures aimed at meeting preset criteria, as in the Clarkson model.

In the real world, portfolio managers do make decisions and judgments on individual stocks as well as
combinatorial decisions regarding portfolios. At the bank we studied, monthly reports from the Performance Analysis group indicated that "buy-sell decisions" often ran counter to the recommendations of Investment Research. This is not necessarily an unacceptable procedure from a performance standpoint since the portfolio managers may be correct more often than the security analysts on the stocks for which there was disagreement. However, from an organizational standpoint, a high incidence of "second guessing" the security analysts is clearly incompatible with the way the department is supposed to function, at least on paper. It also downgrades the role of the bank security analyst, who under the current system, has no idea whether or not his recommendations will be implemented. In the normative model, the feedback monitor system insures the weight given an analyst's recommendation varies as a direct function of his track record. In the real world, the analyst has no assurance that his predictions will be evaluated fairly although portfolio manager judgments about the relative reliability of information from different analysts are often very accurate.

We have seen, therefore, that portfolio decisions in the real world tend to involve judgments about individual stocks and indeed, judgments about the reliability
of analysts' judgments, as well as, the decisions regarding the proper "mix" of stocks to hold in a given portfolio. The decision process as it exists in the real world contains a mixture of programmable and unprogrammable elements. We cannot expect, therefore, to present an unambiguous model of the portfolio decision process which may be confirmed or refuted by empirical test. We can only present, at this stage of the research, intermediate descriptive models which convey to some degree the "modus operandi" of a portfolio manager. Part of the modelling procedure used here is to identify and isolate those aspects of the decision process for which specific decision rules may be formulated.

In practice, the decision protocols varied considerably according to the portfolio manager who was being interviewed. The two portfolio managers in the Investment Advisory group took a "stock-centered" approach to portfolio decisions while the two managers in the Retirement and Endowment group took a "portfolio-centered" approach. The Investment Advisory managers conform much more closely to the prevailing pattern described by Gerrity (1970). Gerrity found that

"In general, the opportunity to buy a specific attractive stock appears to be considerably more important as a de-
cision stimulus than the discovery of a need in a particular portfolio. This observation was strongly supported by the PM interviews and by the questionnaires, where the PM classified each transaction decision as either need- or opportunity-stimulated."

The "stock-centered" managers usually act when an attractive security may be purchased or when research information indicates that a security should be sold.

The following decision protocol is an example of the "stock-centered" approach:
Decision Protocol: 601

The PM began the interview by explaining that he usually buys a particular stock in relation to the needs of certain of his portfolios. For example, he has currently purchased a Real Estate Investment Trust managed by Equitable Life for a number of his accounts. This trust is composed of shares in a real estate mortgage list. Its high for the year was 35, but it is now selling at 26, due to some sluggishness in accumulating more properties. The trust is a good source of income since the law requires that 90% of earnings be paid as dividends. The yield of this stock is 6 or 7%. This stock is good for accounts that need income and appreciation. The portfolio manager has purchased this stock for several accounts at the current price of 26. These accounts each have one of the following two objectives:

1. High income requirement - average risk; and
2. Appreciation with some income requirement.

This stock can be added to a number of accounts for varying reasons, the PM explained. The stock is inappropriate only for highly aggressive accounts with no income requirement.
The Equitable Life REIT has already been purchased for four accounts. These are the following:

1. A 3-B account for which the trust was purchased for predicted market performance, plus current income. This account had accumulated cash when several stocks were sold in March.

2. A company account where yield is only taxed at a 15% rate. The head of the company is very performance conscious and this account is also classified as a 3B.

3. Two new accounts which were opened by a father for his two sons. When the PM received these portfolios, the holdings were "very stodgy." The PM sold all Bethlehem Steel, U.S. Steel, and Consolidated Edison holdings and substituted the Equitable Life stock.

The PM explained that his general procedure involves selling a stock when the time is ripe and buying another or two later when an attractive opportunity arises.
In this case, the Equitable Life REIT was called to the attention of the Investment Advisory Group by the Special Situations securities analyst. This particular security was attractive to the portfolio manager because of what might be termed the "two birds with one stone" effect. The Equitable Life REIT proved to be a multipurpose investment in that it appeared to satisfy the differing requirements of several portfolios. Note that the stock was most attractive in a portfolio where yield was taxed at a low rate and the account was also appreciation-oriented. In this account, all of the attributes of the security were appropriate in terms of account goals, and there were no tradeoffs of desirable and undesirable characteristics to be made.

An interesting question not answered in this protocol relates to the source of funds for the purchase of the Equitable Life REIT. All of the portfolios mentioned by the Portfolio Manager, had cash on hand at the time of purchase. Apparently no trades were made where the manager was forced to trade off the relative benefits and costs of buying the Equitable Life REIT versus selling other securities. The only seeming exception was an "inherited"
portfolios containing many stocks which would be sold immediately in any case.

The "stock-centered" approach seemed to characterize the two managers we talked to in the Investment Advisory group. This approach seemed to flow from the way the group structured its relationship with sources of research information. The special situations analyst and other information sources seemed to trigger buy and sell decisions within the group. In contrast, the Pension Fund group portfolio managers we interviewed used primarily the "portfolio centered" approach. In the chapter of background material on the Bank, we noted that overall portfolio strategy was discussed by this group to a much greater extent than it was discussed by the other two groups.
An example of a "portfolio-based" decision protocol from a Pension Fund portfolio manager is the following:
Decision Protocol: 201

Taken by: Thomas Landau

Date: July 9, 1971

The PM began the interview by explaining how he uses an investment research report. He noted that the report divides stocks into four categories:

A-High Quality Growth
B-Balanced, Medium Risk
C-High Risk, High Income Potential
D-Cyclical

Within each category, recommendations range from Buy, Dollar Average, Partial Buy to Fully Priced and Sell. According to the PM, the list doesn't change too much from week to week. A change in classification list, which shows stocks which have been raised or lowered in classification, is prepared each week.

The PM said the lead portfolio manager in the Pension and Profit Sharing area set up different criteria by which a portfolio manager is to analyze the holdings in his portfolio. According to the PM, a pension fund portfolio should contain only the following distribution of holdings:

1/3 High Quality Growth
1/3 Consumer Related
1/3 Interest Rate Sensitive

The PM then proceeded to review one of his accounts, a pension fund with assets of $8,500,000. The PM then discussed several of the stocks which his division has been trading with a view toward adding or deleting them from the portfolio under consideration. One buy candidate was Boise Cascade which had apparently "bottomed out after a big fall."

The PM noted that Boise Cascade was not on the Research "Buy" or "Dollar Average" list but that his division had been buying it any way. At this point, the PM left for a minute and returned with today's Wall Street Journal. He said that we have been dollar averaging Avon but that it is currently too richly priced. He pointed out that the group had been considering selling Coca-Cola, since this issue might be overpriced at present.
Since this portfolio currently has only one stock in the automobile industry, the PM considered buying Ford, a stock on the research "buy" list. The PM considered selling MarLennon, a stock which had been on the research "sell" list for quite some time. He might buy some life insurance as a replacement. The PM feels that this account is currently in reasonable shape and he is trying for some improvements. The account is already 86% invested in common stock, so you should pick and choose before adding new stock. The PM computed 1% of the value of the assets of the fund and used this value ($85,000) as a guideline to determine how many shares of stocks to buy and sell.

The PM is currently waiting for bloc trades on MarLennon and University Computing. He might also sell Dunn and Bradstreet which he describes as a good stock which is overpriced. The PM feels that a good rate of return on an account may be the accumulation of small gains. That's why we set very strict objectives to buy a stock for a given price. We usually get the price we want.

The PM then decided upon the following list of buys and limited buys (buy if stock falls below specified price)

<table>
<thead>
<tr>
<th>Stock</th>
<th>Max. buy price</th>
<th># of shares</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boise Cascade</td>
<td>2,000</td>
<td>2,000</td>
<td>$160,000</td>
</tr>
<tr>
<td>Ford</td>
<td>68</td>
<td>1,000</td>
<td>68,000</td>
</tr>
<tr>
<td>Revlon</td>
<td>76</td>
<td>1,000</td>
<td>76,000</td>
</tr>
<tr>
<td>Lincoln National</td>
<td>3,000</td>
<td>96,000</td>
<td></td>
</tr>
<tr>
<td>American</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kimberly Clark</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The PM noted that he is currently waiting for bloc trades to be computed which would sell $200,000 of MarLennon and a smaller amount of University Computing Company. He also decided to sell $134,000 of Coca-Cola Bottling and $106,000 of Consolidated Foods. He said that he might buy Royal Dutch or add to American Hospital Supply if the bloc trades brought common stock holdings for this portfolio to less than 86%.

He noted that this particular account had been reasonably aggressive and return had averaged over 8%. The company representative seems pleased that we buy fairly aggressive stocks and seem to be an alert bank. The account is usually kept heavily invested in common stocks.
It is instructive that the computational resources of the portfolio manager permitted only one numerical breakdown of the portfolio—by % High Quality Growth, % Consumer Related, and % Interest Rate Sensitive. He may have wished to "divide the pie" in other ways if computational costs were not so high. Notice also that this portfolio uses many rigid decision rules, perhaps in an effort to resolve uncertainty. For example, the portfolio manager uses 1% of the value of the fund to decide the value of securities to be bought and sold. This seems to be an insensitive procedure in view of sharp differentials in the desirability of buying and selling at differing points in time with different market conditions prevailing. Another example of this effect is the rigid buy-sell prices which the manager sets. The manager justifies this procedure on the basis that "a good rate of return on an account may be the accumulation of small gains."

In an effort to find out more about this portfolio manager's decision process, we explicitly asked him to describe the criteria which he uses to make buy-sell decisions. The following is a summary of that interview:
Decision Process Summary Portfolio Manager Two

There seem to be three major subobjectives which motivate this portfolio manager to make trades. The first is to have a significant amount of money in the right area. Thus, during defensive periods, the PM likes to keep only about 70% of the portfolio in common stock, while during aggressive periods, about 90% of the portfolio should be in common stock. The portfolio manager's second major subgoal is to upgrade the quality of holdings within particular industry groupings. He sells stocks which are fully priced and replaces them with stocks within the same industry group which are more attractively priced or have more favorable growth prospects.

The portfolio manager's third major subgoal is to maintain the proper balance between types of holdings. At the time we collected decision protocols (July-September, 1971), this "balance" goals were as listed in the decision protocol. Upon further questioning, however, the portfolio manager revealed that he felt that different kind of stocks should be held at different stages of the business cycle. According to the portfolio manager, the current business cycle is one which can be characterized as consumer generated. The four stages of the cycle together with preferred industry group holdings within each stage are diagrammed below:

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defensive</td>
<td>Aggressive</td>
<td>Aggressive</td>
<td>Defensive-Aggressive</td>
</tr>
<tr>
<td>Utilities</td>
<td>Consumer non-durables</td>
<td>Building</td>
<td>Chemicals</td>
</tr>
<tr>
<td>Foods</td>
<td>Interest rate sensitive</td>
<td>Retail</td>
<td>Autos</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>Drugs</td>
<td>Insurance</td>
<td>Industrial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Machinery</td>
</tr>
</tbody>
</table>

Drugs

The strategy proposed by the portfolio manager with regard to industry group holdings is the following:

(1) Buy the stocks in the period before the period of maximum growth
(2) Hold the stocks during the period of maximum growth
(3) Sell the stock after the period of maximum growth

The portfolio manager felt that at present (September 30, 1971), we are in the transition between periods III and IV and that 1972 would be a very good earnings year for quotas and other group IV stocks. He felt that the price of Group IV stocks would peak out 6 to 9 months before the earnings peak.
The procedure as described here contains additional examples of rigid decision rules in use by the manager. For example, the rule of 70% common stock during defensive periods and 90% during aggressive periods is certainly in the right direction. There is no indication, however, that these specific figures were derived by an analytic process which considers probable outcomes and recommends optimal setting of parameters.

The elaborate cyclical theory of the market is interesting but not technically within the province of the portfolio manager. According to the normative theory, it is the function of the security analyst to recommend specific buys and sells based on market, industry, and individual company estimates. The portfolio manager does not need an elaborate theory of the market in order to know which stocks to buy and sell. The cyclical theory of the market proposed by the portfolio manager does reveal the shallowness of his earlier rule of thumb that one should hold 1/3 High Quality Growth, 1/3 Consumer Related, and 1/3 Interest Rate Sensitive stocks.

Another portfolio manager in the Retirement and Endowment group was also interviewed. The following decision process interview took place after several decision protocols were collected. Rather than attempting to summarize that interview, it is presented here ver-
batum. This decision process interview centers on a particular trade in order to tap the underlying cognitive structure and process within which the manager considers and executes trades. The interview proceeded as follows:
Decision Process Summary: Portfolio Manager Seven

Summarized by: Charles B. Stabell

Date of Interview: 26 January 1972

[Interview started off with an explanation of the present state of our analysis of the PM's decision making. I showed the PM some copies of a tentative analysis of some DP's and stressed the fact that we were interested in the decision process].

... Perhaps it is best if I start off by presenting you the different possible triggers that might lead up to a trade decision:

1. A contribution of funds to the account.
2. Discussion with the client, either in a formal meeting or informally by phone.
3. Recommendations by I/R.
4. Availability of a stock.
5. Stock fully priced or stock price at a low.

[5 was added to the list towards the end of the interview.]

The most common causes are (1) and (3) above.

[Perhaps you could give me an example of a recent trade decision which had one of the above triggers and that we could follow.]

OK, ... recently I had a case with a trigger of Type 1; the account received a substantial contribution from the client, in the order of 20% of the total assets of the account. This, of course, upset the balance
of the account in terms of how much to have in cash reserves, how much
to have in common stock, etc. . . .

[Were you aware of the fact that the account was going to receive this
collection in terms of thereby being able to plan beforehand your actions?]

In some cases the client announces in beforehand that he is putting in
an amount. In this case the contribution was unannounced. I would say
that in 50% of the cases the contribution is unannounced. Of course, had
we analysed the information, we could probably predict pretty well the
unannounced contributions as they follow certain fixed patterns.
(Returns to the trade decision)
Some other factors seemed to contribute to the fact that I decided to
make a trade for this account:

1. Prior to the contribution, I had already planned to add some
   common stock to the account.

2. I felt favorably disposed towards the market. This is a critical
   factor for otherwise I might not have moved.

3. I had some stocks that I was interested in buying. Actually,
   I keep an inventory of such stocks just for such instances.
I then decided which stocks (from the inventory?) that would best fit
into the account and bought these.

[From your description I see that your trade decision is to a large extent
determined by our stock inventory decision. Could you perhaps describe
how you select stocks for inclusion in your inventory?]
Well, I have two main sources of information and it is difficult to weigh them, although I put greater weight on the first, which is an outside service. The other main sources is the internal, I/R. Usually I follow recommendations when both sources agree, as they do most of the time.

The changes in focus are basically one of group rotation, with different industries in focus in different cycles of the market.

I follow the outside service closely on a continuous basis, continuously updating the information that relates to my stock inventory.

[How do you decide which stocks to put into this particularly]

I select stocks with the best prospects, e.g., within the chemical industry where there are stocks with growth, income or a balance between growth and income I would select a growth stock.

The stocks that I follow (i.e., the stock inventory) consist of approximately 50 different issues where 50% are there because my portfolios contain these stocks and 50% are there because I feel they have potential and might want to use them.

The philosophy is that this inventory of stocks represents a core against which I can compare new ideas. Remember that the CSL contains 290 different issues and my portfolios contain approximately 154 of these with, however, 35 of the issues held in 10% of my 40 accounts.

[Could you describe how and when you use your information sources?]

The outside service publishes a quarterly update on the economy and industry groups that I read. Besides they publish a weekly letter and
some special reports (2/month) that I read.

[Do you ever refer back to any of these documents?]

Yes, I use it as a reference in the idea generating process.

[What about the internal information sources?]

Well, we have the Wednesday morning meeting such as that you attended this morning. We have recently also started up a meeting schedule within R/E which it is still difficult to judge what will come of.

Besides I have contact with the analyst to hear how one stock compares with another.

[Let us return to your inventory of stocks. How do you decide which stocks to follow?]

This is one of my basic problems. It is an impossible mess to follow the 157 stocks in my portfolios. I cut out the less important ones, in terms of the issues that are held in only a few accounts.

Within an industry I usually have two alternative stocks. My goal is to reduce this to one issue so that I knowingly can be managing my portfolios.

[By reducing your stock alternative within one industry, it would seem that your selection becomes one of industries.]
I have just recently changed my approach to the reviewing of stocks and industries. Previously I had a basic review cycle of industries. However, this did not work out well as I was not able to take into consideration the structure of the portfolio. I have now gone over to reviewing both the industries and the portfolios on a periodic basis. Thereby, I hope to get both aspects covered. However, I do not yet know if it will work.

[Just to get a little feel of the relative amount of time you spend in the different aspects of your time, how much time did you spend on the example of a trade decision mentioned previously?]

Approximately two hours.

Some of the problems tackled in the decision process would be if for a certain industry group there was conflict in terms of two alternative stocks within a portfolio, I would buy the preferred alternative without selling out at the same time the other alternative in the account, thereby getting some risk coverage.

If two alternatives within an industry were being considered, and one of the alternatives was already in the account, I would buy the one already in the account. This in order to hold down the number of different issues within an account.

Basically the decision process would be

1. Look at the economy

2. Is market attractive or not attractive?
[What do you mean by attractive/non-attractive in terms of the decision process?]

It is an important distinction: in a situation with an attractive market I will be looking for what (issue) is going to help me most. While in an unattractive market, I will be looking for what is going to hurt me the most.

3. Select a group of industries.

[What criteria do you use in this selection?]

I am looking for industries that are going to do better than the economy. A major distinction in this respect is between growth and non-growth industries.

4. Select a company.

It is very important to follow the market, as the whole analysis might lead to a stock which then turns out to be fully priced.

[Did you go through such an analysis in connection with the example of a trade that we looked at before?]

Yes.

[At the end of the interview, during a discussion of the study we are performing, I proposed that the study might uncover some of the bottlenecks in the decision making process around trade decisions.]
I am sure that it will then find out that I/R is the biggest bottleneck. Everytime we go over there and want to know if we should sell or buy a stock, they answer "it depends."
Notice that in this interview, the Portfolio Manager was specifically asked to comment on such matters as decision triggers, information sources, and selection criteria. Again we notice that the Portfolio Manager is again functionally acting as his own economist and securities analyst. When questioned about this, his chief complaint was that:

"Investment Research is the biggest bottleneck. Every time we go over there and want to know if we should sell or buy a stock, they answer 'it depends'."

It is interesting that the Portfolio Manager's decision process corresponds very closely to the one described by Clarkson. His "inventory of stocks" corresponds very closely to Clarkson's "A List." The procedure of matching portfolio to industries is also very close to the one which Clarkson describes. It may be that the tendency to establish rigid decision rules and "satisficing" procedures such as keeping a "stock inventory list" is related to the lack of quantitative predictions and computational support available to the manager. A standard operating procedure is better than no procedure at all and represents a reasonable adaptation to the informational deficiencies of the environment. A standard operating procedure helps this manager structure his job in order to ensure that certain minimum
standards are met in a confusing world. A greatly expanded informational capability, such as that provided by the Portfolio Composition System, should make his information gathering and decision-making procedures more flexible, analytic, and powerful.

Moving from the "stock-based" techniques of the Investment Advisory Area and the "portfolio-based" strategies of the Pension Fund managers, we come to the "problem-based" decisions often characteristic of the Personal Trust area. The following decision protocol is an example:
We spoke with P.M. just after he had completed a review of this portfolio—a process stretching over several hours, and involving the Sr. P.M. occasionally. At the time of our conversation, P.M. had just drafted a list of suggested buys and sells which he planned to discuss with the client on July 9th.

[How did this account come to your attention?] This is a good example of a problem situation. This account had been with us for many, many years—since the late 30's. It is a trust under will with four beneficiaries, who may or may not have similar investment objectives or be in similar income tax situations. The bank is sole trustee with discretion in managing the account. Beneficiaries receive income but may not touch the principal.

One of the beneficiaries was unhappy with the way we had been managing this trust. This beneficiary has an agency account with Investment Advisory. One day he spoke with "the Product Manager" [perhaps, in conjunction with his agency account] and in the course of the conversation expressed the opinion that the trust account "had performed poorly over the years." "The Product Manager" passed the word on to us.

Shortly afterwards, this beneficiary came in the Bank for a meeting. He said that he was spokesman for the other beneficiaries and stated that they all felt the account should be traded more actively and take greater risks. The account had too many blue chip stocks; it should contain more growth-oriented securities. In short, he said we should sell a lot of the blue chips and a portion of the municipal bonds and put the money into growth stocks even if this meant cutting the income.

I've drawn up a list of suggested buys and sells [P.M. showed us a draft of his recommendations] and plan to discuss it with this beneficiary tomorrow. If he likes it, then we'll talk with the other 3 to get complete agreement.
At this point P.M. showed us a spreadsheet depicting the performance of this account from April 1961 to date. The headings were:

| Date | Value | Amount of Common Stock | % Amount of Bonds | Annual Income | Yield |

P.M. noted that over this 10-year period the Dow Jones Industrials had increased 32% in value whereas the common stock in the portfolio had appreciated 65%. However, the common stock included shares of a closely held company which had grown to $400,000 from $100,000 in April 1961. Even if one does not consider this $300,000 increase, the portfolio still outperformed the Dow. In addition, over the period, the income grew by 47%.

[Will you reclassify this account?] Probably. This account is presently classed as 2-B which is exactly the way it was invested. [balanced growth with average risk]. It will probably end up as at least a 3-B account.

We felt the account was being well run—the equities were up, the income was increasing, too. We were on the receiving end in this one and we're perhaps unjustly accused. Maybe if we didn't have so many accounts. [We would have contacted the beneficiaries before this].

He contacted the Investment Advisory Product Manager because of his agency account...probably he thought the Bank was doing a better job with his agency account then with the trust...

[How did you go about doing the analysis?] All of the stocks on the sell program are sells of one type or another. There are three kinds of sells:
- General Sell Order: we don't like it at all
- Cutback: we like it, but it's overpriced now, so take profits
- Switch: change to a more attractive stock in this industry.

We didn't sell them earlier because we had such low costs. The capital gains would have been staggering. We went through the list of all the stocks in the portfolio and sold all the issues which had any kind of a sell recommendation. In fact, most of the sells were GSO's—General Sell Orders.

The sells were easy. On the buy side, we went down the approved list and bought the "straight buys." The analysis was conditioned to some extent by the fact that the account had too many issues. We wanted to cut it down to about 26 from the present 35—Twenty-six is an arbitrary figure—it's about the number the Bank thinks you should have in a $5 million account.
First we added to existing holdings by buying all of the "straight-buys" or "dollar-averages" for issues presently held. Then we took new positions in 3 issues. After calling the blue chips, we were left with 24 issues,... we wanted to add 2 or 3 more to bring the account up to 26.

The portfolio was already quite spread out so there was no question of taking a position in a new industry. Any new position had to be (1) a strong buy and (2) a situation likely to show good appreciation over the next 2-3 years.

Building materials firms and companies with low labor costs fit the second criterion now...In fact, we found it pretty difficult to select 2 or 3 stocks. There just aren't too many attractive issues now.

**New Positions:**

- Georgia Pacific replaced Sherwin Williams (building materials)
- American Hospital Supply (low labor)
- Panhandle Eastern Pipeline (yield exceeds 5%)

In summary, we were trying to do the following:

1. Eliminate stocks with a small appreciation potential.
2. Increase the proportion of the account invested in stock.
3. Cut down the number of issues.
4. Maintain the income.
Aside from the primary problem of lack of communication between the client and the portfolio manager, other interesting details are revealed by this analysis. For example, the following statement is instructive:

"We didn't sell (the stocks) earlier because we had such low costs. The capital gains would have been staggering."

This statement reveals the reluctance or inability of the manager to make tradeoffs involving benefit of selling versus cost of selling calculations. Part of this effect may be due to psychological factors but another part may be due to the lack of availability of an easily accessible computational aid.

In summary, we have observed several patterns in portfolio manager decision making which may be stated as hypotheses as follows:

(1) There is an inability or reluctance to recognize and calculate the magnitude of tradeoffs in buy-sell decisions. This hypothesis is supported by theoretical and empirical work on cognitive consistency, notably by Feldman (1966), Festinger (1962), and Rosenberg (1960). These psychologists hold that mechanisms of cognitive processing operate in such a way as to maintain an ade-
quate level of consistency in the inference structure. This need to avoid "cognitive dissonance" and maintain consistency leads a person to look for evidence which is favorable to a decision he is considering or has made, and to screen out information which is unfavorable. This effect tends to lower the probability that a person will weigh objectively the pros and cons of a decision before he makes and analyzes it objectively after he has made it.

An example of this effect is a Personal Trust Portfolio Manager's discussion of his decision not to sell stocks that were listed on the Investment Research "sell" list:

"We didn't sell them earlier because we had such low costs. The capital gains would have been staggering."

No attempt was made here to weigh these costs against the predicted after-tax benefits to be derived from replacing the stocks on the "sell" list with other stocks from the "buy" list.

(2) There is a tendency not to integrate related information -- e.g., to recognize that dividend income and capital gains are both part of total return even though each might be taxed differentially in different portfolios and subject to differing transactions costs.
Steinbruner (1968) cites data which indicate that many individuals make compartmentalized decisions and are unable to integrate the diverse information which may bear on a given problem. Bruner et al. (1966) in *Studies in Cognitive Growth* note that

hierarchic integration is achieved only when the child has progressed to the conceptual or symbolic level.

Bruner and his associates postulate that development proceeds from global and diffuse functioning (enactive stage), through differentiation (ikonic stage), to a symbolic stage in which

the child acquires conceptual structures that free him from undue dependence upon the way things look and permit the kind of internal manipulation of symbols characteristic of abstract and logical thought.

The tasks which Bruner et al. use involve asking the subject to indicate ways in which items are different from and similar to those which precede them. The accurate discrimination of differences is considered to be an index of differentiation; while the accurate apprehension of similarities is considered an index of hierarchic integration. The empirical finding that differentiations happen earlier and more easily than integrations lends credence to the notion that the modularization and com-
partmentalization of problems often takes place at the psychological level. Symbolic functioning may be a rarer species than ikonic thinking, especially when the informational environment is poorly structured.

This effect may lead portfolio managers to consider distinct categories (e.g. - dividend yield, capital gains) in separate compartments and not look for interactions or interrelationships between them. The tendency of portfolio managers to use two way classification schemes (e.g. high risk - low risk and income-growth) for their portfolios is an example of this tendency. Portfolios with high current income requirements must of necessity be low risk, while high risk portfolios always contain large numbers of growth stocks.

(3) There is a reluctance to calculate quantitatively the predicted costs and benefits resulting from a given trade in terms of total return. There is not a single example in all our protocols of anyone who explicitly calculated the loss of dividend yield from selling one stock with the gain in dividend yield from buying another stock and then entered similar calculations for predicted capital gains and losses on the same balance sheet. This hypothesis is actually a combination of hypotheses (1) and (2) but is stated explicitly here for purposes of emphasis. Hypothesis (1) may explain why man-
agers do not usually consider the tradeoff between stocks with high dividend yield and stocks with prospects of high capital gains. As we saw in Chapter 2, dividend yields and capital gains yields are strongly negatively correlated. Hypothesis (2) may explain why PM's do not sum up predicted income from dividends with predicted capital gains in order to arrive at total rate of return estimates.

(4) There is a tendency to analyze the portfolio along descriptive rather than quantitative dimensions. For example, portfolio managers often use descriptive categories such as % Consumer Related, % High Quality Growth, and % Interest Rate Sensitive in balancing their portfolios. With the Portfolio Composition System, they will be able to create histogram displays of a portfolio along such quantitative dimensions as Price/Earnings ratio. This may be useful in assessing the amount of "downside risk" which may be present in a portfolio.

There is considerable evidence that there is a sizable amount of covariance between high growth stocks that is not attributable to common covariance with a market index. Hence, the "beta" (market covariance) index may underestimate the degree of exposure of a portfolio with many growth stocks to a bear market. The sad fate of many "go-go funds" during the bear market of
1969-70 testifies to the importance of developing quantitative techniques for assessing "downside risk." In lieu of computing individual covariances, a histogram display of Price/Earnings ratios may provide such an indication.

(5) There is a tendency to apply rigid decision rules in order to reduce uncertainty without considering why the particular parameter settings are better than other possibilities. The practice of the Pension Fund portfolio manager to hold 70% common stock in a portfolio during defensive periods and 90% common stock during aggressive periods is an example of such a nonempirical- ly based decision rule.

(6) There is a tendency for portfolio managers to conduct a localized search for alternatives instead of considering a wide range of securities as possible replacements for a given security. For example, securities which are sold are usually replaced by others from the same industry. This may be a satisfactory procedure for diversification purposes but a wider search might turn up another security which is equivalent for diversification purposes but preferable for other reasons. The FILTER function of the Portfolio Composition System should alleviate this problem since it enables the Portfolio Manager to search for stocks that satisfy given
criteria.

All of these tendencies are non-analytic in direction and may result in considerably less than optimal performance. Rational, analytic models of decision making (such as microeconomic theory) assume that investors (1) consider all reasonable alternatives and (2) act to maximize some objective function subject to specified constraints. The second assumption implies that efficient tradeoffs are made wherever necessary and related information is integrated whenever possible.

The fact that investors do not always act rationally casts some doubt on economic theories of investor behavior which assume rationality. For example, a security with low covariance with the market may not be priced as high as Sharpe's (1970) model predicts it should, simply because investors do not know how valuable that security is for purposes of diversification. This phenomenon may help to explain the positive intercept (higher rate of return than the riskless rate) observed in most empirical tests of Sharpe's model. As we saw earlier, differential tax treatment of dividend income and capital gains may also assist in explaining this discrepancy between the theory and the real world. Similarly, high beta stocks may be overpriced simply because investors do not know how "risky" they are.
For the purpose of assessing the impact of an interactive computing system on investor behavior, the intriguing notion is that investor behavior should become more rational and analytic with PCS. As the analytic capabilities of the PM's are expanded, the economic theory should become a more accurate description of the process generating the rate of return of assets. For example, an interactive computing system could enable the Personal Trust portfolio manager to "customize" total return calculations in terms of the tax characteristics of individual portfolios. He could then more accurately analyze the costs and benefits of individual trades in terms of the general and special characteristics of the portfolio's tax status. Artificial distinctions between "growth" and "income" portfolios could be done away with and portfolio goals and structure could be defined explicitly in terms of return and risk.

Paradoxically, if use of interactive model-based techniques occurs on a widespread basis, the behavior of the marketplace should become more amenable to description in terms of the utility maximizing model. Securities should more accurately approach their true equilibrium prices and it will become harder and harder to "beat" the market by simply being more rational than the average investor. However, "beating the market" is
practically guaranteed, if one's tax status differs considerably from marketwide averages and everyone acts rationally.
CHAPTER FIVE

CONCLUSIONS AND IMPLICATIONS FOR MANAGEMENT

The problem of assessing the impact of man-machine decision systems is a difficult one since the systems themselves have only become technically feasible in recent years. It is only within the last year or two that major computer manufacturers have made general purpose time sharing systems available on a commercial basis. The next four years should see a blossoming of man-machine decision systems design and research.

The man-machine decision system research reported here has implications for at least two different substantive areas. These are (1) man-machine decision systems as a psychological phenomenon and (2) man-machine decision systems as a new tool for portfolio management.

In terms of psychological research, the system provides the opportunity for the test of many hypotheses. Among the questions which should be answered when the Portfolio Composition System has been in use for a period of time are:

(1) Can the cognitive complexity of a manager's conceptual space be increased by means of a man-machine decision system?

(2) Is there a relationship between cognitive com-
plexity and system usage?

(3) Does an interactive computing system change the focus of decision maker attention from very local, qualitative aspects of the problem to more abstract, quantitative considerations?

(4) What kinds of system operators are more attractive? Transformation and recoding operators or filtering and searching operators?

(5) Does system usage become more concise and efficient over time when the capability for the recoding of operators is provided?

(6) Is there a relationship between the cognitive style of a portfolio manager and the frequency and type of system usage?

Direct tests of questions (1) and (2) are possible because the Role Construct Repertory Test and the Portfolio Structure Interview provide longitudinal measures of complexity of discrimination. Question (3) may be addressed in two ways. A shift in emphasis from client-related to status-related attributes of portfolios may also be detected by means of longitudinal usage of the Role Construct Repertory Test. In addition, the Portfolio Composition System contains a trace capability so that the decision process may be directly monitored. In
this manner, user sessions may be directly replayed and longitudinal shifts in user behavior may be analyzed. This procedure is far superior to the verbal trace method used to model the pre-system decision behavior and should reveal shifts in emphasis of decision behavior as they occur.

The trace capability will also permit an answer to question (4). Thus, a test of Newman and Rogers' (1966) finding that transformation or recoding operators are more attractive than filtering or searching operators will be feasible. In Gerrity's (1970) study, which used a prototype of the man-machine decision system described here, "more direct and concise forms of command expression developed with system usage." In particular, greater use was made of the direct command mode of expression at the expense of the menu-selection and stacked selection modes. The present system provides an opportunity to replicate this finding and to follow the behavior changes of decision makers over a longer period of time. The great flexibility of the command system in the Portfolio Composition System permits an answer to question (5).

We have not thus far explored the issue of cognitive style in this paper, although cognitive style considerations have the focus of considerable attention by other members of our research group. The conceptual framework for cognitive style developed by Kolb (1971) has come in
for particular scrutiny with regard to its implications for our research. In Kolb's framework,

"There are two primary dimensions to the learning process. The first dimension represents the concrete experiencing of events at one end and abstract conceptualization at the other. The other dimension has active experimentation at one extreme and reflective observation at the other. Thus, in the process of learning one moves in varying degrees from actor to observer, from specific involvement to general analytic detachment."

Thus, Kolb's formulation creates four distinct cognitive styles corresponding to quartiles on his two dimensional graph. Kolb explains that

"It is my hypothesis that we all as a result of our hereditary equipment, our particular developmental history and the demands of our current environment develop learning styles that are highly individualized. Some of us become divergers, some convergers, some assimilators, some accomodators. Divergers are concrete and reflective in their learning style and learn ikonically. Convergers on the other hand are active and abstract in their learning style and learn primarily through hypothetical-deductive reasoning. Assimilators are reflective and abstract and learn inductively while accomodators are concrete and active and learn enactively. These individual learning styles determine one's approach to and choice of learning situations."

Kolb (1971) has developed a Learning Style Inven-
tory which he feels is valid in that "the measures of learning style...predict behavior" in a manner consistent with the theory. The LSI is a nine item self-description questionnaire. It has recently been administered to each of the portfolio managers who will be using the Portfolio Composition System. Several hypotheses relating LSI scores to usage of the Portfolio Composition System suggest themselves. Portfolio managers who score heavily on the Active side of the Active/Reflective dimension should use the system more heavily than Reflective portfolio managers. Portfolio managers who rank high on the Abstract scale should use the operators relating to portfolio structure more than highly Concrete managers.

Divergent portfolio managers should show more variation in their patterns of system usage while Convergent portfolio managers should develop more systematic, consistent patterns of usage. This hypothesis would tend to follow from Kolb's finding that

"Convergers have narrow technical interests and tend to major in the sciences. Divergers, on the other hand, have broad cultural interests and tend to major in the arts."

Kolb also theorizes that

"The person with an accommodative learn-
ing style tends to emphasize objectives and practical reality over theory. When the facts and theory don't match the accommodator will throw away the theory. The assimilator will be more likely to discard the facts."

This would lead us to expect that the assimilative portfolio manager would search for a model upon which to base his decisions and use it very tenaciously, far beyond the point where the data suggests that the situation is more complex or different from the assumptions embodied by the model. The accommodative portfolio manager, on the other hand, would be very slow to adopt a model which explains the process he is observing, even when a perfectly good model exists.

It is unclear whether the hypotheses listed at the end of Chapter Four are generally applicable to all portfolio managers or characteristic of the cognitive style of certain of the portfolio managers whose decision processes were modelled. The small sample which was used leaves this issue very much in doubt. Major differences between the decision styles of the Portfolio Managers in the different functional areas were also observed, but these also may be artifacts of the small sample size.

We surely know that some portfolio managers' decision processes diverged sharply from those assumed by a utility-maximizing model while others seemed to be more
analytic in their orientation. It will be interesting to see whether the Portfolio Composition System, with its expanded analytic capabilities, will act to level these differences or accentuate them.

We now move from psychological considerations of man-machine decision systems to a discussion of the impact of man-machine decision systems on portfolio management. The two areas are obviously very heavily intertwined since the cognitive style of the manager and the psychological effects produced by the system will have a great impact on the quality of the decision outcomes.

One of the conclusions to be drawn from the discussion of cognitive style is that the relative success of a particular individual in dealing with a particular problem context is a function of both the individual and the context. In particular, convergent and assimilative individuals should be adept at dealing with abstractly structured situations while the accommodative and divergent portfolio managers might be best at dealing with situations for which no good model exists.

With regard to portfolio management, the key question is "Does a model which accurately accounts for the process generating returns on assets exist?" Current evidence, although preliminary, seems to suggest that Sharpe's (1970) model accounts for most of the variation
in the empirical data. Sharpe's model is also expected to improve in its accuracy as more of the utility maximizing assumptions underlying the model are matched by real world behavior. In particular, the assumptions regarding perfect information and quantitative comparisons of alternatives should be more closely adhered to by analytically-oriented investors using systems such as the Portfolio Composition System.

Given the current state of portfolio management theory, the ideal portfolio manager might be the Converger. This individual will be model-oriented but will be active in his attempts to tinker with the model so that it may more closely approximate reality. The convergent manager will be continually concerned about generating hypotheses from the model in a form which are experimentally verifiable. Such an individual might use a feedback monitoring system, such as that provided by PCS, to experimentally validate his model and update or discard it if necessary. If our assumptions regarding the present state of knowledge are accurate, the individual least likely to benefit from the Portfolio Composition System is the Divergent Portfolio Manager. Since the Portfolio Composition System is very flexible, such an individual might wander all over the map rather than develop the systematic procedures necessary to deal with a presumably well-structured situation. In the case of the Divergent Portfolio Manager, a system-produced increase in cognitive
complexity could lead to poorer performance.

The Assimilative and Accomodative individuals should rank somewhere in between the extremes of the Converger (engineer) and Diverger (poet). The assimilator might be good at using models but he can also be expected to be lazy about adapting the models to special circumstances. The accomodator might be good at dealing with specialized circumstances but poor at understanding why he is doing what he is doing.

These hypotheses have interesting implications for personnel selection in the portfolio management area. In particular, individuals with technical backgrounds who can deal with precise, mathematically defined concepts such as Sharpe's beta coefficient might be best at handling the decision making aspects of portfolio management. Non-analytically oriented individuals might best be placed in other kinds of jobs, such as sales or customer contact.

Again assuming that the present author's perception of the present status of portfolio theory is correct, the positions of market forecaster and security analyst are more judgmental and require different kinds of skills than those most suited to the portfolio manager. These positions, according to the normative model described in Chapter Two, require considerable abilities of judgment, psychological insight, and intuition. The Compleat Ana-
lyst is an individual who is good at making "educated guesses." He must be rigorously trained and knowledgable but also have some of the qualities embodied by the good poker player. Of course, to the extent that the organizational design is such that the portfolio manager also plays the role of the security analyst and market forecaster, he must also possess the gambling instincts and psychological and political insights prerequisite to success in these roles. To the extent that a portfolio manager deals with customers, he must also embody the essential qualities of the minister, priest, or rabbi.

If the present author is wrong and there currently exists no good model to guide portfolio managers, then the situation is completely reversed. The "poet" (diverger) might be the ideal portfolio manager and user of the Portfolio Composition System since Kolb has shown that "divergers seem more creative in the sense that they are better at thinking of many uses for a given object."

In any event, the Portfolio Composition System will have the capability of monitoring and evaluating portfolio manager performance in terms of overall rates of return. Controversies as to which kinds of individuals make the best portfolio managers may be resolved. The Portfolio Composition System should also make it possible to establish an incentive compensation system in which
compensation is tied to performance. Of course, if Sharpe is correct, overall systematic risk levels are directly and linearly related to overall rates of return, so average volatility levels accepted by the portfolio manager must be weighted against the overall return which he achieves. The performance monitor system may also generate a warning signal when a portfolio manager exceeds the average systematic risk level deemed acceptable by the customer.

The performance monitor system of PCS will provide additional tests of Sharpe and others' models and should provide an indication of whether or not these models are applicable and adaptable to real decision contexts. The performance monitor system will also provide an opportunity to assess the accuracy of the market forecasters and security analysts. Thus, incentive compensation systems may become feasible for these areas as well.

In conclusion, we have shown that in tracing the behavior of individuals using conversational computing systems in real decision contexts, additional knowledge may be gained in all three areas. More should be learned about individual decision behavior and individual differences since large numbers of events will be recorded for analysis and relation to other phenomena, such as psychological test performances. More should be learned
about conversational computer systems and their capacity to aid the decision maker in complex problem contexts. Finally, we should learn more about portfolio management, itself, and the underlying processes generating returns on investments. As we come to understand these processes better, we will learn more about how to evaluate the quality of performance of those individuals who manage portfolios of investments.
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