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PARTICIPANT VALUES IN SYSTEMS DEVELOPMENT

By

KULDEEP KUMAR, B.TECH., M.B.A., C.G.A.

A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Doctor of Philosophy

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ABSTRACT

A value is the concept of the desirable. If those who develop information systems and those who use information systems have different values, the value gap can lead to serious consequences. Two methods are developed and tested in this thesis to measure the value systems of developers, users and other participants in the information system development process: one based on a personal value questionaire (PVQ) and the other based on multi-attribute value theory (MAVT).

A framework for information systems (IS) relevant values was developed to enumerate and organize the values to be measured into three groups: economic, technical and socio-political-psychological.

There were 86 values enumerated, which were used in the PVQ method to survey 132 system developers and 47 system users in 13 firms. Developers and users were found to have similar values with respect to economic and technological items, but sharply differing values in the socio-political-psychological group.

A condensed set of items consisting of two economic, five technological and four socio-political items, were organized in a hierarchical structure, for the MAVT method. Preference conditions were assessed and values were measured using the rating scale approach. Three subjects were interviewed in depth; two produced additive multi-attribute value functions, while one produced a multiplicative function.

ACKNOWLEDGEMENTS

The task of tracing the influences and guidance which made this dissertation possible, is the most difficult of them all. Through my "real work" background in the business world, I had learnt that all truely successful information systems development projects are a result of teamwork. I was told, that, on the other hand, scholarly inquiry was the result of solitary toil, in dark dungeons, in the halls of academe. Fortunately for me, "they - those who told this" were only semi-accurate. Because of the variety of resources that were made available to me, or which I managed to sneak access to, the results of this dissertation qualify as a group effort, rather than only my solitary acheivement. This is my effort to thank those team players, who either formally or informally, helped make it possible.

First I wish to gratefully acknowledge Professor Richard J. Welke, my Ph.D. supervisor, who provided me not only his encouragement, advise and continual guidance towards the completion of this research effort, but also lent me his support through many a rough passages. Thanks are also due to Dr.Naresh C. Agarwal, Dr. George Torrance and Dr. Robert Love, the members on my dissertation committee, who actively participated in my research and provided guidance and advice throughout the lengthy dissertation process.

Special acknowledgement is due to Dr. Heinz Klein, who spent hours with me, discussing the theoretical foundations and the practical implications of this research. I also wish to thank Dr. Ken Deal, who helped me design the ISD-PVQ questionaire according to sound marketing research and questionaire design principles.

Finally, and most importantly, I would like to acknowledge the contribution, in terms of unending patience and continuous encouragement, provided by my wife Veronica, and my two children Vivek and Maya.

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INTRODUCTION

Depending upon their perspective the researchers in the area of Management Sciences and Systems have variously used the terms problem solving, decision making and system development to describe the managerial activities these disciplines attempt to support. This chapter :

1. Demonstrates the basic equivalance between these three terms.
2. Explains the role values play in problem solving, decision making and systems development.
3. Explains the possible application of value research to these processes.
4. Formulates the formal objectives of the dissertation.
5. Outlines the structure for the remaining chapters of the dissertation.

1.1 Isomorphism between Problem Solving, Decision Making and Systems Development

The terms problem solving, decision making and system development have been used in the vocabulary of management science and systems to explain the underlying purposes of these disciplines. In this section we will attempt to demonstrate the parallelism between these three terms, as a prelude to explaining the role values play in the processes described by them. We will do this by showing that these terms may be viewed as special instances of the more general area of operations research and management science/systems.

C. West Churchman in an attempt to discuss "Operations Research as a Profession" provides a definition for operations research. The emphasis (boldface print) in the definition is Churchman's.

> "OR, let us say, is the **securing of improvement in social systems** by means of **scientific method.**" (Churchman (1970, p.B-39)).

This definition, and the paper it was a part of, appeared in the October 1970 issue of "Management Science", as a preface to a number of mini-papers (Ackoff(1970), Cook (1970), Littauer (1970), Lieberman (1970) etc.) discussing the "Educational Issues in the Management Sciences and Operations Research". The Churchman (1970) paper attempted to define the discipline of operations research/ management science, prior to the discussion of the suggested management science education programs by various authors. In these papers the terms "operations research" and "management science" were used somewhat synonymously. However the term OR used by Churchman, in today's vernacular is more appropriate to the systematic view of "management science" (i.e. management science/ systems).

We will use this definition as the generic definition of operations research/ management science, and show how problem solving, decision making and (information) systems development represent special cases of this definition. This will be shown by demonstrating that all of these subdisciplines conform to the definitional terms emphasized in the Churchman definition.

1.1.1 Improvement

The above definition suggests that operations research/ management science activity is undertaken with the primary purpose of securing **improvements** in the existing system. The stakeholders in the system are either not satisfied (i.e. have a problem) with the current state of affairs or they recognize opportunities to

improve the current system thereby deriving some additional personal or collective benefits from it. Welke (1977) defines this as the "Initiating Problem". Churchman (1968) describes this as the "challenge of improvement":

> "Not only do we assume that one system can be meaningfully regarded as better than another system, but in our praising and complaining we also assume that we can actually do something to improve the systems that we inhabit. Man may consciously review the possibilities of change of his systems, and, in the light of his concept of improvement and deterioration, he can willingly select among the choices available to him."

Therefore in the process of system development the developer aspires towards an improved state (the **Desired** or the Goal Object System). Operations research then becomes the the process which attempts to transform the current object system to the desired or goal object system. This process is illustrated in Figure 1.0:

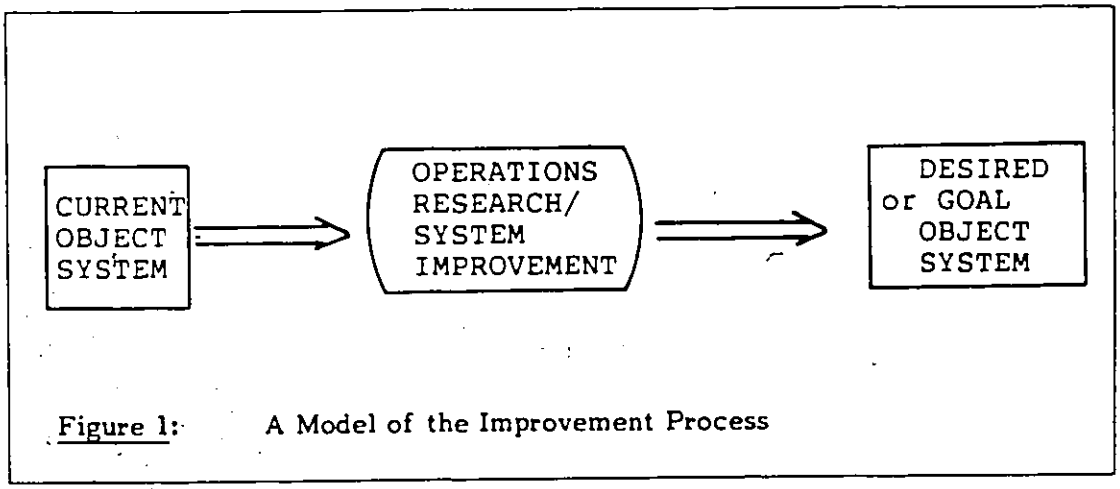


Figure 1: A Model of the Improvement Process

Improvement in Problem Solving Context

Bartee (1973) defines **problem** and **problem solving** as:

> "A problem is defined ... as an unsatisfied need to change a perceived present situation to a perceived desired situation. A solution to a problem is realized when the perceived present and desired situations are perceived to be the same. Problem solving is the

activity associated with the change of a problem state to the solution state."

Bartee's definition of problem solving indicates that it too is concerned with improving the current system towards a desired (and therefore improved) system.

Improvement in Decision Making Context

Johnson, Newell and Vergin (1972) define decision making as:

> "In a systems context, decision making may be viewed as decisions and activities required to bring the state of a system into conformity with a desired state."(Johnson, Newell and Vergin, 1972, p.26)

Samuel Eilon (1969) defines a decision as:

> "to make a judgement regarding what one ought to do in a certain situation after having deliberated on some alternative courses of action"

Eilon then quotes Churchman (1968):

> "The manager is the man who decides among alternate choices. He must decide which choice he believes will lead to a certain desired objective or a set of objectives"

All these three definitions of decision making suggest that decisions are made to attain some desired state of affairs. This indicates that decision making too is oriented towards securing improvements in the current systems.

Improvement in Information Systems Development Context

The information system development process is undertaken to develop and improve information systems. The people who authorize the development, foresee benefits and improvements from the improved information system. Davis (1974) gives the following account of the value of information systems:

> "The value of an information system application may be both economic and noneconomic. Economic benefits are those that cause improvements in revenues or reductions in costs. Noneconomic benefits are related to the quality of life. A reduction in uncertainty which has no economic impact may nevertheless be desirable because humans tend to value uncertainty reduction for its own sake. Closely allied is improved confidence in decision making because of improved quality and quantity of information (even when the decisions themselves do not change). Another example is the reduction in frustration due to improved access to information."(Davis, 1974, p.452.)

Hammond (1974), as quoted in Argyris (1980), notes that effective MIS (1) provide a structure to a situation which is initially relatively unstructured, (2) extend the decision maker's information processing ability, (3) fascilitate concept formation, (4) stimulate the collection of data that otherwise might not be collected, and (5) free the manager from existing mental sets. Kriebel (1979) has suggested that information systems development is supposed to increase the organization's efficiency and effectiveness. Wilkinson (1982, p.679-681) and Burch, Strater and Grudnitski (1983, p.420) list additional benefits and improvements obtained through information systems (development).

This discussion shows that all the three processes of problem solving, decision making and information system development are oriented towards securing improvement in systems.

1.1.2 Social Systems

The above definition of operations research indicates that OR is the securing of improvements in social systems. Churchman defines social systems as:

> "I have used the term "social" to indicate that in all OR studies we are concerned with a three way relationship between people, namely, (1) the decision makers, (2) the people who are supposed to benefit from the system, i.e. the clients or the beneficiaries, and (3) the operations researcher."

As we are discussing problem solving, decision making and system development in the organizational context, and as Johnson, Kast and Rosenzweig (1967) have suggested that organizations are social systems, we can infer that all the three processes are concerned with securing improvement in social systems. Churchman's three social entities may be translated into the specific contexts of problem solving, decision making and information systems development as follows:

The Problem Solving Context

The problem solver, the client or the beneficiary and the management scientist.

The Decision Making Context

The decision maker, the beneficiary and the management scientist.

and,

The Information Systems Development Context

The corporate management, the client or the beneficiary and the information systems analyst.

1.1.3 Scientific Method

The above definition of operations research states that this improvement in social systems is secured by means of **scientific method**. In this section we will present a definition of the scientific method, and then show that problem solving, decision making and information systems development secure the improvement in the social systems by means of methodologies which conform to the scientific method.

For the purposes of discussing the above definition of operations research, Churchman (1970) describes the **scientific method** as follows:

> "The meaning of scientific method which is commonly accepted today by most scientific communities has its origin in two great philosophical traditions, rationalism and empiricism. Rationalism emphasizes the deduction of truth from first principles arrived at by reason and intuition. Its chief spokesmen were Descartes, Spinoza and Leibniz. Empiricism emphasizes the process of learning truths from direct observations of natural events, either externally through the senses or internally through reflection. Its chief spokesmen were Locke, Berkeley and Hume. The disciplines of science have used various combinations of these philosophies as descriptions of their methods... When we turn to OR, the basic texts seem again to be in remarkable agreement... "doing OR" consists of (a) observing a system, (b) formulating a problem, (c) generating a model which predicts how the system will work if certain

changes are made, (d) gathering the necessary data to plug into the model, and (e) estimating from the model the change that maximizes the value of the system." (Churchman, 1970, p.B-40).

The Problem Solving Context

A similar series of steps for problem solving have been suggested by Bartee (1973):

1. Genesis: is concerned with the initial awareness that a problem exists. This step includes the perception of the present and desired situations and the identification of the problem.

2. Diagnosis: in this step a representation of the problem is defined, described and understood in terms of major problem components and boundary conditions.

3. Analysis: in this step the diagnosed problem is reduced to smaller elements and these elements are further diferentiated.

4. Synthesis: analysed information and identified parts are integerated into a solution that is intended to match the present situation with the desired situation.

The Decision Making Context

Eilon's description of the steps involved in the decision process is similar to the steps in Bartee's problem solving process above. These steps are:

1. Information Input
2. Analysis
3. (Specification of) Performance Measures
4. (Specification of the) Model
5. (Enumerate) Strategies
6. Prediction of Outcomes
7. (Determine) Choice Criteria
8. Resolution

In both the above situations the problem-solver/ decision-maker studies the current object system, formulates a problem description, devises alternatives and finally based upon some improvement criteria selects or synthesises a solution.

The Information System Development Context

The process of information system development also involves steps (usually termed the development life cycle) which are similar to those for problem solving and decision making. "The steps or phases in the life cycle for (information) system development are described differently by different writers, but the differences are primarily in the amount of detail and the manner of categorization. There is general agreement on the flow of development steps...(Davis (1974))." The generic system development life cycle may be described as:

The System Development Life Cycle

1. Problem Initiation
2. Examine and Model the Current Object System
3. Diagnose the Current Object System
4. Determine Change Alternatives
5. Select among the alternatives (i.e. Design the Desired Object System)
6. Implementation of the Desired System Design

For example one variation of the system development life cycle given by Sage (1977) is:

Seven Steps of Systems Engineering

1. Problem Definition
2. Value System Design
3. System Synthesis
4. System Analysis
5. Optimization of Alternatives

6. Decision Making

7. Planning for Action (Implementation)

Similar system development life cycles have been proposed by Davis (1974) and DeMarco (1978).

1.1.4 Isomorphism - Summary

The definition of operations research by Churchman (1970) emphasized three terms: the **securing of improvement** in **social systems** by means of **scientific method.** The discussion in sections 1.1.1, 1.1.2 and 1.1.3 demonstrated that problem solving, decision making and information system development processes conform to this generic definition of operations research. Therefore we infer that these three are special instances of the more general area of operations research and management science.

In this study we will focus on information systems development as a particular instance of operations research/ management science. However the following discussion about the role of values in information system development is equally applicable to the processes of problem solving and decision making.

1.2 The Role of Values in Problem Solving, Decision Making and System Development Process

[1]

> "If we do assume that we have the capacity of improving systems, then what do we mean by "improvement"? Much has been said about on the meaning of this concept. Ever since the earliest days of intellectual history, philosophers have paid special attention to the ideas of good and bad, or right or wrong, in the arena of human conduct." (Churchman (1968).

This section discusses the role of values in determining and defining what different stakeholders in the system development consider as "improvement".

The system undergoing development (the current object system) is a complex structure of real world entities and relationships between these entities (Chen(1976)). Sackman (1967) defines an information system as an ".. evolving organization of people, computers and other equipment including associated communication and support systems." Davis (1974) lists the components of MIS as hardware, software, files (databases), procedures and operating personnel. Each of these components, when viewed from different perspectives, results in different aspects of the object system which may be candidates for examination, analysis and development.

Therefore, the developer in his quest for improvements is confronted with a real world (the object system), which is complex and has many aspects. For a mere human, with all the cognitive limitations of human information processing (Davis(1974)), it is impossible to perceive and comprehend the wide complexity of

---

[1] The above description of problem solving, decision making and system development indicates that all of the above three processes are describing essentially the same improvement process in the context of different sub-disciplines of management science and systems. Also in each of the three processes there is an emphasis on evolving the current situation, system or decision alternative towards a set of "desired or goal" conditions. In this study we will focus on information system development as a special instance of the process of systems development. The following discussion about the role of values in the system development process is equally applicable to the processes of problem solving and decision making.

every aspect of the object system. Langefors (1973) calls this the "imperceivability problem". The imperceivability problem severely limits the aspects of a problem a developer may perceive, analyse and comprehend at any one point in time. On the other hand only those aspects (objects and their relationships) which are explicitly perceived and examined, can be consciously considered as candidates for change or improvement. Therfore, if the imperceivability problem limits the aspects which may be consciously examined and analysed by the developer, it also limits the conscious and planned improvement, to only those aspects which are considered relevant for examination and analysis.

In order to overcome the imperceivability problem and in order to derive an acceptable direction for "improvements", the people who are involved in the development process (the "participants") have to make the following basic decisions:

1. Given the imperceivability of the object system, which limited subsets of all the possible aspects of the existing system, are important enough to be examined, analysed and developed.

2. Having determined the aspects for analysis and development, what directions should these aspects be developed in, and

3. What should be the means or the processes through which the move from the current to the desired state should be accomplished.

The first two choices or decisions define the meaning of "improvement" for the system development process. The third choice, by selecting the means or the process of development, influences the meaning of improvement for the development process.

These three decisions involve selections from (a) a possibily large set of aspects which are candidates for development, (b) many goals/ criteria which may determine the the direction of development and (c) a large set of methods and means for accomplishing the process of development. The process of systems development in general and information system development in particular can therefore be viewed as a process of selection of the ends (the candidate aspects, and their direction of development) and the means of development.

The selection process depends on what the participants in the development process consider as "better" or "desirable", i.e. the value system of the participants.

This study focuses on two classes of direct participants in the information system development process: the system developers and the system users (see Figure 2.0). There obviously are other people and participants, such as the system development methodology, the system development management and the top management of the organization whose values have a significant impact on the selection of candidate aspects and direction for development for the system being developed. Though the system development methodology may have imbedded values of its own (Mattessich (1978)), the methodology itself is interpreted and applied by the two direct human participants (the developers and users) and hence for the purposes of this study the values underlying the development methodologies will not be studied. The values of the top management of the organization, play a major role in the system planning process and in defining the initiating problem. In this study we are limiting ourselves to the system development (analysis and design) phase. As they are not "direct" participants in the development process, and as they only impact the analysis and design through their influence on the direct participants, the top management's and the system development manager's values will not be considered in this study.

In this study we assert that the participants in the system development process can be characterized by their respective value sets. The participants, their respective value sets and the gaps (differences) between these value sets are represented by the Value Gap Model in Figure 2.0.

As individuals and as groups, both the system developers and the system users have their own current value systems which suggest (for them) the aspects of the existing system which should be analysed and improved, and the direction this improvement should take. Hedberg and Mumford (1975) explain the role of system developer/ designer values in the system design process:

> "The complexity of the design task is considerable and the consequences of various design alternatives are often hard to evaluate. It is reasonable to assume that values play an important part in guiding the designer's choice between different design alternatives."

Later Hedberg and Mumford (1979) extend the consideration of values to users as well as system designers:

> "The values, needs and objectives of top management and system designers will influence the kind of technical, organizational and task structure alternatives they consider during the design process and the solutions they eventually choose. The needs, expectations and objectives of the employees in the user branches will influence the way they perceive and evaluate system proposals and may also affect the kind of organizational and technical solution that is chosen if the users are allowed to intervene in the design process."

Mattessich (1974) also supports a similar position:

> "The design of a system usually requires value judgements about such features as the system's objective, capacity, robustness, sensitivity with regards to some aspects, efficiency and many other properties. The value judgements constitute perceptions of the system user, via designer, to the actual builder of the system."

Kling (1978) mentions the role of five major value orientations (positions) in providing criteria for social choices in the design and evaluation of Electronic Fund Transfer Systems (EFTS). In a much wider context, Sage (1977) shows the role of values in the system-engineering based policy formulation process. Figure 3.0 has been adapted from Sage's "Methodology for Large-Scale Systems".

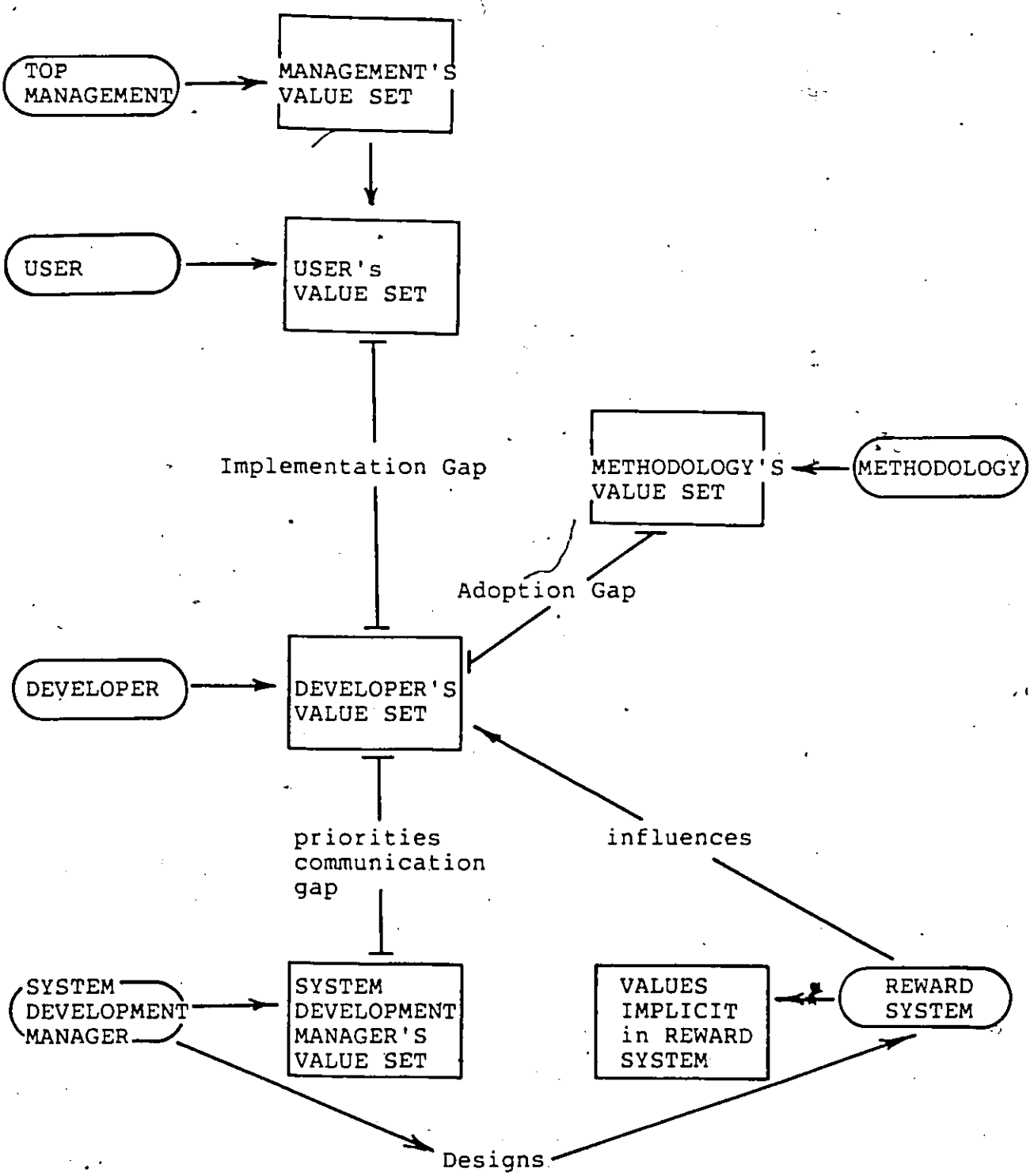


Figure 2: The Value Gap Model. A Model of Participant Values. This study focuses on the value sets of the System Developers and System Users.

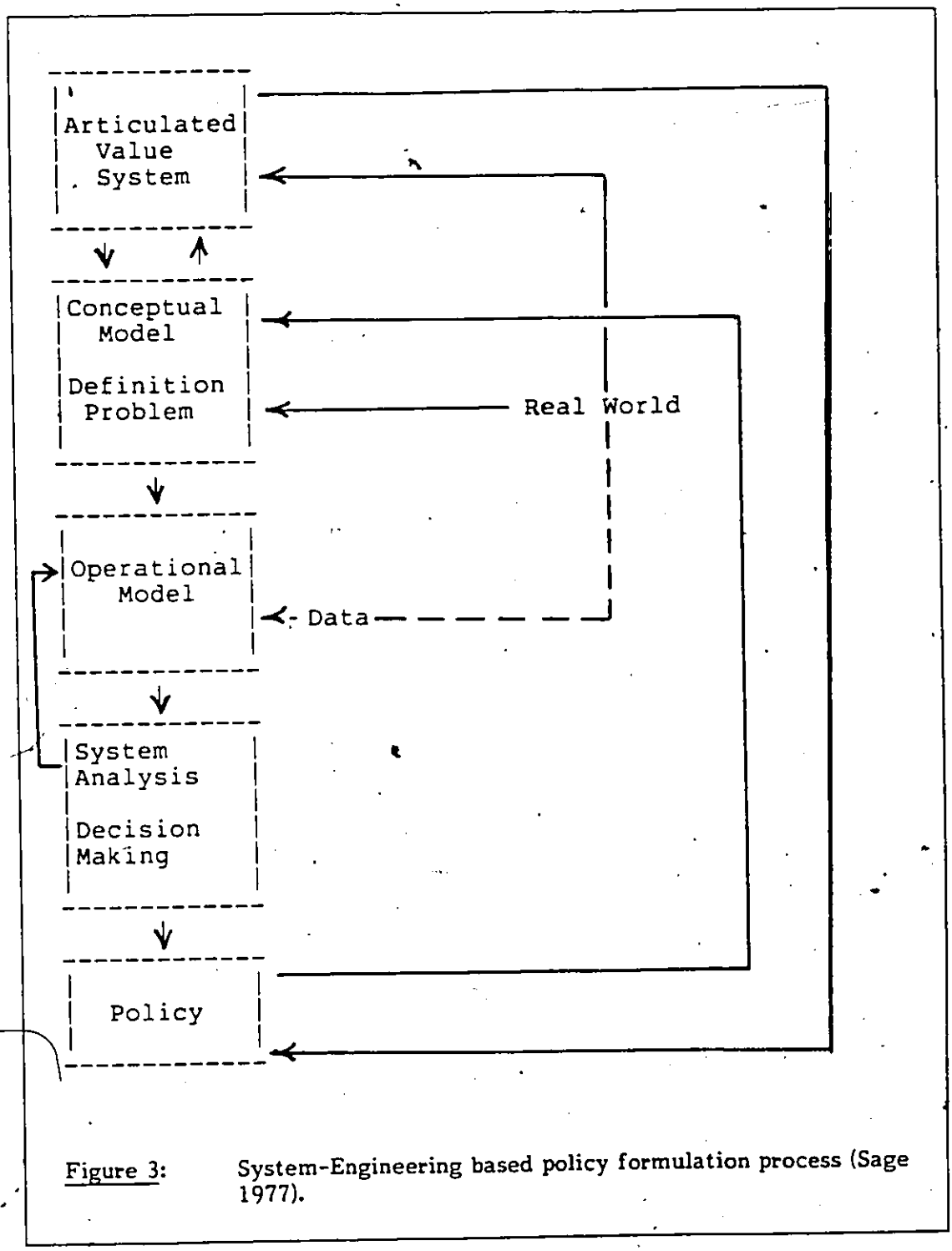


Figure 3: System-Engineering based policy formulation process (Sage 1977).

The above discussion indicates that the values of those who participate in the system development (or problem solving or decision making) process, determine the "desirables", and therefore influence in shaping the final outcome, the solution or the developed system.

The participants in the development process range from developers with highly technical and quantitative backgrounds, to system uses with wider personal and organizational concerns. This suggests that the value profiles of various participant groups in the development process may differ from one another. Smith (1977) has demonstrated that the users and designers of information systems have different system objectives. Differences between system developers and users have also been indicated by Hedberg and Mumford (1979), Gingras (1976), and Kaiser and Srinivasen (1982). In Figure 2.0 the gap between system developers' values and system users' values has been identified as the "implementation gap".

If the value structures of system developers are significantly different from those of the system users, the systems developed by these developers may not satisfy all the value needs of the system users. Argyris (1971) has argued that information systems developed by designers employing the "information systems rationality" do not match the value orientations of the system users and could have problems in their implementation and use. It therefore becomes necessary to a priori identify these value gaps, and take measures to minimize the risk of implementation failure these gaps may create.

Given the major role values play in the system development process it becomes imperative that the value structures of the participants in the system development process are made explicit. Much too often system development, problem solving and decision making tasks are undertaken without the formal explication of the underlying value systems of the participants in the tasks. At

best this may result in aimless drift ending in suboptimization at some trivial objectives level. At the worst it may end up in severe value conflicts resulting in either abondoning the project, or the acceptance of solutions with dysfunctional consequences.

Berg, Chen and Zissis (1976) make the following case for value explication in the wider context of determining policies for technology:

> "Policies are the instrumental judgements which arise from the complex interplay between reality judgements of the possible and value judgements of the desirable. Thus policies are clearly normative, not neutral or value free. The scientific tradition would suggest that the underlying assumptions and propositions should be explicitly stated for all to understand and judge. From this perspective then, a policy generation methodology should acknowledge its underlying normative components and expose its value oriented content as explicitly as possible. A strong case can be made that without this explicit exposure of values and goals the analysis may be subject to drift, inadequate evaluation, and charges of anti-democratic elitism and manipulation."

The need for "Value Research" has been identified by Krone (1980) as an integral part of "Systems Analysis and Policy Sciences":

> "Values are things or principles preferred. Value research provides the analysis to justify that the end is worth doing, the means are acceptable, and the resulting improvements to the system are "good"... Value research addresses the value issues directly through value identification and analysis. The assumption of value research is that values are a major determinant of action and behavior in human systems... Value research can identify the preferences and the qualitative standards exhibited." (Krone 1980, p.39).

Sage (1977) defines "Value System Design" as one of the initial stages of his system engineering methodology:

> "The term value system will be used to refer to the set of interacting elements which provide a basis for decision making.... The systems engineer can assist the decision maker in ... communicating of value judgements..... the value system design activity consists of three distinct features: 1.Defining objectives and ordering them... Definition of objectives is obtained from group and stakeholder community dialogues."

Finally in explaining the need for explicating participant values we turn to Churchman's description of the role of values in "The Systems Approach" (1968). Churchman not only states the need for value explication, he also goes on to include a much larger collection of stakeholders in the list of people whose values need to be explicated:

> "Specifically we must turn our attention to what the real objectives of a system are and how the scientist goes about determining them. Unless we know what the real objectives are, it is clearly quite impossible to determine whether any approach to managing of a system constitues a gain or a loss... As a beginning in thinking about objectives of a system it is natural to ask whose objectives are to be served. Since we will be assuming that the answer to this question is in terms of certain people, let's call the set of all such people the "customers" of the system. The customers in other words are the people who should properly be served by the operations of the system. The customers are not only the people who buy the products but also the employees, the stockholders and perhaps interested sections of the public... The problem of the scientist and the planner is now to determine the real objectives of the customer."

1.3 The Importance of Research in Values Relevant to Systems Development

The importance of this research may be addressed from two perspectives:

- The Implementation Perspective
- The Methodological Perspective

1.3.1 The Implementation Perspective

The Implementation perspective deals with the value-gaps between the system developers and the system users. Systems are usually developed in a direction which is consistent with the value-sets of the system developers. If the value-sets of the system developers are significantly different from those of the

system users, these systems would not satisfy all the value needs of the system users. Argyris (1971) suggests that the information systems developed by employing the "Information Systems Rationality" do not match the value orientations of the system users and could cause problems in their use. This could lead to an implementation failure of the system, where the discretionary users reduce or eliminate their use of the system, and captive users exhibit dysfunctional behaviours such as high turnover, absenteeism and low productivity (Welke (1979)).

Another interesting implication of the gap between the value sets of the users and system developers may be explored in the terms of the possibility of setting up a dialectic process. Churchman (1971) and Ulrich (1977) have discussed the role of the Hegelian Dialectic Process in the Inquiring System Context. Mason (1969) and Klein and Meadows (1980) have empirically demonstrated that when the dialectic process is employed, it produces better decisions. For the dialectic process to be effective, and to ensure that the dialectical differences do not degenerate into dysfunctional conflict, it is necessary that the "thesis" and the "anti-thesis" (the two opposing viewpoints) be consciously recognized by a higher level "synthesizer". A value set measurement proposed in this research could be used to determine the existing value polarities in an organization, and thereby provide an empirical basis for setting up formal "thesis" and "anti-thesis" design-ideals (and therefore alternate designs) which may then be "synthesized" into a "better" design, either by a higher synthesizing group such as a steering committee, or through a synthesizing ISD methodology such as ABACON (Mumford, Land and Hawgood (1978)).

1.3.2 The Methodological Perspective

The Methodological Perspective deals with the design and use/ non-use of system development methodologies. Although there has been a proliferation of system development methodologies, the issue of selecting a methodology to suit the development objectives and environment and the subsequent adoption of the methodology in the system development organization has received scant attention. Some exceptions to this are Zmud (1982) who studied process-innovation as it applies to system development methodologies and Naumann and Palvia (1982) who developed a selection model for system development tools.

The importance of this research into the value systems of the system users and system developers may be examined from two perspectives:

1. Selection and Adoption of available ISD Methodologies
2. Design of New Methodologies

1.3.2.1 Selection and Adoption:

Methodologies, either implicit or explicit, are the vehicle by which organizations develop and implement their information systems. If the users of the methodology, the participants in the development process, do not accept the methodology, the methodology may never be used. If, despite non-acceptance, the use of the methodology is legislated from the top, it would either result in the misuse of the methodology or may result in considerable job dissatisfaction among the developers, with all the attendent dysfunctional consequences.

Therefore there is the need for a framework to list and classify values relevant to information system development, and a technique to measure the value-gaps between the system development methodology on one hand and the participants in the development process on the other hand. Having determined such

gaps, the developers of the methodology (or its advocates in the organization) can better predict the chances of its acceptance, and if necessary, devise strategies to make its (the methodology's) implementation more successful.

1.3.2.2 Design of Methodologies:

Having identified the value sets of the methodology users (the system developers and the system users) the information may then be used to "engineer" a methodology which satisfies the value structures of the participants in the system development process. Alternately, subsets, tools and techniques from existing methodologies which satisfy the value criteria may be combined into an eclectic methodology, custom tailored to the organization's system development value structures (Welke (1981)).

1.4 Objectives of the Research

In section 1.2 we discussed the role of participant values in the process of system development. From this discussion two basic ideas emerge:

- Values of the system designers and the system users influence the kind of alternatives they consider during the design process, and the solutions they eventually choose.
- In order to guide the analysis and design process, it is necessary to make explicit the underlying value systems of the participants/ stakeholders in the system development process.

These two conclusions have lead us to formulate the following research objectives:

1. To develop a framework for enumerating and classifying the values relevant to the system development process.
2. To develop a methodology for eliciting and explicating the value systems of various participants in the system development process.

3. To use this methodology to determine and compare the value profiles of information system developers and system users in the Canadian (Ontario) context. This will include a test of hypothesis of differences between system developers and users.

1.5 Organization of the Thesis Document

This section describes the organization of the thesis in relation to the objectives for the research outlined above.

Chapter II discusses the relevant prior research on which the thesis is based. This chapter has been organized to follow the structure provided by the objectives of the dissertation. Section 2.1 discusses the available value frameworks from value theory, the field of general management and management science. Section 2.2 describes the relevant prior literature on the empirical measurement of values, in both the general and management specific contexts. Section 2.3 describes some previous work in measuring the differences between system developers and users.

Chapter III outlines a proposed framework for Information Systems Development relevant values (objective 1.0 above).

Chapter IV outlines a PVQ (England (1967)) based methodology for measuring the values of participants in the systems development process (objective 2.0).

Chapter V reports on the results of a survey conducted to measure and compare the value profiles of system developers and users. (objective 3.0).

Chapter VI discusses a MultiAttribute Value Theory (Keeney and Raiffa (1976)) based methodology for measuring value structures of information systems development participants (objective 2.0). It also reports upon the results obtained with a pilot sample of three systems developers.

Chapter VII presents a summary of our conclusions and outlines directions for further research.

Chapter II

SIGNIFICANT PRIOR RESEARCH IN VALUES AND VALUES MEASUREMENT

In this chapter we discuss the relevant prior research which has provided the theoretical and methodological foundations for this research. The relevant research may be discussed from two perspectives: (a) the definitional frameworks for understanding and classifying the values, and (b) the methodologies for measuring the value subscriptions of individuals and groups. The definitional frameworks provide a theoretical background on the nature of values, their relevance for behaviour or action and their possible classification schemes. The definitional frameworks are addressed in section 2.1. The methodologies for value measurement and elicitation can be discussed from two different viewpoints. Value measurement in philosophy and the social sciences (sociology, anthropology, psychology etc.) usually deals with the level of importance (either through ranking or through absolute rating) a subject or a value subscriber attaches to various value concepts. Examples of this type of value measurement are the value measurement scales developed by Allport and Vernon (1931), Rokeach (1968), England (1967) and Anderson (1978). On the other hand the mathematical preference modeling in management science, operations research and economics determines the subject's value structure (usually in relation to a set of multi-attribute outcomes) by determining their value or preference trade-offs for these multiple attributes within the framework provided by mathematical value composition models. These composition models combine the individual's value trade-offs for

various value attributes into a single value rating for the multi-attribute outcomes. Examples of such value structure elicitation techniques are, multi-attribute value theory (Keeney and Raiffa 1976), the analytic hierarchy process (Saaty 1980), and fuzzy set techniques in decision making (Hipel 1982).

This chapter is organized in three sections to reflect the three objectives for the dissertation outlined in section 1.4:

1. Section 2.1 discusses the concepts of value theory, and associated value frameworks, in the general socio-philosophical value theory context (subsection 2.1.1), in the general management science context (subsection 2.1.2) and in the information systems development context (subsection 2.1.3).

2. Section 2.2 discusses the empirical measurement of values in the contexts of sociology- philosophy (subsection 2.2.1), management (subsection 2.2.3) and information systems (subsection 2.2.3).

3. Section 2.3 discusses prior research investigating the differences between various participants in the information systems development process.

2.1 Value Theory and Frameworks

2.1.1 Theoretical Frameworks from Value Theory

The literature of philosophy is rich in various frameworks for studying human values. Handy (1969) and Rescher (1969) provide a comprehensive overview of twentieth century thinkers on value theory, such as Dewey, Perry and Pepper. Rather than discuss the wide variety of literature available on value theory, this section will be limited to discussing only those works that have been selected as the foundation for the research into the value systems of participants in the systems development/ decision making process.

The principal works examined for this dissertation are Rescher's "Introduction to Value Theory" (Rescher (1969)), Kluckhohn's "Values and Value-Orientations in a Theory of Action" (Kluckhohn (1951)), Pepper's "The Sources of Value" (Pepper (1958)) and England's "Theoretical Model of the Relationship of Values to Behavior" (England (1967)). This subsection outlines some of the basic ideas from these works. Chapter 3.0 integrates these ideas into a proposed framework for values relevant to the systems development process.

At this point it would be advisable to define what is meant by the terms "Value" and "Value-Sets" or "Value-Structures".

For the definition of "values" we go to the literature of philosophy and specifically Value-Theory. The philosophers themselves are not in agreement about a single definition of value which can cover all the different nuances of the use of the term. As Nicholas Rescher(1969) in his comprehensive treatise on "Introduction to Value Theory" suggests:

> "In the English language the word is used in a somewhat loose and fluctuating way. Philosophers and social scientists concerned with value questions have long recognized the need for a more precise value terminology to facilitate the exact formulations needed in scholarly and scientific contexts. But this desideratum seems to be the only point of agreement. All workers in the field echo this complaint. Nevertheless all their positive efforts have failed. No proposal for a delineation of value terminology has been able to generate any significant degree of concurrence, let alone become a focus of settled consensus."

In this study we side-step this definitional controversy by rigorously defining the context in which we are using the term value. As we are interested only in those values that determine the objects and the direction of improvement (see section 1.2) in the context of information system development, we would be well advised to stay in the realm of action and choice oriented theory of value. Action, because system development involves action in moving from the current

to desired state of affairs. Choice, because determining the object and course of action involves choices between action alternatives. Clyde Kluckhohn (1951) provides a definition in his "Values and Value-Orientations in the Theory of Action", which takes both these aspects into account:

> "A **value** is a **conception**, explicit or implicit, distinctive of an individual or characterstic of a group, of the **desirable** which influences the **selection** from available **ends** and **means** of action. (Kluckhohn (1951))."

Systems development is an action oriented process in which we select or choose which aspects of the system we want to examine and develop, and the direction we would like to develop them (the **ends** of action), and the way we go about developing the chosen aspects in the desired direction (the **means** of action).

Employing the above definition of value, Value-Systems/ Sets may be defined as:

> "A **Value-System/ Set**, of an individual or a group of individuals, is the collection of values the individual/ group subscribes to, or deems as important."

Rokeach (1973) classifies values as "terminal" and "instrumental" values:

> "When we say that a person has a value, we may have in mind either his beliefs concerning desirable **modes of conduct** or desirable **end-states of existence**. We will refer to these two kind of values as **instrumental** and **terminal** values." (Rokeach 1973, p.7)

Some examples of Rokeach's terminal values (also known as intrinsic values) are: equality, a world of beauty, freedom, happiness, self-respect, salvation, a world at peace. On the other hand instrumental values such as intellectual, ambitious, capable, clean etc. are instrumental in attaining these terminal values. Sage (1977) and Hall (1962) have suggested that this ends (terminal) and means (instrumental) duality of values can be successively built into a value hierarchy where a lower level of values acts as the instrumental value for the next higher

level intrinsic value. The next higher level in turn becomes an instrumental value for its higher level intrinsic value, and so on up to the apex of the hierarchy which would represent the ultimate terminal or end value. In such a hierarchy, lower levels of values are synonymous with lower level objectives, and as we go higher in the hierarchy we will encounter gradually increasing levels of objectives, until we reach the ultimate terminal values. The terms "values" and "value systems" have been used in systems engineering (Sage (1977), Hall (1962)) and systems development (Churchman (1968), Mattessich (1974, 1978) and Berg, Chen and Zissis (1976)) for both the lower level values or objectives and the higher level terminal values. However, their usage of these terms seems to be more appropriate to the middle and lower level values or objectives. As this study deals with systems development, we would follow their lead in the use of these terms.

Rescher (1969) discusses how values are manifested as a "two-sided affair" both verbal (talk and inner-discourse) and behaviour (action). Based upon these manifestations, Rescher goes on to describe how "value-subscription" may be ascribed to various individuals and group of individuals. The idea of value-subscription leads into how the subscription of values could be measured for individuals, and what could be the measures of values for a group of individuals. Rescher also discusses how values may be classified by (1) their subscribership (2) their object items, (3) the nature of benefits at issue, (4) the sort of purposes at issue, (5) the relationship between the subscriber and the beneficiary and (6) the relationship of values to other values (instrumental vs. intrinsic values). The classifications which are relevant from our perspective are the classifications by subscribership (the participants or the stakeholders), and the classification by the nature of benefits (Economic, Technical and Psycho-Sociological-Political)

It may also be useful to distinguish between the term "value" and another close but different meaning term "attitudes" used in the literature of values. Nunnally (1978) defines attitudes and distinguishes them from values in the following manner:

> "**Attitudes** concern feelings about particular social objects, physical objects, types of people, particular persons..... What distinguishes attitudes from interests and values is that attitudes always concern a particular target or object."

Values on the other hand deal with preferences which may be instrumental in choosing among a variety of objects and are not limited to a particular object. Therefore when a subject's value set confronts a particular object which is being evaluated, it generates particular attitudes towards that object.

The literature of psychology, sociology, anthropology and the political sciences abounds with techniques for measuring attitudes towards specific objects, such as ethnic groups, political parties etc.. Closer to management disciplines, marketing research is involved in measuring the attitudes of customers towards specific products or services. The methodology to measure values is the same as that for measuring attitudes, and various authors, such as Nunnally (1978), Rescher (1969) have treated it as part of the same methodological discussion.

Pepper (1958) has introduced the concept of "Selective Systems" as:

> "A **Selective System** is a structural process by which a unitary dynamic agency is channeled in such a way that it generates particular acts, dispositions or objects (to be called "trials"), and also activates a specific selective agency (to be called the "norm") by which some of the trials are rejected and others are incorporated in the dynamic operation of the system."

The concept of selective systems has added value when combined with the concept of purposive systems (Ackoff (1971)), in the sense that it introduces "norms" or values which are to be activated for the selection/ rejection process.

Pepper (1958) also introduces the concept of "three selective polarities" in purposive behaviour. These are "conative value" (favouring or liking as opposed to disfavouring or disliking), "affective value" (pleasure as opposed to pain) and "achievement value" (success as opposed to failure or frustration). Although England (1967) (to be discussed below) has not suggested the connection, these three selective polarities may be used to justify his three "secondary modes of evaluation" used in his measurement of the intentionality of values i.e. "right, pleasant and successful".

England (1967) has developed a theoretical model of the relationship of values to the behavior of managers. This model is used in devising and analysing his Personal Value Questionaire (PVQ) which has been used by him and several others to measure the value-systems of various cross-cultural managerial groups, union leaders, naval officers and educators. As explained below, this model, and the associated value measuring instrument differentiates between the stated importance of a value concept to a subject, and the probability that this concept would be translated by the subject into behaviour. In the information systems development process we are interested in identifying those values that have implications for action. Therefore the England framework and the related PVQ instrument seems most appropriate for our purposes, and will be used in devising a Personal Value Questionaire for studying the value-sets of the human participants in the system development process in our study.

England (1967) recognizes that all those values that an individual considers as important may not always be translated into action. This phenomenon was also noted by Jick (1981), who found that though survey subjects (business executives and MBA students) personally professed subscription to the quality of working life

ideal for their employees, they were not certain if they would translate this value subscription into behaviour which would improve the quality of working life. England's theoretical model of the relationship of values to behaviour approaches this problem of inconsistency between the "verbal" and "behavior" manifestation (Rescher (1969)), by empirically determining the "intentionality of values" (i.e. by classifying the values by their probability of being translated into behaviour).

The model as shown in Figure 4.0 recognizes several major classes of values. The total value space consists of all **potential values.** The potential values for an individual or a specific group are made up of two classes of values: (1) **Nonrelevant Values** (values having little or no impact on behaviour) and (2) **Conceived Values** (values which may influence behaviour). Conceived Values are further partitioned into (i) **Operative Values** (those values that have a high probability of translation from intended to actual behaviour), (ii) **Adopted Values** (those values that are less part of the personality structure of the individual, but may influence behaviour because of situational factors) and (iii) **Intended Values** (those values that the individual verbally deems as important but have a low probability of being translated from intentions to actual behaviour).

The model also indicates two major ways in which values can influence behaviour- behaviour channeling and perceptual screening. In our research into the role of values in system development, perceptual screening will determine which aspects of the object system the participants will perceive and hence consider as candidates for analysis and improvement (i.e. the "ends" of action). Behaviour channeling has implications in terms of how the system would be developed, i.e. the "means" of action.

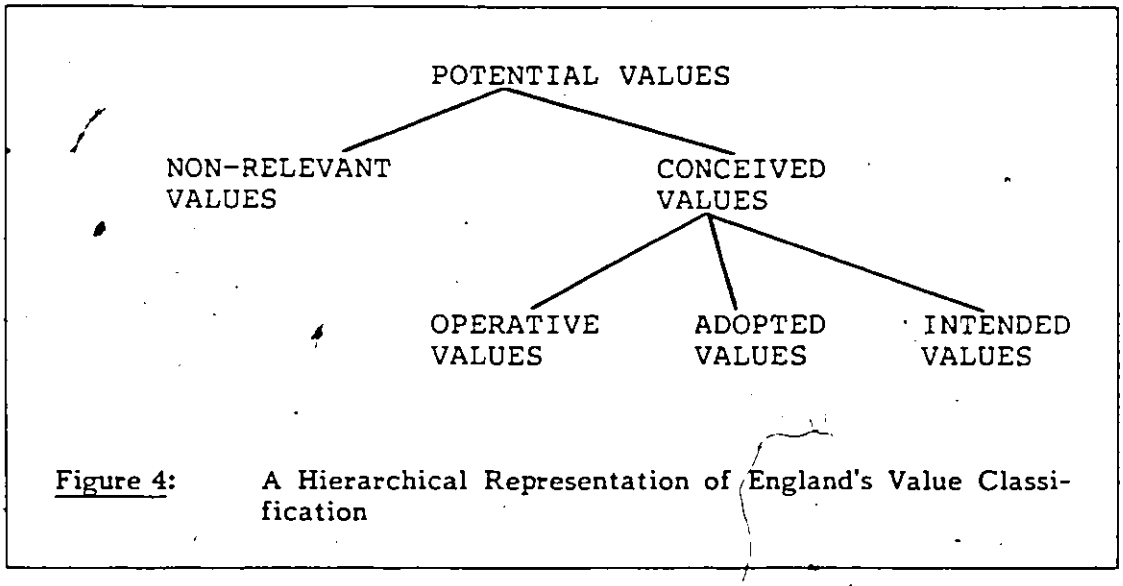


Figure 4: A Hierarchical Representation of England's Value Classification

The model further indicates that the impact of values must be considered in relation to other environmental influences and constraints before they can be used to predict behaviour. Values are a necessary but not sufficient predictor of action.

Figure 5.0 describes the complete theoretical model of the relationship of values and behaviour as suggested by England (1967).

The subsection on the empirical measurement of values in the managerial context (section 2.2.2) describes how this theoretical model is used in generating an instrument to measure the value profiles of managers.

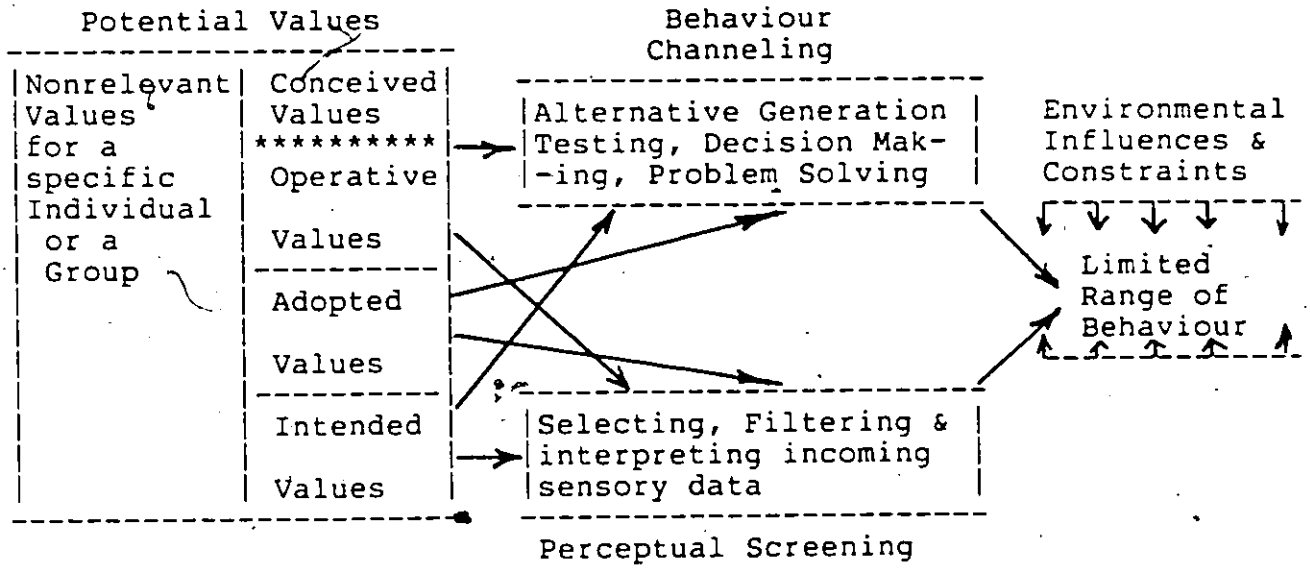


Figure 5: Theoretical Model of the Relationship of Values to Behavior. (Adapted from England, Agarwal and Trerise (1971)).

2.1.2 Value Issues in Management Science and Information Systems

Values as a determinant for the direction for improvement in the object system have been recognized by various researchers in Management Science and Information Systems. Churchman (1961) in his book "Prediction and Optimal Decision: Philosophical Issues of a Science of Value" discusses the nature of values, the relationship of science and ethics, how values could be measured and the role of values in decision-making. His subsequent works (Churchman (1968) and Churchman (1970)) enlarge upon the theme that values determine what is meant by improvement in a system and therefore determine the goals for the process of Operations Research and System Development.

Klein (1981) identifies from a literature study the design-ideals or value systems that underlie current MS/ MIS work. He addresses the methodological problems of construction of design-ideals by relating the design-ideals to four major schools of meta-science. He further critically examines the cost/ benefit and socio-technical design ideals in detail, by applying normative ethical concepts, and finds them lacking. He finally proposes the design ideal of 'socio-responsiveness (Etzioni (1968)) as an extension of the socio-technical system design ideal originally proposed by Emery and Trist (1960).

Land (1975) describes a method for identifying and evaluating the goals of the organization, and of measuring the contributions of alternate systems designs to the achievement of these goals. In so far as the goals are an expression of the underlying values, and are determined by them, Land's work is relevant in structuring the system goals into underlying values.

Ulrich (1977) and Mattessich (1978) are some other authors who have explored the role of values in the management science and systems disciplines.

2.1.3 Existing Frameworks for ISD relevant Values

The above literature survey shows that the issue of values in the information systems context has mostly been ignored at the operational level. Though Churchman and Klein (see section 2.1.2) have discussed the role of values in the system development process, they have not isolated the values in question explicitly and therefore have not developed frameworks to classify them. Similarly, Land above provides a method for structuring the values, but does not shed any light on the set of relevant values that may need to be structured using this method.

However, there are two authors who provide frameworks for classifying information systems development (ISD) relevant values.

Kling (1978) while discussing the value positions for assessing electronic fund transfer systems (EFTS), provides a list of "five major value orientations implicit in published discussions of EFT systems":

1. "**Private Enterprise Model.** The preeminent consideration is the profitability of the EFT systems, with the highest social good being the profitability of the firms providing or utilizing the system. Other social goods --- are secondary.

2. **Statist Model.** The strength and efficiency of government institutions is the highest goal. Government needs for access to personal data on citizens and needs for mechanisms to enforce obligations to state always prevail over other considerations.

3. **Libertarian Model** The civil liberties as specified by the U.S. Bill of Rights are to be maximized in any social choice. Other social purposes such as profitability or welfare of the state are to be sacrificed if they conflict with the perogatives of the individual.

4. **Neopopulist Model.** The practices of public agencies and private enterprises should be easily intelligible to ordinary citizens and be responsive to their needs. Societal institutions should emphasize serving the common man.

5. **Systems Model.** The main goal is that EFT systems be technically well organized, efficient, reliable and esthetically pleasing".

These models or value orientations of Kling are related to different "objects" of value (i.e. the firm, the government, the populace both directly and through the bill of rights, and the system itself, respectively). Therefore, according to Rescher's value classification schemes discussed in section 2.1.1, this is a classification by the object of value. This classification scheme to be comprehensive, requires a complete enumeration of all the relevant "objects" of value (i.e. the stakeholders) for the system under discussion and, therefore, is contingent upon the nature of the system. The contingent nature of this scheme makes it unsuitable for developing a context free general framework for information systems development related values.

The second classification framework is provided by Klein, Meadows and Welke (1980) "perspectives on the design ideals for QWL methodologies". These "mutually exclusive and collectively exhaustive" perspectives are:

- "The Socio-Political Perspective (SPP) includes all dimensions referring to the maintenance of legitimate social relations and systematic planning and control.
- The Psyco-Social Perspective (PSP) refers to all aspects of psychological and social health of work system participants.
- The Economic Perspective (EP) is to deal with all factors affecting the allocation and exchange of utilitarian values. The EP comprises of two levels of analysis. Under the macro level, organizational outcomes are to be considered by employing the usual techniques of cost/ benefit analysis. These very same techniques are also to be used for determining the gains and losses of any IS change from an individual point of view defined by the economics of the work system participants. Included at this level of analysis are also the aspects addressed by analytic job evaluation (e.g. exposure to noise, heat, stress, skill requirements etc.)
- The Technical Systems Perspective (TSP) emphasizes criteria which relate to the instrumental functionality of IS: they should be efficient and effective as measured by productivity indicators, reliable, technically well organized, aesthetically pleasing etc."

The value perspectives identified by Klein et. al. classify values by the "nature of benefit" according to Rescher's classification schemes. Given that they are "collectively exhaustive" and not contingent upon the nature of the system (and hence its stakeholders), this classification would be more useful in developing a context free general framework for ISD relevant values.

2.2 Empirical Measurement of Values

Significant prior research in the measurement of individual values (i.e. the value subscription of human participants in system development) may be examined within three contexts:

1. in the general socio-philosophical context

2. in the managerial context

3. in the information systems context

2.2.1 The General Social-Philosophical Context

The empirical investigation of values has received considerable attention in the disciplines of anthropology, sociology, philosophy and psychology. Philosophers have at length debated the question: "are values measurable?" and have come to the conclusion that, though it is not possible to empirically decide what is ethical or good (the "objective" value as per Krader), it is definitely possible to measure a value subscriber's value "subscription" to a value, and thereby "ascribe" values to him (Handy (1970) and Rescher (1969)). It is in this sense that we say that values can be measured, and this is how the measurement efforts in psychology, sociology, anthropology and philosophy have measured values. Value subscription then becomes a question of personal or group preference or choice structure and can be expressed very well by Kluckhohn's definition in section 2.1.1 , and Krader's interpretation of "subjective value" (Krader (1982)).

In the earlier years (1930's) a number of similar value-scales appeared in the literature of social sciences which were either directly or indirectly influenced by Spranger's contention that there were various "types of men" who could be identified by their dominant interests (Theresa Levitin in Measurement of Social Psychological Attitudes; ed. John P. Robinson and Philip R. Shaver, (1969)). Spranger postulated six major human values which he termed theoretical, economic, aesthetic, social, political and religious. His theoretical notions were made operational through the work of Allport and Vernon (1931). Lurie (1937) carried out a factor analysis of items based upon Spranger's work and obtained factors differing from Allport-Vernon's. Van Dusen et al. (1939) constructed a Likert-type inventory of values based upon the conceptions of Spranger and Lurie. (Theresa Levitin (1969)).

Some of the more recent instruments developed to measure values have been the Personal Value Scales (Scott (1965)), Value Survey (Rokeach (1968)) and Variations in Value Orientations (Kluckhohn and Strodbeck (1961)).

All these value scales have been devised to measure value subscriptions in a rather general context of the Western world (and more specifically North America). The following subsections will gradually narrow the focus of empirical value measurement literature to information system contexts.

2.2.2 The Managerial/ Organizational Context

This subsection discusses two different empirical methodologies for measuring and explicating value structures. The first methodology is an operationalization of England's framework described in section 2.1.1. The second methodology is based upon the multiattribute utility and value models developed by Keeney and Raiffa (1976). Both these form the basis of the methodologies proposed in chapters 4 and 6, for measuring and explicating the value systems of participants in system development.

2.2.2.1 England's Personal Value Questionaire

In the managerial/ organizational context a major part of the value measurement effort has been inspired by George England's "Theoretical Model of the Relationship of Values to Behaviour" (England (1967)), described in section 2.1.1. Based upon literature survey and expert review, England developed a list of values relevant to the managerial context. This list was then translated into a Personal Value Questionaire (PVQ) which measures the value subscription of an individual along two major dimensions or "modes of valuation". Since the general value of an object or concept to an individual is thought to be largely a function of its degree of importance to him, the **Primary or Power Mode of Valuation** is a

three point importance scale (high, average and low). Also because the study focuses upon the behavioral implications of values, a Secondary or Meaning Mode of Valuation is used to make operational the theoretical distinction between the intentionality of values and their translation into behaviour (operative vs. intended vs. adopted values in section 2.1.1).

> "To the extent that it is possible to determine a consistent rationale as to why an individual or a specific group thinks certain concepts are important or unimportant, one has a reasonable basis of distinguishing operative from among conceived values. In this process, three secondary modes of valuation are used. The pragmatic mode of valuation is represented by a "successful" scale the ethical-moral mode of valuation is obtained through a "right" scale and the affect or feeling mode of valuation is measured through the use of a "pleasant" scale. A combination of primary and secondary modes of valuation was thought to be a better behavioral predictor than would either mode alone." (England, Olsen and Agarwal (1971)).

The Personal Value Questionaire (PVQ) has been used by various researchers to measure the value profiles of a variety of managerial groups. For example England himself has used it to measure the value profiles of American Managers (England (1967)). It has been used to make cross-cultural comparative studies of managers of various nationalities (England and Kyong-Dong Kim (1968)), (England, Agarwal et. al (1970)), (England and Lee (1971)) and (England, Agarwal and Dhingra (1974)). The PVQ has also been used to measure the value profiles of union leaders and to compare them to managers (England, Agarwal and Trerise (1971)). Since then, the Managerial PVQ has been used in many doctoral dissertations as an instrument to measure the value systems of the managerial groups under study. The latest use of the PVQ was reported in 1981 when it was used to study the value sets of small business owners (Lindecamp (1981)).

The personal value questionaire (PVQ) has been successfully adapted/ modified to measure the personal value systems of educational administrators (Sjogren, England and Meltzer (1969)), and Naval Officers (England and Agarwal et. al

(1970)). In both these instances the concepts or values in the managerial PVQ were replaced with a list of concepts or values more appropriate to their own context. For each context the value/ concept list was developed by an extensive literature survey, and expert interviews, followed by a review by a panel of experts.

2.2.2.2 MultiAttribute Value Theory Based Assessment of Value Structures

Multiattribute Utility/ Value theory is a systematic attempt by Keeney and Raiffa (1976), to provide a single utility rating (in case of uncertainty), or a single value rating (in case of certainty), to alternatives which are to be judged on multiple attributes or criteria.

Given that each alternative may be judged on multiple criteria, each alternative may be described by a n-dimensional attribute vector $(x_1,x_2,...,x_n)$, where "n" is the number of criteria on which the alternatives are to be evaluated. In order to be able to choose between these multiattribute alternatives, the decision maker should somehow be able to assign a scalar utility or value to each alternative vector. This assignment is of the form:

$$\text{Utility Function:} \quad u(\tilde{x}) = fn.(x_1,x_2,..,x_n)$$

$$\text{Value Function :} \quad v(\tilde{x}) = fn.(x_1,x_2,..,x_n)$$

The decision maker can than choose the alternative with the most favourable scalar utility or value rating.

The assignment of the scalar utility/ value rating is done by determining a utility/ value function for each decision maker which structures the decision maker's preferences for various attributes or criteria into one of the three stan-

dard functional forms (additive, multiplicative and multilinear). This function then becomes the composition function which is used to assign a scalar utility or value to the multiattribute outcome vector.

Multiattribute Utility/ Value theory therefore provides a possible means for structuring a decision maker's value preferences. Most of the empirical work associated with multiattribute theory deals with decision making under uncertainty (i.e. the consequences of various actions or decisions are not certain and can be characterized by a probability distribution). In these cases the researcher assesses a multiattribute utility function using some variant of the lottery based utility determination technique.

In our value determination study, we are attempting to determine the value preference structure of system development participants for information system development relevant value concepts. As there are no actions involved whose consequence may introduce uncertainty, and therefore the need for a utility function, we restrict ourselves to the certainty case and assess a "Value Preference Function". Also, some of the value concepts investigated in this study are not commonly accepted as being in the realm of information systems development concerns, and having had almost no experience in analysing and designing for these concepts, it may be difficult for the respondents to visualize the ISD process with various levels of these concepts. The lottery based assessment procedures for assessing utility functions may therefore add an intolerable burden of cognitive complexity to an already complex assessment procedure and are better avoided.

Multi-Attribute Value Theory for Individual Preferences:

Theoretically there have been three fundamental forms defined for a multiattribute value function (MAVF): The additive, the multiplicative and the mul-

tilinear. In practice, in assessing value functions, only the additive form seems to be in use, as the mutual preference independence conditions (defined below) for the additive form are easily satisfied:

> "Conditions have been known for about 20 years which imply the existence of an additive decomposition
>
> $$v(x_1, x_2, \ldots, x_n) = \sum_{j=1}^{n} v_j(x_j).$$
>
> These preferential independence conditions are relatively weak and often satisfied in practical situations."(Kirkwood and Sarin (1980) p.225).

Note: The mutual preference independence conditions for the value function are analogous to the mutual utility independence conditions for the multiplicative utility function. Keeney and Raiffa (1976, p.298) have indicated that additive and multiplicative utility functions are robust enough to approximate most of the preference structures. Given the above analogous independence conditions, it is reasonable to infer that in practice the additive value function provides reasonably robust results and approximates most of the preference structures. However we intend to test the independence conditions using two different tests to check if the mutual preference independence conditions hold in our case.

The following is a review of standard multiattribute value theory for a single decision maker. Readers unfamiliar with standard MAVT, who find the remainder of this subsection too condensed may wish to refer to one of the following: Keeney and Raiffa (1976) and Fischer (1979). The notation for MAVT used throughout this dissertation is summarized for easy reference in the following table:

Table 1: MAVT Notation

X_j, j = 1, 2,.. n represents attribute j

n the total number of attributes in the multiattrib. model

x_j^* represents the best (most preferred) level of attribute j

x_j° represents the worst (least preferred) level of attribute j

k_j is the weight attached to the attribute j

k is a parameter of the multiplicative model

$v_j(x_j)$ represents the single attribute value function for attribute j on the value scale $v_j(x_j^*) = 1$ and $v_j(x_j^\circ) = 0$.

$\tilde{x}$ represents the vector of attributes $(x_1, x_2, .., x_n)$

$\tilde{x}^*$ represents the vector of attributes $(x_1^*, x_2^*, .., x_n^*)$

$\tilde{x}^\circ$ represents the vector of attributes $(x_1^\circ, x_2^\circ, .., x_n^\circ)$

$\bar{x}_j$ represents the complement vector to the attribute x_j : i.e. $(x_1, x_2, .. x_{j-1}, x_{j+1}, ..., x_n)$

Y represents a subset of the attribute vector, i.e. $(x_1, x_2, .., x_m)$

Z represents the complementary subset of Y, i.e. $(x_{m+1}, x_{m+2}, .., x_n)$

$v(\tilde{x})$ represents the individual's multiattribute value function on the scale $v(\tilde{x}^*) = 1$ and $v(\tilde{x}^\circ) = 0$.

$\succsim$ represents the preference relationship

The Additive Form:

An additive value function exists if and only if the attributes are mutually preferentially independent.(Keeney and Raiffa (1976) Theorems 3.3 and 3.6)

Definition 1 The attributes $X_1, X_2, ..., X_n$ are mutually preferentially independent if every subset Y of these attributes is preferentially independent of its complementary set of attributes. (Keeney and Raiffa (1976) p.111)

Definition 2 The set of attributes Y is preferentially independent of the complementary set Z if and only if the conditional preference structure in the y space given z does not depend on z . More symbolically Y is preferentially independent of Z if and only if for some z :

$$\left[(y',z') \gtrsim (y'',z')\right] \Longrightarrow \left[(y',z) \gtrsim (y'',z)\right] \text{ , for all } z,\ y',y''$$

(Keeney and Raiffa (1976) p.109)

If mutual preference independence exists, the multiattribute value function is additive:

$$v(\tilde{x}) = \sum_{j=1}^{n} k_j v_j(x_j) \qquad (1)$$

where

$$\sum_{j=1}^{n} k_j = 1. \qquad (2)$$

and

$$k_j = v(x_j^*, \bar{x}_j^\circ) \quad j=1,2..n \qquad (3)$$

One simple method to determine the function is to measure each single attribute value function, $v_j(x_j)$ separately relative to $v_j(x_j^*) = 1$ and $v_j(x_j^\circ) = 0$, while holding the levels of all other attributes constant. Then the k_j's are determined by measuring the value of the corner points $k_j = v(x_j^*, \bar{x}_j^\circ)$ relative to $v(\tilde{x}^*) = 1$ and $v(\tilde{x}^\circ) = 0$.

Multiplicative Value Function:

Though Keeney and Raiffa (1976) do not mention a multiplicative value function (presumably because the mutual preference conditions for additive function are easily satisfied), it can be inferred as an analog of the multiplicative utility function as follows:

$$v(\tilde{x}) = (1/k)\left[\prod_{j=1}^{n} (1 + k.k_j v_j(x_j)) - 1\right]. \qquad (4)$$

One method, suggested by Torrance, Boyle and Horwood (1982), to determine the function, is to measure each $v_j(x_j)$, determine each k_j value from (3), and find the k value by iteratively solving (5) which is derived from (4) for $\tilde{x} = \tilde{x}^*$.

$$1 + k = \prod_{j=1}^{n} (1 + k.k_j) \qquad (5)$$

Parameter k is related to parameters k_j as follows:

if $\sum^n k_j > 1$, then $-1 < k < 0$ (5a)

if $\sum^n k_j = 1$, then $k = 0$ (5b)

if $\sum^n k_j < 1$, then $k > 0$ (5c)

Hierarchical Value Functions:

By exploiting the mutual preference independence conditions and the consequent additivity, we may aggregate a large list of attributes into intermediate composite attributes, which can in turn be composed into an overall scalar value. Each of the composite aggregates can then be considered as separate additive value functions in their own right and can be evaluated according to the method outlined for additive functions above.

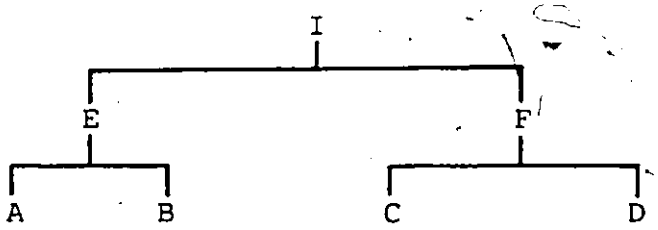
The weights or the k_j's evaluted within an intermediate composite attributes are called conditional assignments, and their absolute weights in the overall function may be calculated using an analog from conditional probabilities as follows(Keeney and Raiffa (1976) p.124):

$$k(B/E) = k(B)/k(E) \quad \text{for } B \subset E \qquad (6)$$

which gives:

$$k(B) = k(B/E) * k(E) \qquad (6a)$$

where the hierarchy is of the form:



2.2.3 The Information Systems Context

There have been relatively few studies in the management information systems area which have the stated purpose of measuring the value systems of participants in the system development process. On the other hand there is at least one study in MIS whose stated aim is "Survey of Values & Sources of Dissatisfaction", but which ends up measuring system developer's job-satisfaction related factors, such as pay, benefits, relationship with superiors etc. (Bryant (1976)).

Mumford and Hedberg (1974) is the only study found in the MIS literature with the stated aim of measuring value profiles of system designers. This study measured the value profiles of system designers in United Kingdom and Sweden in terms of how they (the designers) viewed the users of the information system. This measurement, aptly titled "Man's Vision of Man-", measured, on a set of Semantic Differential scales, the subscription to Theory X vs. the subscription to Theory Y (McGregor (1960)) of these two groups of system developers. The results of the study indicated that the system designers use a Theory X model of the users for whom they are designing computer based information systems. The

study also showed that the Swedish system designers on an average tended to be more Theory Y oriented then their British counterparts.

Anderson (1978) measured the "Value Orientation of Computer Science Students". In this study he asked a group of computer science students to rate a list of sixteen values on a five point scale from "unimportant" to "extremely important". This value list was derived from Rokeach (1973) list of desirable end-states, called "terminal values" (see section 2.1.1), and was augmented to include scientific and technological concerns. It included values such as family security, world at peace, happiness, self-respect, salvation, mature love, a world of beauty, prosperity, scientific knowledge, mechanization etc.. Anderson found that the value orientations of computer science students were more complex than those of social science students, in the sense that they subscribed to a much larger range of values. Anderson also performed a cluster analysis of the results, identifying three dominant clusters which he identified as the Protestent-ethic Value Orientation, Technology Value Orientation and the Humane Value Orientation.

C. Peter Smith while investigating the User/ Systems Differences came to a conclusion that these differences were caused by differences in objectives between system users and system personnel (Smith (1977)). He empirically investigated the ranking (in terms of allocation of a system specification budget of $1000.00) of ten "system control objectives" by both users and system developers. His conclusion was, that while the users and the systems staff both ranked materiality, timeliness, security, completeness, retrievability and useability the same, there were differences in ranking of control objectives such as accuracy, responsibility, modifiability and compatibility.

Lin Gingras (1976) measured and compared the "Psychology of Users and Designers of Information Systems" through a field study using semantic differen-

tial scales and profile analysis. Specifically, he measured and in various combinations compared the designer's perception of (his own self-profile, the actual user's profile, the ideal designer's profile and the ideal user's profile) with the user's perception of (his own self-profile, the profile of the actual designer, the profile of the ideal designer and the profile of the actual user). In all these cases he found significant differences which led him to conclude that the users and the designers were not in the state of mutual understanding recommended by Churchman and Schainblatt (1965). Gingras also investigated the hypothesis that, given the differences between the users and the system designers, the evaluations of the information system quality by users and designers will also be different but found only limited support for this hypothesis.

Hallam and Scriven (1976) surveyed 305 MIS managers for their EDP objectives and found that the five highest ranking objectives in descending order of importance were to (1) meet deadlines, (2) minimize costs, (3) minimize turnaround time, (4) maximize training of MIS personnel, and (5) maintain a stable workload.

Schussel (1974) surveyed 200 DP and user executives, who participated in his AMR DP management seminars, on the importance of 14 DP performance criteria scored on a 1 to 100 scale. The highest ranking criteria he found were, in order of actual ranking, (1) meeting deadlines, (2) accuracy and completeness, (3) quick response to user requests, (4) budget performance and cost control, and (5) operational tranquility. He also ranked the ideal or desired criteria for these people and found that the actual rankings differed from the desired rankings which were (1) long term goals, (2) accuracy and completeness, (3) budget performance and cost control, (4) meeting deadlines and (5) use of cost-benefit analysis in project selection.

Robert Alloway and Jerome Nolte (1979) surveyed DP personnel in five firms in an attempt to measure the importance or the priority they attached to sixteen different analyst/ project leader skills. The priority attached to such skills as user-orientation, behavioral senstivity etc. may be interpreted in terms of the value the DP personnel attach to them. Alloway and Nolte found that in four out of five organizations there were significant differences in the priorization by the systems analysts and the CIO (Chief Information Officer, or the person managing the system development department). The authors interpreted these differences or "gaps" as an indication for the need for a better priority communication and skill development program.

2.2.3.1 Limitations of the Above Studies

All the studies mentioned above deal with relatively few dimensions of values (the number of items or value concepts in these studies vary from a low of ten to a high of twenty four). Most studies tend to be localized in the technical and economic value dimensions, except for Mumford and Hedberg (1974) which remains exclusively in the socio-psychological domain. Alloway and Nolte (1979) do introduce a mixture of social, technical and economic items, but his categories are so broad that much of the finer discrimination is lost. Anderson (1978) measures values at a very general philosophical level, which can not be used to give a micro-level insight into values and objectives which may drive systems development.

Finally all these studies suffer from a basic lack of an underlying theory based framework (with the exception of Mumford and Hedberg (1974) who rely on McGregor's theory X and theory Y formulations, and Anderson (1978) who bases his survey on Rokeach's terminal values). Therefore the list of values considered in these studies tends to be rather sparse and may not include all possible dimensions which need to be accounted for.

2.3 Comparison of Participant Values

The theme of user-analyst differences has been a recurrent one in both management science and information systems literature. In most instances of such work, there has been an implicit underlying model which hypothesizes that (a) there are differences in the objectives, attitudes and psychology of the systems analysts and the systems users and (b) these differences are responsible for the deficiencies of the designed system and the consequent implementation failures. The available models usually consider only two participant types (e.g. the system user vs. the system developer or the system management vs. the system developers) in the ISD process. None of the existing models (with the exception of Mattessich (1978)) consider the value orientations embedded in the system development methodology. This subsection discusses significant prior research outlining the models of participant differences used by various authors in management science and information systems.

Smith (1977) investigates the differences between the system user and the system developer objectives. Gingras (1976) suggests that the differences in the user and analyst psychology are a determinant of the user evaluation of the information systems built by the system developers. Churchman and Schainblatt (1965) discuss the relationship and communication between the researcher (operations researcher or the analyst) and the user manager in terms of the "mutual understanding" of each other's "reason" and "what the other is trying to do, and why he does what he does" i.e. his goals and motivations. More recently Kaiser and Srinivasan (1982) have empirically studied the user-analyst differences in their attitudes related to systems development.

Couger, Zawacki and Opperman (1979) study the motivation level differences of MIS managers versus those of their employees i.e. the system developers.

Alloway and Nolte (1979) interpret the analyst-skill priority gaps between the CIO (Chief Information Officer) and the system developers as an indicator of the need for better communication and skill development programs.

Hamilton and Chervany (1981) provide a survey of the literature, documenting empirical comparisons between the "system effectiveness evaluation viewpoints" of users vs. MIS development personnel, users vs. MIS management, users vs. internal audit, MIS developers vs. (MIS) management, MIS developers vs. internal audit and (MIS) management vs. internal audit. Except for the first case (MIS developers vs. users) Hamilton and Chervany did not report any instances of empirical research exploring these differences.

Chapter III

FRAMEWORK FOR ISD RELEVANT VALUES

This chapter outlines the proposed research framework for information systems development relevant values. In this framework, the individual participants in the information system development (I.S.D.) process are considered to be "selective systems" (Pepper (1958) - see subsection 2.1.1). As selective systems they employ "norms" or "values" to select among different goals and alternatives in the system development process.

The operative definition of values used in this framework is from Kluckhohn (1951):

> "A value is a conception, explicit or implicit, distinctive of an individual or characterstic of a group, of the desirable which influences the selection from available means and ends of action."

As discussed in that subsection 2.1.1, this definition is deemed to be appropriate for our purposes, as it is action oriented and deals with the choice of both the ends and the means of action.

The above definition, along with Rescher's (1969) classification scheme for values, is used to propose a classification framework for studying values in the information system development context.

3.1 The Basic Two-Dimensional Framework for ISD Values

The framework recognizes two dimensions of values.

The first dimension is derived from Kluckhohn's definition of value stated above. Kluckhohn suggests that values influence the selection of the ends and means of action. Therefore in the context of an action and change oriented development process, the relevant values may be classified as "Ends-Values" (i.e. the values that influence the selection of the ends of system development, or the "desired object system") and the "Means-Values" (i.e. the values that influence the selection of the means or the "development approach" employed in the process of development). The End-Values have been further partitioned into "End-Value (Aspect)" and "End-Value (Normative)". End-Value (Aspect) helps selects those aspects of the system which would be considered for analysis and change. The term aspect is used to signify the objects and relationships which are selected from a multitude of such aspects as relevant to the problem and hence candidates for investigation and possible change. Given that we have selected the aspects, End-Value (Normative) would suggest the direction for improvement in the properties or attributes attached to these aspects. For example, given that we may be interested in the "data" aspect of the system (end-value (aspect)), we may want to develop it in the direction of "accuracy", "relevance" and "timeliness", the corresponding end-values (normative).

The second dimension in the classification of values is based upon Rescher's classification of values by the "nature of benefit" (Rescher (1969)). This dimension recognizes three types of values typified by the nature of benefits they provide: (a) Economic Values (which deal with minimizing costs and maximizing monetary returns to the organization), (b) Technical Values (which deal with the aspects and properties of the physical data systems and computer systems) and (c)

Socio-Political-Psychological Values (which deal with individual human beings within the system, their relationships with other human beings within the system, their organization into work groups, departments units etc. and the functioning of the organization as a whole). These three basic nature of benefits have been recognized in a variety of literature dealing with technology adoption, change and innovation (for example Klein, Meadows and Welke (1981) and Berg, Chen and Zissis (1976)).

Using these two classifications a two-dimensional framework is proposed for structuring the values in the information systems development context (Figure 6.0).

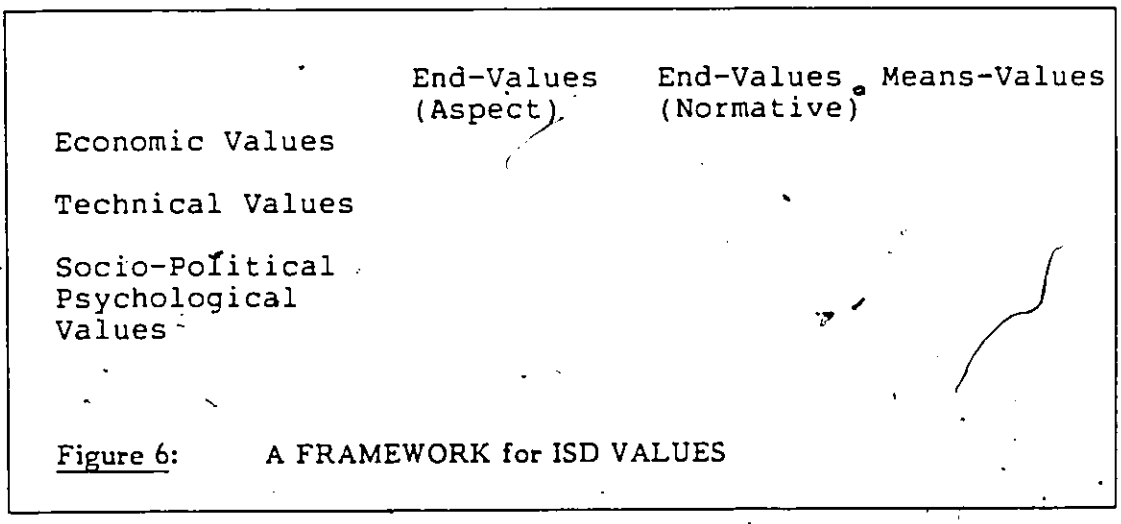


Figure 6: A FRAMEWORK for ISD VALUES

This framework was used to generate and classify a value list relevant to information systems development. As a starting point, a large literature survey was used to identify various objectives and concerns which arise in relation to the ISD process. This preliminary list was then classified into the nine categories outlined in the framework. The aspects so determined were associated with their

attributes therby generating the end-value normative list. The development project analogs of the system aspects and their associated attributes were then identified to determine a possible list of Means-Values. This generated a rather large value list which was then reviewed by a panel of system development experts (systems analysts, experienced users, managers and directors of systems, information system consultants and academics) for clarity, relevance and completeness. The resulting list of value concepts, which has been classified according to the framework and incorporated in the Personal Value Questionaire described in chapter 4, contains 86 value concepts. The complete list of values is presented in appendix A.

3.2. Additional Implicit Dimensions for the Framework

In addition to the two dimensions described above, the ISD Values framework recognizes two implicit dimensions for values classification.

The first implicit dimension is introduced in the framework by recognizing that not all values subscribed to by an individual or a group may be translated into action. To distinguish those values which have a high probability of becoming operative, the framework uses the theoretical framework proposed by England (1967) and described in sections 2.1.1 and 2.2.2 of this document. England's framework distinguishes between operative, adopted, intended and non-relevant values which have different implications for translation into behavior (see above sections for the explanation of England's framework and definition of these classifications). Pepper's (1958) three "selective polarities" (conative, affect and achievement) discussed in section 2.1.1 supply the philosophical foundation for using the right, pleasant and success (moral, affect and pragmatic) classifications in the England methodology for classifying the values in the operative, adoptive, intended and nonrelevant categories.

The second implicit dimension arises as a result of the possibility that not all individuals may deem a certain direction of change to be beneficial or "good". For example considering the value concept "Level of Technical Sophistication of Hardware and Software", there could be individuals who think that increased sophistication is "good", and there could be others who would prefer a decreased level of technical sophistication. Therefore to each of the End-Value (Normative) and the Means-Values we may attach an additional dimension of "Preferred Direction of Change". It is expected that for most of the commonly accepted value concepts such as accuracy, timeliness etc. there would be consensus as far as desirable direction of change is concerned. But there could be some value concepts for which the desired direction of change may not be the same for different participants.

3.3 Measurement of the Values defined by the Framework

This section outlines the proposed methodologies for measuring the value structures of participants in the system development process. Two separate methodologies have been proposed and used for measuring participant values. The structure for discussing these is as follows:

1. Chapter 4 discusses a personal value questionaire (England (1967)) based methodology for measuring the value structures of system analysts and system users. Chapter 5 discusses the use of this methodology for measuring and comparing the value systems of system developers and system users.

2. Chapter 6 discusses a multiattribute value theory (Keeney and Raiffa (1976)) based methodology for determining the value structures of system analysts. The use of this methodology was limited to a small pilot sample of systems analysts as it required a large amount of indepth one-on-one interviewing with each subject, and also posed a severe cognitive burden on the subject.

Both the methodologies rely on the value framework and the list of value concepts developed in section 3.1. The PVQ based methodology utilizes the detailed list of eighty-six value concepts, ordered according to the end-value(aspect), end-value(normative) and the means-value dimension. In case of the MAVT based methodology the detailed list of 86 value concepts was deemed to be too large for modelling. Typical non-hierarchical MAVT models usually deal with three to five attributes. In the hierarchical MAVT models typical number of levels in the hierarchy are never greater than two, and the total number of attributes modelled is of the order of ten. Therefore the original list of 86 value concepts was severely cut back by (a) levelling based upon the classification by the nature of benefit, and (b) by including only most commonly discussed attributes in the ISD context. (see section 6.1). Therefore the attribute list used in the MAVT methodology is only generally comparable to the list used in the PVQ based methodology.

Chapter IV

THE ISD-PVQ BASED MEASUREMENT OF SYSTEM USER AND DEVELOPER VALUES

This chapter discusses the development of the Information Systems Development - Personal Value Questionnaire (ISD-PVQ), and its use in measuring the value profiles of participants in the ISD process.

1. Section 4.1 describes the design and development of the ISD-PVQ.
2. Section 4.2 describes how the basic variables measured on the ISD-PVQ are used to classify an individual's value concepts into the behaviour relevant categories of operative, intended, adopted and non-relevant values. Most of the material in this section is adapted from England's (1967) personal value questionnaire (England, Olsen and Agarwal (1971)).

4.1 The Design and Development of the ISD-PVQ

This subsection describes the design and development of a Personal Value Questionnaire for measuring values in the information systems development context. Subsection 4.1.1 describes the basic variables we intend to measure, and the rationale behind them. Subsection 4.1.2 describes the issues and factors considered in designing the measuring instrument. Subsection 4.1.3 reports on the reliability and validity of the measuring instrument (ISD-PVQ) developed in section 4.1.1 and 4.1.2.

4.1.1 What are we Measuring?

The ISD-PVQ (Information Systems Development - Personal Value Questionnaire) is adapted from England's (1967) PVQ, and is based on his "Theoretical Model of Relationship of Values to Behavior". The development of England's PVQ was based on the rationale that meanings attached by an individual to a carefully specified set of concepts will provide a useful description of his personal value system, which may in turn be related to his behavior in systematic ways. This in turn was influenced by the work of Charles Osgood (1957) and his associates and represents an adaptation of their methodology. Most of the research done by Osgood et. al. has been directed towards the development of an adequate measurement system for meaning. Osgood et. al. indicated that meaning has several dimensions which can be measured using bipolar adjectives (such as good-bad, strong-weak and active-passive). How concepts are valued in terms of like-dislike, important-unimportant, right-wrong, whatever reactions a concept elicits from an individual - all are expressions of what the concept means to an individual, and have implications for his value system and understanding his behavior (England, Olsen and Agarwal (1971)).

England's PVQ for managers uses two modes of valuation to measure the meaning attached to value concepts (England, Olsen and Agarwal (1971)):

> "Since the general value of an object or an idea to an individual is thought to be largely a function of its degree of importance to him, the primary or power mode of valuation utilized is the importance scale. — Because of the focus of the study on the behavioral effect of values, it was deemed necessary to make operational the theoretical distinction between the intentionality of values and their translation into behaviour (operative values from among conceived values). To the extent that it is possible to determine a consistent rationale as to why an individual or a specific group thinks certain concepts are important or unimportant, one has a reasonable basis for distinguishing operative from among conceived values. In this process three secondary modes of valuation are used. The pragmatic mode of valuation is represented by a "successful" scale; the ethical moral mode of valuation is obtained through a "right" scale and the affect or feeling mode of valuation is is

measured through the use of a "pleasant" scale. A combination of primary and secondary modes of valuation was thought to be a better behavioral predictor than would either mode alone."

The ISD-PVQ uses three modes of valuation for the information systems development relevant value concepts. The first two modes (i.e. the power mode and the secondary or the meaning mode are identical with the ones used by England et. al.). The third mode, the "direction" mode, measures the preferred direction of change as discussed in the second implicit dimension in section 3.2 The following discusses these three modes of valuation used in the ISD-PVQ.

4.1.1.1 Primary or the Importance Mode

When we say that we are "measuring the value systems of ISD participants" we are in fact measuring the "intensity of subscription to a set of value concepts". The respondent's intensity of subscription to a value concept will be measured by the "level of importance" the individual attaches to the value. England (1967) has interpreted this as the meaning in the unimportant- important dimension the individual attaches to the value concept. Therefore, from now onwards, the measurement of a subject's values will be discussed in the context of the level of importance he or she attaches to various value concepts in the value set.

4.1.1.2 Secondary or the Meaning Mode

This mode measures the meaning or the rationale attached to each of the value concepts. Instead of providing three distinct scales for "successful", "right" and "pleasant" as per the managerial PVQ, we have combined them into a single secondary "meaning" scale, in which the respondent is asked to select his most applicable rationale or meaning from the three categories (successful, right and pleasant).

4.1.1.3 The Direction Mode

For the End-Value (Normative) and Means-Values, this mode measures the preferred direction for change for each of the value concepts. "Increase" category is used if the respondent generally prefers a change in the increased direction, "Decrease" category, if the respondent prefers a change in the direction of decreased levels of this concept.

4.1.2 The Design of the Measuring Instrument

An individual's values are not open to direct observation as are some of his more obvious attributes such as his height or the color of his eyes. Their existence and their strength (i.e. the strength of subscription) must be inferred from what is observable. Rescher (1969) has shown that values manifest themselves as "talk" and "behaviour". Therefore if we can observe either an individual's talk or his behaviour, in theory we should be able to infer the values the person subscribes to. Cook and Selltiz (1964) discuss the use of five different ways of measuring attitudes, which may be generalized to the measurement of values:

> "(a)measures in which the material from which inferences are drawn consists of self-reports of beliefs, feelings, behaviour etc. towards an object or a class of objects; (b) measures in which inferences are drawn from observed overt behaviour towards the object; (c) measures in which inferences are drawn from the individual's reaction to, or interpretations of, partially structured material relevant to the object; (d) measures in which inferences are drawn from the performance on objective tasks where functioning may be influenced by disposition towards the object; and (e) measures in which inferences are drawn from physiological reactions to the object."

In this dissertation we we would rely solely on (a) above, i.e. the self-report technique of measuring value subscriptions. Method (b), inference from observation of behaviour, has not been considered because of the large effort required to

observe the behavior of a sizable sample of individuals. There is also the problem of having a representative sample of behavior which covers all the required value dimensions. Also, it is difficult to deduce the underlying value or motivation behind a behaviour sample. All these objections combined together discounted the use of method (b). Methods (c), (d) and (e), i.e. indirect techniques, performance of objective tasks and physiological reactions were rejected because of lack of expertise, and the large time requirements which make these measurements infeasible in the context of a doctoral dissertation.

Cook and Selltiz (1964) have mentioned two characterstics of the self-report measures that make them susceptible to distortion of overt responses. First, if the purpose of the instrument is obvious to the respondent and the implications of his answers are apparent to him, he can consciously control his responses to suit the picture of himself he would like to project. Second, some individuals have a consistent tendency to agree (disagree) with items presented to them irrespective of their content, or to give extreme answers.

The first tendency could be partially offset by assurances of annonymity and statements to the effect that "there are no wrong or right answers" or that "people differ in their views". Also as the respondent does not gain or lose any explicit benefit as the result of his responses, there is less possibility of this factor operating to provide false or contrived responses.

In discussing the measurement of sentiments (Nunnally classifies values, attitudes etc. as sentiments) Nunnally (1978) suggests ways of addressing the "frankness of response" problem:

> "Actully in many instances what people say is more predictive of the course of action than what they may feel in a deeper sense. —— In some instances it is reasonable to believe that the verbalized attitudes represent the "cutting edge" of changes in feelings. —— Also, verbalized attitudes have powerful effects on courses of social action."

Finally we invoke Kluckhohn's (1951) definition of values (which is also our operative definition) to deal with this problem. Kluckhohn has defined value as the "concept of the desirable" rather than "desired". It can be argued that if in responding the subject is not displaying his inner feelings and is responding with what he thinks is desirable (rather than what he actully desires) then his response should be acceptable as his value subscription.

The second tendency of either consistently agreeing or disagreeing with questions or giving only extreme answers is not so much a problem in our case because we have avoided questions which ask the respondent to agree or disagree with a statement. An informal analysis of the survey responses also shows that this problem in general has not arisen.

4.1.2.1 Choice between Questionnaires and Interviews

Selltiz, Wrightsman and Cook (1976) recognize two forms of self-report instruments, the interview and the questionnaire. The interview provides the opportunity of being able to extensively probe the subject's responses and clearing up any obvious contradictions and ambiguities. The questionnaire format has been chosen for this study due to the following advantages of questionnaires mentioned by Selltiz et. al.:

1. Questionnaire administration is less expensive than interviews.
2. Questionnaires require much less skill to administer than interviews.
3. Questionnaires can be administered to a large number of individuals simultaneously.
4. With questionnaires, respondents have greater confidence in their annonymity, and thus feel freer to express their views.

The disadvantages of questionnaires, low return rates, variability of environmental factors at the time of response, and the lack of on the spot clarification, have been minimized by the researcher personally administering the questionnaire to a group of individuals under a controlled situation.

4.1.2.2 Questionnaire Design

Open-Ended vs. Forced Choice Questions:

All questions in the questionnaire are forced choice questions, in order to eliminate the ambiguity encountered in evaluating and coding open-ended responses.

Absolute vs. Comparative Ratings:

According to Nunnally (1978):

> "An important distinction concerns whether the subject is required to make an absolute response to each stimulas separately or to make comparative judgements or expressions of sentiments among the stimuli."

In case of an absolute response, the subject is confronted with one stimuli (value-concept) at a time. He or she is required to rate the stimuli along a single scale of importance. Theoretically the subject responds to each stimulas on its own, and indicates its importance in an absolute sense.

With comparative ratings the stimuli are presented in groups of two or more, and the subject ranks them with respect to their importance.

Nunnally (1978) states:

> "Whereas people are notoriosly inaccurate in judging the absolute magnitudes of stimuli, -- they are notoriously accurate in making comparative judgements. -- As is true of most judgements in daily life, to a lesser extent most sentiments are partly comparative. The individual has some feeling regarding the absolute liking for an object or an activity, but such sentiments are influenced by the range of objects or activities available. Thus an individual required to rate boiled cabbage on a like-dislike rating scale (an absolute response) must surely say "What else would there be to

> eat?".— Even when subjects are requested to make absolute responses to each stimulas set, there is considerable evidence that these responses are sometimes comparative. — When giving absolute judgements and expressions of sentiment, subjects tend to anchor their responses in terms of (1) stimuli of the same kind that they have encountered in the past, and (2) the range of stimuli in the set presented. However, the difficulties of obtaining absolute rather than comparative responses are usually much more serious with judgements than with sentiments."

In this research project we are measuring the absolute responses of subjects, in terms of the level of importance they attach to the value-concept on a five point scale. Absolute responses do not provide a "penalty or cost" for each high importance response, in terms of something else given up. As there is no cost provided, theoretically it is posible that a respondent may rate everything as uniformly high.

The above danger though recognized, is not very probable because (1) as Nunnally (1978) above suggested that even when the subjects are asked to make absolute judgements they still have some comparative element in it, and (2) many empirical studies (England (1967) and other PVQ studies) have shown that this phenomenon does not occur. Our own survey reults also show that people do not uniformly apply high ratings to all the value-concepts.

The reasons for choosing absolute response method over the comparative response method, despite Nunnally's warnings are:

1. The large number of value-concepts make it impossible for the subject to compare and rank all the value concepts simultaneously. Selltiz, Wrightsman and Cook (1976) have indicated that such a rank-order method works only for a limited group of stimuli.
2. A pairwise comparison of 86 value concepts would require $n(n-1)/2$ or 3655 comparisons to be made by each respondent, which would be too large a time committment to ask for.
3. Using a Q-sort has similar drawbacks:

> "If the economy of time, effort and money was the major consideration, it would pay to make comparative analysis of separate ratings rather than employ the Q-sort. Subjects can make 100 separate ratings in less than half the time that they can perform a Q-sort of 100 stimuli." (Nunnally (1978)).

4. The separate absolute ratings can be easily transformed into comparative ratings when necessary.

5. The absolute ratings, if properly generated, can be interpreted to be on an interval scale, as compared to the ordinal scale obtained from comparative ratings.

Number of Scale Steps:

The number of scale steps for the secondary (meaning) mode and the direction mode are fixed because of the particular nature of the categorical scales in both these modes. On the other hand the primary or the "importance" mode needs a decision about the number of imporance levels or the scale steps which would be included in this scale.

> "In terms of psychometric theory, the advantage always is with using more rather than fewer steps. This is demonstrated by numerous studies showing that the reliability of individual rating scales is a monotonically increasing function of the number of steps. --- As the number of scale steps is increased from 2 up to 20, the increase in reliability is very rapid at first. It tends to level off at about 7, and after about 11 steps there is little gain in reliability from increasing the number of steps." (Nunnally (1978 p.595)).

The managerial PVQ (England (1967)), uses only a 3-point importance rating scale: Low, Medium and High. Following Nunnally's suggestion above, a five-point importance scale has been used for the ISD-PVQ questionnaire in this study. Guion (1965) has indicated that most respondents can discriminate between up to seven such levels, and therefore we are justified in attempting to increase the

discriminatory power of our scale. Miller (1956) has also shown that humans can discriminate between "seven plus minus two" levels. For the purpose of PVQ analysis, where coarser discrimination is needed, we would collapse the scale into the three required levels of low, medium and high, by combining the two high levels into a single high level and the two low levels into a single low level.

Anchoring the Scale Steps:

The linguistic concepts "very high, high, medium, low and very low" have rather "fuzzy" meanings (Zadeh (1972)). Different people may attach different levels to the same terms. In order to ensure that when the "comparison process" influences the absolute ratings process (see above discussion of absolute vs. comparative ratings), it does so in a controlled and prespecified manner, the questionnaire supplies interpretations (anchors) of the rating levels on the rating scales as follows:

RATING LEVEL	NUMERICAL RATING	INTERPRETATION
Very High	5	No system should be designed unless this concept is considered or attained
High	4	Some deficiency in considering/ attaining this concept is acceptable sometimes
Medium	3	Average level of emphasis
Low	2	May examine this or attempt to acheive this if no other more important things to do
Very Low	1	Complete Waste of time

Figure 7: Semantic Anchors for the Importance Scale

Questionnaire Layout:

The ISD-PVQ has been designed to elicit an individual's responses to 86 value concepts on three dimensions: importance, meaning and the preferred direction of change. In addition, the respondent is also asked to provide some demographic, and in case of system developers, additional attitudenal data.

This is a rather large amount of data required from a respondent, and if the questionnaire is not carefully designed it may appear to be putting an inordinate amount of time and cognitive burden on the respondent. This may result in sloppy answers or in extreme cases refusals to complete the questionnaire.

In order to minimize and avoid these problems, we designed the physical layout of the questionnaire based upon the established principles of questionnaire layout and design used in marketing research. In particular we used the "Total Design Method" for the design of mail and telephone surveys (Dillman (1978)). This method specifies the questionnaire format and size (8.5x5.5 center stapled booklet with graphics on front cover), color of the paper (beige or light yellow), the layout of the questions (vertical answer format), and the use of motivating and bridging text to maintain interest during the completion of a long questionnaire. A sample page from the questionnaire is attached in Appendix C.

4.1.3 Questionnaire Reliability and Validity

4.1.3.1 Reliability of Measurement

The American Psychological Association and the American Educational Research Association in their "Technical Recommendations for Psychological

Tests and Diagnostic Techniques" (1954), have standardized three types of reliability definitions and reliability coefficients:

1. Coefficient of Stability, (correlation of measures with a second set of measures obtained at a later time).

2. Coefficient of Equivalance, (correlations between measures obtained from equivalent instruments).

3. Coefficient of Internal Consistency, (obtained from internal analysis of data, gathered in a single administration of the measuring device).

For the ISD-PVQ it is not possible to measure the latter two coefficients for the following reasons:

1. No equivalent instrument is available. Also as each of the 86 concepts on the questionnaire deals with a different value, it is not possible to easily construct an equivalent instrument. Therefore it is not possible to measure the coefficient of equivalence.

2. The coefficient of internal consistency (also called the coefficient of homogeneity) applies to those instruments, which have a number of items (responses) being aggregated to a single scale. Here we have to ensure that all the constituent items of the scale correlate to the scale. An example of such an instrument is the IQ test where responses to many questions are aggregated into a single Intelligence Quotient. In our questionnaire the 86 items do not aggregate to any single scale, and are not homogeneous. Therefore the idea of internal consistency has no meaning for this questionnaire.

The only reliability coefficient which has a meaning for our questionnaire is the "Test-Retest Reliability", or the "Coefficient of Stability". To measure the coefficient of stability, we administered the questionnaire to a group of 14 undergraduate students in accounting. After a time lapse of four weeks the questionnaire was readministerd to the same group. The data from these test retest were employed to calculate the test retest stability of the instrument at both the overall questionnaire level and at the item level.

At the overall questionnaire level, the test retest reliability was calculated for both the primary orientation of the respondents, and the conditional probabilities P(S/HI), P(R/HI), P(P/HI), P(S/ $\overline{HI}$), P(R/ $\overline{HI}$) and P(P/ $\overline{HI}$). (The calculation of these conditional probabilities is explained in section 4.2.)

In order to determine the primary orientation stability of the respondents, subjects in the test retest sample were classified into primary orientation groups on each administration of the instrument (see section 4.2.1). The proportion of subjects that classify objects in the same category in test-retest studies has been suggested as a crude measure of agreement by Goodman and Kruskal (1954), Rogot and Goldberg (1966) and Kirshner (1981). It was found that 12 out of 14 (85.71 percent) subjects retained their primary orientation, implying a measure of agreement of 0.857. This compares favourably with the measure of agreement for primary orientations of 0.70 for educational administrators and 0.65 for naval officers, reported by England, Olsen and Agarwal (1971). Professor G. W. England has suggested that the square root of the proportion of respondents classifying items similarly is a good approximation of the reliability coefficient. Reliability coefficients of 0.83 for educational administrators and 0.80 for naval officers were reported by England, Olsen and Agarwal. The comparable reliability coefficient for ISD-PVQ is 0.926.

In addition to the reliability coefficient for the primary orientation we also calculated the contingency coefficient for the test and retest primary orientations. The value of the contingency coefficient was .709. In discussing the limitations of the contingency coefficients as a measure of correlation, Seigel (1956) has indicated that for a 3x3 contingency table (which was obtained in this case), the upper limit of the contingency coefficient for perfectly correlated data is 0.816. Therefore the value of C = 0.709 is acceptable.

The test retest reliability coefficient for the conditional probabilities was calculated as correlation coefficients between the test and retest values of these conditional probabilities. The Table 2 presents the results.

Table 2: Correlations between Test-Retest Conditional Probabilities

No.	Conditional Probability	Test-Retest Correlation
1.	P(S/HI)	0.89711
2.	P(S/ $\overline{HI}$)	0.76116
3.	P(R/HI)	0.88576
4.	P(R/ $\overline{HI}$)	0.76500
5.	P(P/HI)	0.58935
6.	P(P/ $\overline{HI}$)	0.33955

Except for the conditional probabilities of pleasant given average and low (i.e. not high) importance, all other reliability estimates are fairly high and compare fovourably with England, Olsen and Agarwal's (1971) reported average correlations of .70 for educational administrators and .67 for Naval Officers. Also according to Kirshner(1981) and Helmstadter(1964, p.84)), whom Kirshner quotes, 0.5 is recommended as the minimum requirement for a correlation coefficient when the purpose of a study is to evaluate a group performance. Therefore these correlation coefficients are in the acceptable range.

At the item level the questionnaire measures the subject's response on three dimensions of importance, meaning and direction. Using the same methodology as

England, Olsen and Agarwal (1971), to assess the item reliability, the proportion of respondents classifying a concept similarly at two times (i.e. the measure of agreement) was computed for each of the concepts. The Table 3 summarizes the relevant data and compares it to results obtained by England et. al. The column labelled "Median Proportion" lists the median of the proportion of respondents who classified the concept similarly on both the test and the retest.

Table 3: Summary of Item Reliabilities

Mode of Valuation	Median Proportion	ISD-PVQ Reliabil. Coeff.	England's Reliabil. Coeff.
Importance (5-levels)	.643	.80	Not Appl.
Importance (3-level collapsed)	.786	.89	.83/ .84
Meaning	.714	.84	.73/ .75
Direction (3-level)	.857	.93	Not Appl.
Direction (2-level)	1.000	1.00	Not Appl.
Value Type	.571	.755	Not Given

The column labelled "England's Reliabil. Coeff." gives the corresponding reliability coefficients for educational administrators and naval officers, reported by England, Olsen and Agarwal (1971), in their Manual of Development and Research for the Personal Value Questionnaire. The ISD-PVQ reliability coefficient for

importance ratings for the 5-level scale is .80, compared to England et. al.'s 3-level importance scale reliabilities of .83 and .84. This result seems to contradict Nunnally's assertion regarding the number of scale steps presented in section 4.1.2.2. However no definite conclusions about the correctness of Nunnally's assertions may be made unless we can repeat the test-retest experiment for PVQ instruments which are similar in all respects except the number of scale steps used. When the two high and the two low categories are collapsed together into a 3-level scale the ISD-PVQ reliability goes up to .89, which is higher than that reported by England et. al.

4.1.3.2 Validity of the Measurement

In the literature concerning validity there seems to be some confusion in classifying the types of validity measures applicable to an instrument. Authors Guion (1965), Churchill (1979), Nunnally (1978) and Bornstedt (1970) seem to have agreed upon three basic types of validity criterion: Content Validity, Criterion or Predictive Validity and Construct Validity. Both Guion and Bornstedt further subdivide the criterion validity into Concurrent Validity and Predictive Validity, but as long as we are willing to associate the term prediction with either present (concurrent) or future events, this distinction becomes meaningless. The term Face Validity has been associated by Guion with content validity. whereas Bohrnstedt uses it as a subset of construct validity, along with other similar terms such as "logical validity", "intrinsic validity", "factorial validity" and "trait validity". For the ISD-PVQ we are subsuming the concept of face validity under content validation of the questionnaire.

The content validity of the ISD-PVQ was ensured through the process of developing the information systems development relevant value list. A thorough search of the relevant information systems and management science literature

was conducted to yield the initial pool of concepts to be included in the ISD-PVQ. The two dimensional framework for ISD-relevant values discussed in section 3.1 was then used to check if all the values could be classified into the categories designated by the framework. The framework was also used to augment the list in those areas which were left sparse in the survey of the traditional information systems literature. This pool of concepts was then subjected to scrutiny for relevancy to information systems by a panel of experts which presumably lent considerable content validity to the instrument.

Henerson, Morris and Gibbon (1978) define Content Validity as "the extent to which you can be sure it represents the construct whose name appears in the title". In our case as no single construct appears in the title ISD-PVQ, (unlike the IQ test which measures the single construct "intelligence"), it is not possible to measure the construct validity of the complete instrument. However, we could judge the construct validity of individual concepts or items on the value list. Henerson et. al. suggest three ways of establishing the construct validity: opinion of the judges, correlations with another measure and criterion group studies in which we use the instrument to measure a set of subjects with known level of constructs being measured. The opinion of the judges / panel of experts collected for the value list, in which they determined the unambiguity of the stated concept has been taken as ensuring this type of construct validity.

For the purposes of the dissertation we have not established the predictive validity of the instrument. This would require correlating the test-scores to some future behavior (Guion (1965)). In order to keep the dissertation managable we have not performed any empirical studies which would establish any criterion (both predictive and concurrent) validity of the instrument.

4.2 Classifying Value Concepts into England's Behaviorally Relevant Categories

The ISD-PVQ described in section 4.1 measures each subject's response to each value concept on three modes of valuation: a 5-point importance mode, a 3-category meaning mode and a 3-category direction mode. This subsection describes how the individual's valuation of each value concept on the importance and the meaning modes is translated into a behaviorally relevant value category (see sections 2.1.1 and 3.2) for each value concept. The following is adapted from the "Manual of Development and Research for the Personal Value Questionnaire" by England, Olsen and Agarwal (1971).

As PVQ analysis requires a 3-point importance scale (high, average and low), we first collapse our five point scale into three levels by combining the two high levels into high and the two low levels into low.

The instrument does not yield a single scale value in the traditional sense, but the probabilities of a respondent making given responses is calculated from his response matrix, the frequency distribution for the total number of concepts that he scored. The first step in scoring the instrument for an individual respondent is to construct a response matrix for the total number of concepts scored by him. Each concept is tallied into the appropriate cell of the matrix according to its importance rating and the meaning response. An example of the response matrix is shown in Figure 8.

This matrix is then converted to a matrix with proportions in the cells and the margins. These proportions are the proportion of total number of concepts (86) that are in that cell. The proportion matrix for the above response matrix is presented in the Figure 9.

	High Importance	Average Importance	Low Importance	Total
Right	38	9	0	47
Successful	7	17	0	24
Pleasant	6	5	4	15
Total	51	31	4	86

Figure 8: Response Matrix for One Individual

	High Importance	Average Importance	Low Importance	Total
Right	.4419	.1046	.0	.5465
Successful	.0814	.1976	.0	.2790
Pleasant	.0698	.0581	.0466	.1745
Total	.5931	.3603	.0466	1.0000

Figure 9: Proportions Response Matrix

These proportions are considered as probabilities that a concept will be placed in a given cell. A questionnaire is regarded as incomplete and excluded from analysis if the subject has left blank or has not responded completely to more than 5 percent of the total number of concepts. For our questionnaire if more than 4 of the 86 concepts were blank or incomplete than the questionnaire was excluded from the analysis.

The questionnaire data are analysed in two ways: by examining individuals across concepts (by-person analysis) and by examining concepts across individuals (by-concept analysis).

4.2.1 By Person Analysis

By person analysis of PVQ data involves looking at responses of an individual across all the concepts in the PVQ. On the basis of his responses, summarized in his response matrix, an individual is classified into one of the following primary orientations:

- o Pragmatic
- o Moral
- o Affect
- o Mixed

The following steps are involved in classifying subjects into one of the above primary orientations:

1. Using the response matrix determine the following conditional probabilities: P(S/HI), P(R/HI) and P(P/HI), where S = Successful, R = Right, P = Pleasant and HI = High Importance Level. From these identify the largest conditional probability for an individual. The meaning mode of the largest conditional probability is tentatively taken as the primary orientation. If the two highest conditional probabilities are tied, the difference between each of these conditional probabilities and its complement is calculated. The primary orientation is then represented by the meaning mode having the largest difference between its conditional probability and its complement.

2. Compare the value of largest conditional probability to its complement. If, for example, the largest conditional probability was P(S/HI) its complement is the probability of responding successful, given average and low (i.e. not high) importance, or, that is P(S/ $\overline{HI}$). If P(S/HI) is greater than P(S/ $\overline{HI}$), then the individual's primary orientation would be pragmatic, else it would imply a mixed orientation.

3. After the primary orientation has been determined, calculate the value of the joint probability of the cell which constitutes the individual's operative value cell. If this joint probability is less than .15, his primary orientation is reclassified as mixed.

For example if from steps 1 or 2 the person's primary orientation is pragmatic, then the joint probability of his operative value cell would be P(S∩HI). In general the joint probability of the operative value cell is defined by P(Mode of Primary Orientation∩HI).

4.2.2 By Concept Analysis

By concept analysis of an individual's PVQ involves the classification of each of the value concepts on his PVQ into one of the behaviorally relevant categories: operative, intended, adopted and nonrelevant, described in Figures 3 and 4. in section 2.1.1.

The "by concept analysis" is not possible for individuals with a mixed value orientation. Given that S, R, P, HI, and $\overline{HI}$ are defined as above, and PO = The individual's Primary Orientation, the classification into the above categories is done according to the following rules:

1. Operative Values all value concepts rated at high importance and which fit the individual's primary orientation (HI∩PO).

2. Adopted Values all values that fit the person's primary orientation but are rated only at average or low importance (HI∩PO).

3. Intended Values all values that are rated at high importance, but do not fit the individual's primary orientation (HI∩PO).

4. Nonrelevant Values all values that are regarded as neither highly important nor fit his primary orientation (HI∩PO).

4.2.3 Aggregating for a Group

After the primary orientation has been identified for each individual in the sample, the primary orientation for the total group is determined by counting the number of individuals in each primary orientation category and identifying the category which contains the largest number of individuals. The modal category, then, represents the primary orientation of the group.

To determine the classification of a concept for the group, the classifications of that value concept are aggregated across all individuals in the group. This then shows the number of individuals as the proportion of the group for whom this concept is operative, adopted, intended and nonrelevant. The by concept aggregation for the group may be utilized for two purposes. The first involves deriving an average value profile of the group being studied. This involves classifying the concept into that category in which it is most frequently classified by the group as a whole (i.e. the modal category). The second way in which this data may be used is for analysing the behavioral relevance of each concept for a group of individuals. For this purpose, the percentage of the group for which the concept is an operative value is utilized, the rationale here being that a higher proportion would imply higher behavioral relevance.

4.3 Summary

In this chapter we outlined the development of the ISD-PVQ, an instrument for measuring the value profiles of participants in the information system development process. This instrument was based upon the framework for information system development relevant values discussed in chapter 3, and was adapted from England's personal value questionnaire (PVQ), described in chapter 2. This chapter also discussed the reliability and validity of the instrument and explained how the instrument is used to classify the value concepts for an individual, into behaviourally relevant value categories of England's "Theoretical Model of Values" (England (1967)). The next chapter (chapter 5) discusses the results obtained from a survey of system developers and system users, using the ISD-PVQ instrument.

Chapter V

USER ANALYST DIFFERENCES - RESULTS FROM THE ISD-PVQ SURVEY

In section 1.4, the third objective of the dissertation was stated to be the measurement and comparison of the value profiles of system developers and system users. This chapter describes the results obtained from a field survey of system users and system developers in the province of Ontario.

1. Section 5.1 presents the research hypothesis for this study.
2. Section 5.2 describes the sample which was obtained for the survey.
3. Section 5.3 presents the results of the comparisons between the value structures of users and developers in the sample.

5.1 The Hypothesis of User Analyst Differences

The differences between system developers and system users have long been a favourite theme of authors in management science and information systems areas. Duncan and Zaltman (1975), Churchman and Schainblatt (1965), Ackoff (1967), Argyris (1971) and Mason and Mitroff (1973) have discussed these differences at the theoretical level and have suggested their dysfunctional consequences for the system implementation process. At the empirical level, the differences between system developers and system users have been demonstrated by Smith (1977), Gingras (1976), Gingras and McLean (1982), Senn (1978) and Kaiser and

Srinivasan (1982). Given the different education and professional training of these two groups and the different work environment and tasks performed by them, it is to be expected that they would exhibit differences in their values and attitudes. Therefore this study addressed the following research question: Do the two different participant groups (i.e. users and developers of information systems) exhibit different value profiles? This question was framed through the null hypothesis that there are no differences between the value profiles of the system users and developers.

5.2 The Sample

In order to measure and compare the value profiles of system users and developers (Objective III, chap. 2), the ISD-PVQ developed in section 4.1 was administered to a group of system users and developers. The target population for this study included the total population of all the developers and users of computer based information systems in Ontario. As it was not feasible to get random access to this population, it was not possible to employ any random or stratified sampling scheme. Therefore we employed a convenience sampling scheme. Given the difficult access to the target population, this is the route which seems to have been taken in most of the studies cited in section 2.3.

To obtain the sample, we the contacted the highest ranking information systems executive in various organizations. Out of approximately twenty organizations which intially agreed to participate, seven dropped out after the second contact, leaving us with thirteen organizations in the survey. In these organizations, the contact information systems executive was asked to select at random five to ten information systems developers (responsible for systems analysis and design) to participate in the survey. The information systems executive was also

requested to arrange for system user subjects, though in some cases we had to independently approach executives in the user areas to gain access to the users. The Table 4 describes the sample characterstics.

Table 4: Sample Characterstics (N = 179)

This tables describes the sample population in terms of the percentage of individuals in the sample who belong to the stated category.

PERCENT of RESPONDENTS		AGE of RESPONDENTS	
Federal Govt.	26.7	20-24 years	5.7
Provincial Govt.	2.8	25-29 years	16.3
City Govt.	10.1	30-34 years	34.8
Electric Utility	8.4	35-39 years	18.0
Nuclear Power Gen	4.5	40-44 years	11.8
Manufacturing	2.8	45-49 years	6.7
Retail	5.6	49-59 years	6.7
Insurance	23.4	60 and over	0.0
Universities	15.7		
SEX		NATURE of JOB	
Female	36.5	Users	26.3
Male	63.5	Developers	73.7
PROFESSIONAL CERTIFIC. (CA, CGA, RIA, P.Eng etc.)		EDUCATION	
No	77.8	High School	18.0
Yes	22.2	Some College	19.1
		College Dipl.	20.8
		Univ.Degree	29.2
		Some Postgrd.	3.9
		PostGraduate	9.0
USER RANK (N = 47)		DEVELOPER RANK (N = 132)	
President/V.P.	0.0	V.P. Systems	0.8
Dept.Head/Manager	11.1	Director	2.5
Sectn.Head/Suprvsr	15.6	Mgr.Systems	10.2
Professnl.Staff	13.3	Supv/Proj.Mgr	19.5
Clerical Staff	60.0	Lead Analyst	21.2
		Sr. Analyst	16.9
		Syst. Analyst	17.8
		Prog. Analyst	6.8
		Programmer	4.3

5.3 Comparison of Value Systems of System Users and Developers

The individual ISD-PVQ responses were analysed using the personal value questionaire analysis steps detailed in section 4.2. Based upon the responses on the importance and the meaning mode for the value concepts, every individual respondent was classified into one of the four possible primary orientations: pragmatic, moral, affect and mixed. Then each of the value concepts, for those respondents with primary orientation other than mixed, were classified into one of operative, intended, adopted and non-relevant categories, using the rules in section 4.2.2. This resulted in a detailed value profile for each individual respondent in the sample. These profiles formed the basis of comparison between the users and developers in the survey sample.

The differences between the system users and system developers were analysed at two levels of analysis: at the level of the primary orientation of the group, and at the value profile level.

5.3.1 Differences in Primary Orientation

The primary orientation for each of the user and developer groups was determined by counting the number of individuals in each primary orientation category and identifying the category which contained the largest number of individuals. The modal category then represented the primary orientation of these groups.

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[2] The 2x4 2-dimensional table obtained for the primary orientations has expected counts of less than 5 for over 20 percent of the cells. According to Fienberg (1980, p.172), "In the precomputer era, advice by such distinguished statisticians as Cochran and Fisher was based on practical experience and intuition and led to standard adequacy rules such as the minimal expected cell size should exceed 5. Such rules tended to be somewhat conservative, and more recent Monte Carlo studies by Odoroff (1970), Yarnold (1970) and Larntz (1978) suggest that, at least for tests conducted at a nominal 0.05 level of signifi-

PVQ literature, suggests two different methods for aggregating the concept by concept information from each individual value profile into a group value profile. To determine the classification of a value for the group, the frequencies of classification into the four categories are tabulated for that value over the whole group. For identification purposes we will call this the "Value Category Distribution" for the particular value concept. These frequency counts may then be utilized in two ways. The first involves determining the modal category for that value, the implication being that the modal category represents the value classification for the group. We will call this the "Modal Category" for that particular value concept. The second way in which this data may be used is for analysing the behavioral relevance of each concept for the group of individuals. For this purpose, the percentage of the group for which the concept is an Operative Value is utilized, the rationale here being that a higher proportion would imply higher behavioral relevance. We will call this the "Behavioural Relevance Score" for the group, of that particular value concept.

The Value Profiles of the system users and developers were compared on the following dimensions:

1. The Value Category Distribution
2. The Behavioral Relevance Scores
3. The Preferred Direction of Change

Two-dimensional contingency tables were constructed for each of the 86 value concepts, for their (a) value category distribution, and (b) the preferred direction of change. Table 6, Table 7 and Table 8 present the results of these comparisons for the economic, technical and socio-political-psychological value classes. The table columns "USER" and "DEVELOPER" present the behavioral relevance scores for each of the value concepts for users and developers. The

"DIFF" column of the table presents the level of significance at which there was a significant difference in the value category distributions of these groups. The value category distribution differences were analysed, both for four category classifications (operative, intended, adopted and non-relevant), as well as classification into operative vs. non-operative categories. The entry of "05" and "10" in this column signifies that the value of chi-square was significant at a level of significance less than 5 percent and 10 percent respectively. The entry "D"in the DIFF column indicates that differences in the preferred direction of change were significant at levels of significance less than 5 percent.

5.3.2.1 Difference in Value Profiles - Economic Values

Table 6 presents the comparison of the user developer value profiles for economic values.

Table 6: Differences in Value Profiles - Economic Values

VALUE	USER	DEVEL	DIFF
Flow, Consump. of Org. Resrce.	37	39	
User manpower reqd.for operating system	20	37	05D
System Operating Costs	35	55	05D
Control of Organiz. Resources	46	36	
Monitoring, control of clerks	31	20	
System Development Costs	36	48	
Analysis skills level reqd.	46	57	
Sys. Devel. manpower reqd.for devel.	38	38	D
User manpower reqd. for development	43	44	
Elapsed time for development	50	58	
Development project on schedule	55	62	
Development project on budget	45	60	10
Planning, control of dev. project	54	69	05

In general there is a fair degree of agreement between user and developer groups for the economic value class. For both the groups the most behaviourally relevant values deal with concepts related to the planning and control of the system development project. The project being on schedule and budget and the elapsed time for the project seem to be common concerns of both the developers and the users. However the behavioral relevance of these project planning and control concepts seems to be higher for system developers than for users. For

the system developer the system development project is his main area of work activity, and it is reasonable that for him the planning and control of the project is much more behaviourally relevant than for users.

The other significant area of difference between users and developers seems to be in the behaviorally less relevant areas of the ongoing costs and user manpower requirements for operating the system. The developers and users differ on not only the value category distributions, but also on the preferred direction of change. For both these value concepts the developers seem to attach much higher behavioral relevance than the users. For the concept "user manpower requirements for operating the system", the modal category for the user group is non-relevant, as compared to operative for the developers. The reasons for this difference become clearer when we examine the very significant differences in the preferred direction of change for these concepts. For "user manpower requirements" 57 percent of the users prefer to maintain and 30 percent users prefer to increase the user manpower requirements for operating the system, as compared to 52 percent of the developers who want to decrease and 32 percent who want to maintain the user manpower. These differences are significant at the 0.01 percent level. For the "System Operating Costs" value concept, 75 percent of the developers would like to reduce them, as compared to only 51 percent of the users (significant at 0.02 percent level).

There are two possible reasons for this behaviour. One - in most of the organizations the initial feasibility of the system development project is usually justified in terms of reductions in the operating costs and operating manpower requirements for the system. As the primary job activity for the system developers is the system development project, it is natural that whatever justifies the project would also have behavioral relevance for them. Two - a reduction in user

manpower requirements and system operating costs may be threatening to a majority of non-mangerial users, and hence the direction and the lower behavioral scores for the users.

5.3.2.2 Differences in Value Profiles - Technical Values

Table 7 presents the value profiles of the user and developer groups for the technical class of values.

Table 7: Differences in Value Profiles - Technical Values

VALUE	USER	DEVEL	DIFF
Input/Output Processing	66	70	
Data Stores	46	53	
Data Flows	46	61	10
Computer Programs	35	49	
Manual Procedures	40	48	
Computer Hardware/ Software	14	30	10
User's decision tasks	63	50	
System controls	49	63	05
System documentation	60	55	
System response time	46	46	
Timeliness of Information	69	69	
Currency of information	61	58	
Security of update/ retreival	29	40	D
Accuracy, consistency of data	69	68	
Adequacy, completeness of data	71	55	10
Relevance of info. to task	54	57	
Maintainability of procedures	60	60	
Modifiability of procedures	57	52	
Flexibility of the system	66	64	
Possib. of human errors in process.	54	47	
Sophistication of hardware/software	26	21	
Centralization of hardware/software	17	13	
Computer support for decision tasks	34	51	10D
Align. computer display to decsn.style	26	30	D

Table 7 - Technical Values continued

VALUES	USER	DEVEL	DIFF
Useability of documentation	43	65	05D
Reliability of system	77	74	
System throughput	60	58	
Compatability with interfacing systems	40	59	05
Prompt response to develop. requests	51	52	
Flexible development standards	26	51	05
Analyst induced errors in design	38	68	05
Latest develoment methodologies	31	30	
Computer based efficieny tools for dev.	31	40	D
Ease of documentation prepar./mainten.	34	50	05D
Useability of document. by project team	41	65	05
Consistency btwn.work by diff. analsts.	54	56	

If we examine the top ranking values on the behavioral relevance score, there seems to be a large area of agreement between the users and developers.Table 9 gives the ranking of the top six ranked values for both users and developers

Table 9: Top Ranked Technical Values

The number in the bracket next to the value concept gives the behavioral relevance score for the value concept.

USERS	DEVELOPERS
Reliability (77)	
	Reliability (74)
Adeq. & Completeness (71)	
	I/O Processing (70)
Timeliness (69)	Timeliness (69)
Accuracy (69)	
	Accuracy (68)
	Analyst Errors (68)
I/O Processing (66)	
Flexibility (66)	
	Docmnt. Usebl/Prjct.Team(65)
	Docmnt. Usebl/ User (65)
	Flexibility (64)
User Decision Tasks (63)	Controls (63)
Currency of Info. (61)	

Among the six top ranked value concepts on the behavioral relevance scores, the value concepts "Reliability, Timeliness of Information, Accuracy and Consistency of Data, I/O Processing and Flexibility of the System" are included both for system developers and users. On the other hand the users include concepts such as "Adequacy and Completeness of Stored Data" and "User Decision Tasks" which are not so highly ranked by developers. Developers rank "Analyst Induced Errors in Design", "Useability of the Documentation" both for the project team and the users, and "System Controls" much higher than the users.

The differences between the users and the developers on both Table 7 and Table 9, can be explained using two basic arguments. For the user, "Adequacy and Completeness of Stored Data" and "User Decision Tasks" strongly affects his regular functioning, and hence the high level of importance attached to these by

the user. For the developer these are just two more attributes of the user system under development and hence the medium level (55 and 50) of behavioral relevance. On the other hand, "Analyst induced errors in design", "Useability of Documentation", "Ease of Producing and Maintaining Documentation", "Flexible Development Standards", "Compatability with Interfacing Systems" are development project related concepts, and their effect is felt directly and regularly by the system developer in the course of his regular job activities. The user is usually insulated from these factors, and therefore these factors have a low behavioral relevance score for him.

In addition to the above, the users and developers also differ significantly on two behaviorally less relevant concepts. In case of "Computer Hardware and System Software" the higher score for system developers could be due to the fact that 71 percent of the developers had prior work background in the technically oriented areas of programming and computer operations. As far as the differences in "Computer Support for Decision Making and Judgemental Tasks" is concerned, it is our conjecture, that the developers being more familiar with the capabilities of the computer and the concepts of Decision Support, see more possibilities of impact in this area. This would account for their greater behavioral relevance score, and the preference for increase (75 percent) in the direction for change.

The value category distributions for "System Controls" also show a difference at the 4.96 percent significance level. The respective behavioral relevance scores for users and developers are 49 and 63. It is possible that constant exposure to internal and external auditors, who demand that controls be built into the system, has created a greater awareness for controls among the developers.

5.3.2.3 Differences in Value Profiles - Social-Political-Psych-Values

Table 8 presents the value profiles of the users and the developers for social-political-psychological class of values.

Table 8: Differences in Value Profiles - Soc-Pol-Psych Values

VALUE	USER	DEVEL	DIFF
Design of user jobs/ job satisfaction	51	36	05
Organizational Structure	46	34	
Organization's goals, objectives	51	55	
Communication structure	46	38	
Effect of system on primary client	56	68	
Others in society affected	11	12	
Routine, repetititive user tasks	29	32	05
Alignment of user salaries to job	43	9	05D
User's physical health safety comfort	26	26	
Variety of tasks in user jobs	34	16	05
User job security	20	12	05D
User's sense of making imp. contrib.	43	36	
Learning and growth in user jobs	43	19	05
Status of user job in organization	34	9	05D
User's autonomy in performing job	31	16	05
User's challng vs.simple tasks on job	23	13	
Job induced mental stress on user	14	23	
Social contact on job for users	14	18	
Centraliztion of authority, dec.making	34	14	05D
Assignment, formal. of user responsib.	40	46	
Support for organ. goals and objectives	51	51	
Communication btwn. organiz. units	60	41	10
Privacy of data stored on individuals	29	36	
System's Responsiveness to people	49	59	

Table 8 - Social-Political-Psych-Values continued.

VALUE	USER	DEVEL	DIFF
Routine, repetitive analyst's tasks	11	16	D
Variety of analyst's tasks in develmnt.	23	18	
Learning new skills during develpmnt.	46	28	10
Analyst's autonomy in perform. his job	31	26	
Anlst's chllng vs simple tasks in job	26	15	
Social contact on job for analyst	20	19	
User manager participation in sys.design	66	65	
User clerks particip. in system design	57	42	05
User understanding of developmnt plan	57	57	
User understand. of overall sys.design	51	67	10
User understand. of tech. sys. design	14	4	
Formal definite respnsbl assgn.on proj.	37	57	05
Frequency of user reviews of design	51	52	

Unlike the technical and economic value classes there seems to be very little agreement among the top ranking values in the social-political-psychological value class. Table 10 gives the top six ranks and the ranked values for both developers and users.

Table 10: Top Ranked SPP Values

The numbers in the brackets next to the value concept, give the behavioral relevance score for the value.

USER	DEVELOPER
	Primary Client (68)
	User Understanding of the Overall Design (67)
User Manager Particip. in Design (66)	
	User Manager Particip. in Design (65)
Communication btwn. Organz. units (60)	
	System Responsiveness (59)
User Understanding of the Develop. Plan (57)	User Understanding of the Devel. Plan (57)
User Clerk Particip. in Design (57)	Formal and Definite Assgn. of Resp. on Proj. (57)
Primary Client (56)	
	Organizational Goals (55)
	Freqncy of User Reviews(52)
Organz. Goals (51)	
Freq. of User Reviews(51)	
Support for Org.Goals(51)	Support for Org.Goals (51)
User Job Design and Job Satisfaction (51)	
User Understanding of Overall Design (51)	
System Responsiveness (51)	

In Table 10 the values that are very close in either their behavioral score, or their rank are "User Manager Participation in Design Decisions", "User understanding of the Development Plan", "Support for Organizational Goals and Objectives" and "Frequecy of User Reviews". Values such as "Communication between organizational units", "User clerks participation in design decisions" and "User Job

Design" rank and score much higher for the users than for the developers. On the other hand values like "User understanding of the overall design", "Effect of the system on the primary client", "Formal and definite assignment of responsibilities on the development project" and "System responsiveness to the primary client" rank and score much higher for the developers than for users.

When the Table 8 is examined for behaviorally less relevant values, major and highly significant differences are found between the users and the developers on the user job design and the resulting job satisfaction aspect (end-value aspect), and its associated attributes (end-values normative). The differences in the value category distribution for "User Job Design and Job Satisfaction" are significant at the 3.7 percent significance level. Other highly significant differences (at significance levels ranging from 0.01 percent to 5.0 percent) are found for value concepts "Alignment of User Salaries to the job description", "Variety of tasks in the user job", "Job Security for the User", "Amount of routine and repetitive tasks in user jobs", "Provision for learning and growth in user jobs" and "The Status of the user's job in the organization". The modal categories for all these value concepts for the users, are the behaviourally highly relevant categories of operative and intended values. The modal category for the same value concepts for the developers is the behaviourally least relevant category of non-relevant.

Other significant differences were found for "Centralization of authority and decision making" (at 1.04 percent significance level), "Communication between organizational units", (at 6.5 percent level), "Participation of user clerks in design decisions" (at 0.9 percent level).

Overall it seems that the users are more concerned with their personal well being (i.e. the job satisfaction aspect and its associated attributes), whereas the developers find this non-relevant. On the other hand the developers seem to be

more concerned with the overall system level aspects (the primary client, organizational goals etc.), and the value concepts which deal directly with the development project (user understanding of the overall system design, the development plan and the formal and definite assignment of responsibilities on the project)

5.4 Summary-Differences in Value Profiles - An Overall Perspective

In section 5.1 we formulated the null hypothesis that there was no difference between the value profiles of the system users and the system developers. This hypothesis was rejected at the 5 percent significance level for 21 out of the 86 value concepts. In addition to these differences, there were 13 significant(at 5 percent level) differences in the preferred direction of change for the value concepts.

From the overall point of view we found that there was a large amount of agreement between the users and the developers on the economic and technical value concepts. The few differences in these value classes arise in the technical and system development project related areas which are mainly the concern of the information system developers. However the difference in the economic value concepts, relating to the system operating costs and the manpower required to operate the system, illustrates the perceived threat the non-managerial users might feel from automated information systems.

In the socio-political-psychological value class the differences between the users and the developers become more pronounced. The developers continue to be more concerned about matters relating to the development project. On the other hand the users display certain concerns about their job design and the resulting job satisfaction, which the developers find non-relevant.

In sections 2.2.3 we discussed some significant prior research studies which measured the values and objectives of system developers. In sections 2.3 and 5.1 we mentioned studies which empirically determined user-developer differences. The results of this study confirm the presence of such differences. Our results are significant because of the following reasons:

- The study and the associated measuring instrument are based upon a theoretical framework for ISD relevant values.
- The instrument includes a much more comprehensive list of value concepts than any of the studies mentioned above.
- The measuring instrument has been designed using sound methodological principles and has adequate reliability and validity results.
- The framework and the value concepts have direct pragmatic implications, and the value profiles so measured may be used for ensuring implementation success, and for the design and adoption of information system development methodologies (see section 1.3).

In addition to determining the value profiles of various groups, the study also determined the primary orientations of the two groups. We tested an additional null hypothesis that there was no difference between the primary orientation of the user and the developer groups. Our survey failed to reject this null hypothesis at the 5 percent significance level. However as quoted in section 5.3.1, "individuals with identical value orientations need not be expected to behave similarly". Therefore we still get different value profiles, despite the similarity of primary orientations.

Chapter VI

THE MAVT BASED MEASUREMENT OF SYSTEM DEVELOPER VALUES

This subsection discusses a multiattribute value theory (Keeney and Raiffa (1976)) based methodology for determining the value structures of system developers. In this dissertation the use of this methodology has been limited to a small pilot sample (3 subjects - to be called Alpha, Delta and Sigma) of highly experienced and highly educated system developers. This is because the methodology requires a large amount of in-depth, one-on-one interviewing of the subject - and at times imposes a severe cognitive burden on them. This limits the number of qualified subjects who are willing to participate in the interview.

The methodology measures the value preference structures of the subjects by assessing the multiattribute value function for the subject's preferences for various levels of attainment of the particular value or attribute. The relative weights of each of the attributes then are interpreted as the relative importance the subject attaches to that attribute or value.

The standard multiattribute value theory specifies several possible forms of the MAVF, and the associated independence conditions. As a practical matter Kirkwood and Sarin (1980) have suggested that the mutual preference conditions associated with the additive value function are relatively weak and are easily satisfied. According to this and other arguments presented in section 2.2.2.2, it is reasonable to infer that in practice the additive value function provides robust results, and approximates most of the value preference structures. Therefore for

this methodology we elected to assume the existence of mutual preference independence and to test this assumption later with two separate tests for additivity.

The assessment of the MAVF for the system development values preferences consists of the following steps:

1. Define the information systems development value hierarchy
2. Assess the leaf level single attribute value functions
3. Evaluate the scaling constants (the k_j's) for both the lower level and the top level value functions.
4. Verify the mutual preference independence conditions (i.e. the conditions for additive value functions).

6.1 Defining the ISD Value Hierarchy

The ISD relevant value framework has been used to develop a list of 86 information system relevant value concerns. This list is far too large to be modelled using the standard MAVT models. Typical single level (non-hierarchical) MAVT models in literature, deal with three to five attributes. To deal with the proliferation of attributes Keeney and Raiffa (1976, section 2.3), suggest the use of hierarchically structured attributes. Again in the hierarchical MAVT models, the typical number of levels in the hierarchy are usually two, and the total number of attributes modelled is of the order of ten (see Keeney (1980), Keeney and Raiffa (1976, p.43-44, 341-343)). A larger number of levels and attributes will place a very heavy time and cognitive burden on the respondent. Therefore the original list of 86 value concepts was severely cutback by (a) arranging the values/ attributes into hierarchically arranged levels,and (b) by including only the most commonly discussed values in the ISD context. The attribute list used in the MAVT methodology is therefore, only generally comparable to the full 86 value list used in the ISD-PVQ.

The attached appendix B describes the ISD attributes hierarchy used in our study. This hierarchy consists of two hierarchical levels. The overall value structure is decomposed into "economic, technical and socio-political-psychological" values at the first level. The value attributes at this level are further partitioned into their constituent quantitative attributes (for example the SPP values are partitioned into organizational specification, user job satisfaction, right to self determination and wider social good). These then constitute our eleven leaf level single attributes. The hierarchy is further defined by expanding the lowest levels of the hierarchy into "Qualitative Attributes" (Keeney and Raiffa (1976), p.44-45):

> "The vertical depth of the proliferation of the hierarchy does not necessarily force us to quantify our preferences down to this level of detail. The hierarchy after a given level may serve merely as qualitative checklist for items to consider."

For example the quantitative leaf level attribute "user interface excellence" has been explained by its constituent qualitative value concepts of relevance, accuracy, timeliness etc.. The qualitative attributes are shown within oval boxes in the appendix B, whereas the quantitative attributes are shown as rectangualar boxes. The value hierarchy was presented to the subjects, at the begining of the interview process, to familarize them with the overall structure of the ISD value problem.

6.1.1 What are we Measuring?

A system development effort may attain different levels of each of the attributes of the system undergoing development. For example in a particular development effort one may attain high levels of economic and technical values, but may only attain a very low level of SPP or its constituent values.

In this study we are attempting to measure the preferences for various levels of attainment, of the value attributes presented in the hierarchy. Each of the quantitative value attributes in the study, may be attained at one of "high, medium or low" levels of attainment, in any particular system development effort. Therefore with each of the eleven single leaf level attributes, and the three composite attributes (Econ., Tech. and SPP) we can associate three attainment levels. We would be measuring the preferences and tradeoffs for these attainment levels of various attributes. In order to ensure that all the respondents attached similar meanings to the three levels of attainment, the respondents were provided with semantic anchors for the terms high, medium and low. These anchors are presented in Table 11.

Table 11: Semantic Anchors for the Level of Attainment

LEVEL	INTERPRETATION
High	In developing the system all possible effort was made to attain this attribute, and the resulting system exhibits a high level of the attribute
Medium	Average
Low	In developing the system no formal effort was made to attain this attribute, and the resulting system exhibits only minimal levels of the attribute

6.2 Assessing the Leaf Level Single Attribute Value Functions

The ISD-Value hierarchy has eleven single leaf level attributes to be measured. Each attribute at this level can be characterized by one of three levels of attainment - high, medium and low.

All our single attribute preference functions were evaluated at the three levels of attainment, using the category scaling rating method (Fishburn (1967)).

To operationalize the category scaling rating method we used the "Feeling Thermometer" technique developed by Torrance, Boyle and Horwood (1982). This technique uses a visual analog device called a "feeling thermometer". It is a thermometer shaped 0-100 scale on a white board, with 0 labelled "least desirable" and 100 labelled "most desirable". The three levels of attainment for each of the attributes are printed on pointer sticks labelled high, medium and low. The names of the eleven single level attributes were printed on 11 separate cards and shuffled in a random order.

The subject was presented with one of the attribute cards at a time. He was then asked to imagine a system in which all other attributes have been attained at an average level and are fixed at that level of attainment. The subject was asked to pick the most desirable level of pointer stick and place it at the most desirable level 100, on the feeling thermometer. Next he was asked to place the least desirable level pointer stick at 0, the least desirable level of the feeling thermometer. The remaining pointer stick was then to be placed on the feeling thermometer at the appropriate level of desirability, relative to the placement of the most and the least desirable pointer sticks. In all the cases (i.e. all three respondents, all eleven attributes), the respondents chose high level of attainment as most desirable and the low level of attainment as the least desirable. This meant that the corner points for all the respondents were the same and this sim-

plified further interviewing procedures. The single attribute value functions for the three respondents Alpha, Delta and Sigma are presented in Table 12, Table 13 and Table 14 respectively.

Table 12: Single Attribute Value Function - Alpha

RESPONDENT: Alpha

ATTRIBUTE NAME	LEVEL LOW	MEDIUM	HIGH	SYMBOL
Economic (Development)	0	0.7	1.0	v_{11}
Economic (Operations)	0	0.7	1.0	v_{12}
User Interface Excelln.	0	0.85	1.0	v_{22}
Reliability	0	0.8	1.0	v_{21}
Technical Sophistication	0	0.5	1.0	v_{23}
Maint. and Changeability	0	0.8	1.0	v_{24}
Documentation	0	0.8	1.0	v_{25}
Organz. Specification	0	0.7	1.0	v_{31}
User Job Satisfaction	0	0.5	1.0	v_{32}
User Participation	0	0.5	1.0	v_{33}
Wider Social Good	0	0.7	1.0	v_{34}

Table 13: Single Attribute Value Function - Delta

RESPONDENT: Delta

ATTRIBUTE NAME	LEVEL LOW	MEDIUM	HIGH	SYMBOL
Economic (Development)	0	0.8	1.0	v_{11}
Economic (Operations)	0	0.6	1.0	v_{12}
User Interface Excelln.	0	0.8	1.0	v_{22}
Reliability	0	0.8	1.0	v_{21}
Technical Sophistication	0	0.4	1.0	v_{23}
Maint. and Changeability	0	0.6	1.0	v_{24}
Documentation	0	0.4	1.0	v_{25}
Organz. Specification	0	0.6	1.0	v_{31}
User Job Satisfaction	0	0.8	1.0	v_{32}
User Participation	0	0.8	1.0	v_{33}
Wider Social Good	0	0.3	1.0	v_{34}

Table 14: Single Attribute Value Function - Sigma

RESPONDENT: Sigma

ATTRIBUTE NAME	LEVEL LOW	MEDIUM	HIGH	SYMBOL
Economic (Development)	0	0.7	1.0	v_{11}
Economic (Operations)	0	0.7	1.0	v_{12}
User Interface Excelln.	0	0.65	1.0	v_{22}
Reliability	0	0.75	1.0	v_{21}
Technical Sophistication	0	0.5	1.0	v_{23}
Maint. and Changeability	0	0.7	1.0	v_{24}
Documentation	0	0.65	1.0	v_{25}
Organz. Specification	0	0.6	1.0	v_{31}
User Job Satisfaction	0	0.5	1.0	v_{32}
User Participation	0	0.75	1.0	v_{33}
Wider Social Good	0	0.8	1.0	v_{34}

6.3 Evaluating the Scaling Constants for the Model

The overall hierachical structure consists of a top level three attribute model. Each of these three attributes are themselves multiattribute functions with two to five lower level attributes. Therefore we have to evaluate the scaling constants for four additive MAVFs. The evaluation of the scaling constants is simplified by using the additivity assumption. We can therefore treat each of the lower level models as separate models, evaluate their scaling constants, and then do the same for the overall model. The absolute weight or the scaling constant may be determined using equation (6) in section 2.2.2.2 for conditional weights.

From our definition of the additive value function in section 2.2.2.2, it can be shown that

Given

$v(x_1^*, x_2^*, .., x_n^*) = 1,$
$v(x_1^\circ, x_2^\circ, .., x_n^\circ) = 0.$

and

$v_j(x_j^*) = 1, \quad v_j(x_j^\circ) = 0$ for all j,

then

$v(x_j^*, \bar{x}_j^\circ) = k_j, \quad$ for all $j = 1,2,..,n;$

Therefore the values of the scaling constants k_j for any model may be established by eliciting the holistic ratings of the corner points $v(x_j^*, \bar{x}_j^\circ)$.

These corner points are evaluated using the feeling thermometer based category scaling technique described above. Based upon the extreme (most and least desirable) attainment levels for each single attribute, measured in the previous step, the best $(x_1^*, x_2^*, .., x_n^*)$ and the worst $(x_1^\circ, x_2^\circ, .., x_n^\circ)$ attainment alternatives for each of the three models are constructed. For each of the models, the following procedure is repeated:

The best and the worst alternative cards for each model are placed upon the 100 and 0 points respectively, of the feeling thermometer. The respondent is presented with a card which leaves all the constituent attributes of the model at the worst level, and raises the j th. attribute to its best level. This then defines the corner point $(x_1^o, x_2^o, .., x_{j-1}^o, x_j^*, x_{j+1}^o, .., x_n^o)$ or $(\bar{x}_j, \bar{\bar{x}}_j)$ for that attribute. The respondent is then asked to place this corner point card on the feeling thermometer, relative to the best and the worst alternatives for that model, in such a manner that the position of the corner point card reflects its contribution to the best alternative level. The position of the card then gives the value of the corner point, and the scaling or weight constant for that attribute.

The process was repeated for each of the attributes within the model and for all the four models. Replicated measures of all the corner points for each of the subjects were obtained and averaged to get the scaling constants. Equation (6) of section 2.2.2.2 was then employed to get the absolute weight of each of the leaf level attributes. Table 15, Table 16 and Table 17 present, both the conditional and the absolute scaling constants for respondents Alpha, Delta and Sigma respectively.

For all the three respondents, irrespective of the additivity assumption, we used equations (5), (5a), (5b) and (5c) of Chap. III, to calculate the multiplicative parameter k for each of the three models. The results are presented in Table 18 for all the three respondents.

Table 15: Parameters for the Hierarchical MAVFs - Alpha

Respondent: Alpha

MODEL ATTRIBUTE	CONDITIONAL PARAMETER	ABSOLUTE PARAMETER
OVERALL		
Economic		0.4
Technical		0.2
SPP		0.4
TOTAL		1.0
OVERALL MODEL (DECOMPOSED)		
ECONOMIC		
Development	0.3	0.12
Operations	0.725	0.29
TOTAL	1.025	0.41
TECHNICAL		
Reliability	0.3	0.06
User Inter. Excell.	0.55	0.11
Tech.Sophistication	0.05	0.01
Maint., Changeability	0.05	0.01
Documentation	0.05	0.01
TOTAL	1.00	0.20
SOCIAL-POL-PSYCH.		
Organz. Specification	0.2	0.08
User Job Satisfaction	0.2	0.08
User Participation	0.4	0.16
Wider Social Good	0.25	0.10
TOTAL	1.05	0.42
TOTAL of ABSOLUTE PARAMETERS		1.03

Table 16: Parameters for the Hierarchical MAVFs - Delta

Respondent: Delta

MODEL ATTRIBUTE	CONDITIONAL PARAMETER	ABSOLUTE PARAMETER
OVERALL		
Economic		0.4
Technical		0.2
SPP		0.45
TOTAL		1.05
OVERALL MODEL (DECOMPOSED)		
ECONOMIC		
Development	0.35	0.14
Operations	0.6	0.24
TOTAL	0.95	0.38
TECHNICAL		
Reliability	0.25	0.05
User Inter. Excell.	0.25	0.05
Tech.Sophistication	0.15	0.03
Maint., Changeability	0.225	0.045
Documentation	0.1	0.02
TOTAL	0.975	0.195
SOCIAL-POL-PSYCH.		
Organz. Specification	0.3	0.135
User Job Satisfaction	0.3	0.135
User Participation	0.3	0.135
Wider Social Good	0.15	0.0675
TOTAL	1.05	0.4725
TOTAL of ABSOLUTE PARAMETERS		1.0475

Table 17: Parameters for the Hierarchical MAVFs - Sigma

Respondent: Sigma

MODEL ATTRIBUTE	CONDITIONAL PARAMETER	ABSOLUTE PARAMETER
OVERALL		
Economic		0.6
Technical		0.3
SPP		0.6
TOTAL		1.5
OVERALL MODEL (DECOMPOSED)		
ECONOMIC		
Development	0.6	0.36
Operations	0.65	0.39
TOTAL	1.25	0.75
TECHNICAL		
Reliability	0.6	0.18
User Inter. Excell.	0.5	0.15
Tech.Sophistication	0.3	0.09
Maint., Changeability	0.575	0.1725
Documentation	0.45	0.135
TOTAL	2.425	0.7275
SOCIAL-POL-PSYCH.		
Organz. Specification	0.575	0.345
User Job Satisfaction	0.45	0.27
User Participation	0.35	0.21
Wider Social Good	0.625	0.375
TOTAL	2.000	1.200
TOTAL of ABSOLUTE PARAMETERS		2.6775

Table 18: Table of Multiplicative Parameters

	ALPHA	DELTA	SIGMA
OVERALL	0.0	-0.145019	-0.707459
ECONOMIC	-0.11494	0.000002	-0.641025
TECHNICAL	0.0	0.000009	-0.960067
SPP	-0.12767	-0.126088	-.920685

6.4 Verification of the Mutual Preference Independence Conditions

So far we had assumed the existence of mutual preference independence (MPI) and the associated additive value function form. This subsection outlines our procedure for verifying these conditions. We have used two separate techniques to test for MPI. The first method is based upon the definition of MPI, and tries to establish that the definition holds for the MAVF. The second method is based upon the fact that for an additive value function the sum of-all the scaling constants equals to one.

6.4.1 Verification of MPI Based upon the Definition of MPI

Mutual Preference Condition has been defined by Keeney and Raiffa (1976) as:

> "The attributes $X_1, X_2, .., X_n$ are mutually preferentially independent if every subset of these attributes is preferentially independent of its complementary set of attributes".

As the above definition is stated, the number of preferential independence (PI) conditions that we would need to verify gets astronomically large as n gets

even modestly large. For any value of n, there are n(n-1)/2 possible pairs of attributes that must be preferntially independent of their complements, and this says nothing about the triples, quintuples etc. of the attributes and their complements.

Fortunately exploiting theorem 3.7 in Keeney and Raiffa (1976, p.112), can help us reduce the number of PI conditions which we need to establish. As a result of this theorem, if we can establish the pairwise preferential independence of n-1 pairs of attributes, we can establish the MPI for the complete set of attributes. A simple n-1 sets of such pairs indicated by Keeney and Raiffa are $\{X_j, X_j\}$, j = 1,2,..,n-1.

Keeney and Raiffa have given an interview procedure, and the dialogue to establish these pairwise preferential independence conditions in section 6.6.1 (p.299) of their book. We have followed this format in establishing the following set of PI conditions, given in Table 19.

In our interviews with the three respondents Alpha, Delta and Sigma, the first nine conditions were verified for all the respondents. The last condition (Tech,SPP are PI of Econ.), was verified for all levels of the economy attribute for respondent Delta. For respondents Alpha and Sigma, the condition applied as long as the changes in the economy levels were not from one extreme to another. When the economy level shifted from very high to very low, the respondents indicated a very marginal shift in their preferences if the levels of technical and SPP attributes was close to each other.

Based upon these observations, we do not find that our assumption of additivity is unreasonable for our three subjects. However the slight shift in preference for the last preference independence check, in cases of extreme changes in the level of the complementary attribute, does leave a small doubt, which may be confirmed or denied by additional evidence.

Table 19: Number of Pairwise PIs to be Verified.

ECONOMIC		
Dev. Economic	is PI of	Oper.Econ.
TECHNICAL		
Reliab.,User Intrf.	is PI of	all other tech.attrib.
User Intrf,Sophist.	is PI of	all other tech.attrib.
Sophist,MaintChgabl.	is PI of	all other tech.attrib.
MaintChgabl,Documnt	is PI of	all other tech.attrib.
SOCIAL-POL-PSYCH		
OrgSpec,JobSat	is PI of	all other spp attrib.
JobSat,Particip.	is PI of	all other spp attrib.
Particip,SocGood	is PI of	all other spp attrib.
OVERALL		
Econ,Tech	is PI of	SPP
Tech,SPP	is PI of	ECON

6.4.2 Verification of MPI Based Upon the Sum of k_js

For the additive value function it can be shown that:

$$\sum_{j=1}^{n} k_j = 1.$$

If we empirically measure all the k_js, j = 1,2...,n. and then can show that the result is equal to one, then we can assume that the additive model is valid and the MPI holds. Table 15, Table 16 and Table 17 in section 6.3 outlined the measured values of k_js for the four models for each of the subjects. Table 20 gives the summation of the scaling constants (k_js), for these models[3].

[3] The std. dev. given in the table is the standard error of measurement of the individual k_js, and is calculated from:

$$\text{Standard Error of Measurement} = \sigma_e = \sqrt{(d^2/2N)}$$

Table 20: $\sum_{1}^{n} k_j$ For the MultiAttribute Value Functions

	ALPHA	DELTA	SIGMA
Standard Dev.	0.03407	0.02835	0.109789
SUMMED k_js			
OVERALL MODEL	1.00	1.05	1.50
ECONOMIC	1.025	0.95	1.25
TECHNICAL	1.00	0.975	2.425
SPP	1.05	1.05	2.00

The Σk_j for all the models for respondents Alpha and Delta are within 5 percent of 1.00. Therefore they do not contradict the earlier assumption of additivity of value preferences for subjects Alpha and Delta. However the summed values of the scaling constants for subject Sigma are very different than 1.00 and therefore challenge the additivity assumption.

6.5 Discussion of the Results

In this section we discuss:

1. Our conclusions regarding the appropriate MAVF functional form for each of the subjects (subsection 6.5.1).
2. Our observations about the interview process (subsection 6.5.2)

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where d = difference between the original and the replicate measure.

(Torrance, Boyle and Horwood (1982)).

6.5.1 The Appropriate MAV Functional Form

Three types of evidence may be examined to determine the functional form of the multiattribute value functions for each of the respondents:

1. The evidence from the literature (Kirkwood and Sarin (1980), Keeney and Raiffa (1976) and the arguments presented in section 2.2.2.2), which indicate that the assumption of the additive form is justified.
2. The evidence from the mutual preference verification procedure, presented in section 6.4.1.
3. The examination of the summed scaling constants (k_js) presented in section 6.4.2, and the calculation of the multiplicative function parameter presented in Table 18.

For subject Delta, all three pieces of evidence justify the use of an additive function. Though the summed values of k_js, for this subject are not exactly equal to 1.00, they are sufficiently close, and for all practical purposes can be assumed to be equal to 1.00. Therefore we conclude that the use of the additive functional form for this subject is justified.

For the subject Alpha, the first and the third piece of evidence supports the use of an additive functional form. The second piece of evidence (the verification of the mutual preference conditions), is also supportive, as long as we do not have extreme variations in the level of the economy attribute. Therefore, on the balance we conclude that the use of the additive functional form is justified.

For the subject Sigma, the only strong evidence for the additive functional form is in the arguments available in the literature. The evidence from section 6.4.1, like that for subject Alpha, is supportive of the additive functional form as long as we do not have extreme variations on the levels of the economy attribute.

However the summation of the individual scaling constants for all the four models are significantly different than 1.00, and strongly contradict the assumption of additivity. As a consequence, the calculations for the multiplicative parameters for these models provides rather large values (Table 18). Therefore on the balance we conclude that the additve functional form is not justified, and the MAVFs for this subject are better described using the multiplicative functional form given in section 2.2.2.2..

The single attribute value functions, and the scaling constants to compose them into the appropriate functional forms have already been presented in sections 6.2 and 6.3. Table 21, Table 22 and Table 23 summarize the notational symbols, the scaling constants and the explicit functional forms for subjects alpha, delta and sigma.

Table 21: Notation for the ISD-MAV Functions

MODEL ATTRIBUTE	VALUE FUNCTION	SCALING CONSTANT
OVERALL MODEL		
Economic	v_1	k_1
Technical	v_2	k_2
Social-Pol-Psych	v_3	k_3
ECONOMIC SUBMODEL		
Development	v_{11}	k_{11}
Operations	v_{12}	k_{12}
TECHNICAL SUBMODEL		
Reliability	v_{21}	k_{21}
User Interf. Excell.	v_{22}	k_{22}
Tech. Sophistication	v_{23}	k_{23}
Maint. and Changeability	v_{24}	k_{24}
Documentation	v_{25}	k_{25}
SOCIAL-POLITICAL-PSYCH.		
Organiz. Specification	v_{31}	k_{31}
User Job Satisfaction	v_{32}	k_{32}
User Participation	v_{33}	k_{33}
Wider Social Good	v_{34}	k_{34}

MULTIPLICATIVE CONSTANTS

MODEL	CONSTANT
Overall Model	K
Economic Submodel	K_1
Technical Submodel	K_2
Social-Pol-Psych Submodel	K_3

Table 22: ISD-MAV Scale Parameters - Summarized for all Respondents

MODEL/ATTRIBUTE	SYMBOL	ALPHA	DELTA	SIGMA
OVERALL MODEL				
Economic	k_1	0.4	0.4	0.6
Technical	k_2	0.2	0.2	0.3
Soc-Pol-Psych	k_3	0.4	0.45	0.6
Multiplicative	K			-0.707
ECONOMIC SUBMODEL				
Development	k_{11}	0.3	0.35	0.6
Operations	k_{12}	0.725	0.6	0.65
Multiplicative	K_1			-0.641
TECHNICAL MODEL				
Reliability	k_{21}	0.3	0.25	0.6
User Inter. Excl.	k_{22}	0.55	0.25	0.5
Tech. Sophist.	k_{23}	0.05	0.15	0.3
Maint. and Chang.	k_{24}	0.05	0.225	0.575
Documentation	k_{25}	0.05	0.1	0.45
Multiplicative	K_2			-0.960
SOCIAL-POL-PSYCHOL.				
Organiz. Specific.	k_{31}	0.2	0.3	0.575
User Job Satisfac.	k_{32}	0.2	0.3	0.45
User Participation	k_{33}	0.4	0.3	0.35
Wider Social Good	k_{34}	0.25	0.15	0.625
Multiplicative	K_3			-0.921

Table 23: The ISD Multiattribute Value Functions

SUBJECTS- ALPHA and DELTA

ADDITIVE MULTIATTRIBUTE VALUE FUNCTION

OVERALL MODEL

$$v(x_1,x_2,x_3) = k_1v_1 + k_2v_2 + k_3v_3$$

where

ECONOMIC SUBMODEL

$$v_1 = k_{11}v_{11} + k_{12}v_{12}$$

TECHNICAL SUBMODEL

$$v_2 = k_{21}v_{21} + k_{22}v_{22} + k_{23}v_{23} + k_{24}v_{24} + k_{25}v_{25}$$

SOCIAL-POLITICAL-PSYCHOLOGICAL

$$v_3 = k_{31}v_{31} + k_{32}v_{32} + k_{33}v_{33} + k_{34}v_{34}$$

SUBJECT- SIGMA

MULTIPLICATIVE MULTIATTRIBUTE VALUE FUNCTION

OVERALL MODEL

$$v(x_1,x_2,x_3) = (1/K)\left[(1+K.k_1v_1)(1+K.k_2v_2)(1+K.k_3v_3) - 1\right]$$

ECONOMIC SUBMODEL

$$v_1 = (1/K_1)\left[(1+K_1k_{11}v_{11})(1+K_1k_{12}v_{12}) - 1\right]$$

TECHNICAL SUBMODEL

$$v_2 = (1/K_2)\left[\prod_{j=1}^{5}(1 + K_2k_{2j}v_{2j}) - 1\right]$$

SOCIAL-POLITICAL-PSYCHOLOGICAL SUBMODEL

$$v_3 = (1/K_3)\left[\prod_{j=1}^{4}(1 + k_3k_{3j}v_{3j}) - 1\right]$$

6.5.2 Observations about the MAVT Interview Process

By its intensive interviewing nature, the MAV technique developed above is appropriate only for a relatively small number of attributes. If we are interested in measuring the preferences of a large sample of subjects, over a wide variety of value concerns (attributes) the technique will be impractical.

With all the three subjects, we found that the MAV interview process was very time consuming and placed a heavy cognitive burden on them. The times for the MAV interviews ranged from two hours to four and a half hours. For one of the subjects the interview became mentally so tiring that we had to break off the interview, and continue it in a second session. Therefore we would not recommend the use of this technique for surveying the general ISD value profiles of a large department or a complete organization. On the other hand, if we could get access to a few key people in the organization, and get their strong committment, then the technique is viable for structuring their value preferences.

During specific measurement steps we had the following problems. In the measurement of the single attribute value functions, from the "thinking out loud" of the subjects, we found that they had problems in disassociating the single attribute from the other attributes. Once the problem was pointed out to them, they realized their error, and subsequently did not have the problem.

In establishing the mutual preference independence (MPI) conditions, we found that once the subject had gone through the procedure three or four times, and had understood the concept of preference independence, he tended to take shortcuts in the checking of the remaining preference conditions. Keeney and Raiffa (1976, p.300-301) have recognized this possibilty, and have suggested exploiting this phenomenon to reduce the time required.

These shortcuts were avoided for subject Sigma, who was asked to completely check and mark all the preference independence condition evaluation forms. As shown in section 6.4.1, he indicated the existence of PI in all but one cases. In the one case (SPP and Tech are PI of Econ.) he only showed a marginal preference shift in cases of extreme fluctuations of the levels of the complementary attribute. This indicated that there was evidence for mutual preference independence. But when we measured the scaling constants (k_js) for the subject (section 6.4.2) the evidence strongly contradicted the appropriateness of the additive functional form. This apparant contradiction in the two types of evidence suggests, that for some individuals their preference structures either do not follow mathematical rationality, or the procedures for eliciting the evidence are not developed enough to provide consistent results. As our observations depend only on a very small sample, further study is required before we may be able to verify this observation.

Chapter VII

CONCLUSION

In chapter II we stated the objectives of the dissertation as follows:

1. To develop a framework for enumerating and classifying the values relevant to the system development process.

2. To develop a methodology for eliciting and explicating the value systems of various participants in the system development process.

3. To use this methodology to determine and compare the value profiles of information system developers and system users in the Canadian (Ontario) context.

In the spirit of the information system development project life-cycle, in this chapter we perform a "post-implementation audit" of the dissertation. This audit will evaluate the extent to which the stated objectives were attained, and will suggest directions for further research and improvement. This chapter is structured as follows:

1. Section 7.1 evaluates the attainment of the research objectives.

2. Section 7.2 summarizes the results obtained from the field research.

3. Section 7.3 compares the two approaches to value measurement used in our study.

4. Section 7.4 suggests directions for future research.

7.1 Evaluation of the Objectives Attainment

In chapter III we developed a value theory based framework for stating and classifying values relevant to information systems development. This is a two dimensional framework based upon Kluckhohn's definition of values (Kluckhohn (1951)), and the classification of values by the nature of the benefit (economic, technical and soicio-political-psychological) (Rescher(1969)). The categories of economic, technical and socio-political-psychological value classes were found to be useful in classifying and communicating the value list. This classification was also useful in aggregating the value concepts, and building a value hierarchy for the multiattribute value theory based methodology. The other categorization (end-values (aspect), end-values (normative), and means-values), helped us analyse the value list and fill in empty cells or gaps in the framework matrix. It also formed the basis of sequencing the ISD-PVQ questionnaire, and explaining it to the respondents. Overall we found the framework to be a useful means for both generating and analysing the value list, and for communicating it to others. However let me close our evaluation of the framework with a quote from the creator of another famous framework:

> "Our second disclaimer is against implying an unwarranted degree of precision in our classifications. The lines between categories are blurred, and, as our colleagues have amply demonstrated in discussions of the framework, it is easy to find situations that do not fit clearly in a single category. We believe that these borderline situations and exceptions are not so numerous as to upset the essential validity of the categories, but there is room for disagreement on this point.". (Robert N. Anthony in **Planning and Control Systems - A FRAMEWORK FOR ANALYSIS**; Harvard University Press; 1965, p.20).

The second objective dealt with the development of a methodology for eliciting and explicating the value systems of the various participants in the system development process. To this end we developed two methodologies. An informa-

tion systems development personal value questionnaire (ISD-PVQ), based upon England's theoretical framework for values and the personal value questionnaire (PVQ), was developed and tested. We also developed a multiattribute value theory (Keeny and Raiffa (1976)), based interview methodology for measuring the value structures of individuals participating in the ISD process. The ISD-PVQ was found to be suitable for measuring the value profiles of both individuals and large stakeholder groups. On the other hand, due to its effort and time intensive nature, the MAVT methodology was more suitable for explicating the value structures of individual respondents only. Section 7.3 presents a comparison of the two methodologies.

The final objective dealt with the measurement and comparison of the value sets of information system users and developers in the province of Ontario. To this end we utilized the ISD-PVQ to survey system users and developers from the south and east Ontario regions. The results from the survey are summarized in section 7.2. These results indicate that there is a large measure of agreement between users and developers in the economic and technical value classes. On the other hand significant differences exist in the socio-political-psychological value class.

7.2 User-Analyst Differences - Results from the ISD-PVQ Survey.

In section 5.1 we formulated the null hypothesis that there was no difference between the value profiles of the system users and the system developers. This hypothesis was rejected at the 5 percent significance level for 21 out of the 86 value concepts. In addition to these differences there were 13 significant (at 5 percent level) differences in the preferred direction of change for the value concepts.

From the overall point of view we found that there was a large amount of agreement between the users and the developers on the economic and technical value concepts. The few differences in these value classes arise in the technical and system development project related areas which are mainly the concern of the information system developers. However the difference in the economic value concepts, relating to the system operating costs and the manpower required to operate the system, illustrates the perceived threat the non-managerial users might feel from automated information systems.

In the socio-political-psychological value class the differences between the users and the developers become more pronounced. The developers continue to be more concerned about matters relating to the development project. On the other hand the users display certain concerns about their job design and the resulting job satisfaction, which the developers find non-relevant.

In sections 2.2.3 we discussed some significant prior research studies which measured the values and objectives of system developers. In sections 2.3 and 5.1 we mentioned studies which empirically determined user-developer differences. The results of this study confirm the presence of such differences. Our results are significant because of the following reasons:

- The study and the associated measuring instrument are based upon a theoretical framework for ISD relevant values.
- The instrument includes a much more comprehensive list of value concepts than any of the studies mentioned above.
- The measuring instrument has been designed using sound methodological principles and has adequate reliability and validity results.
- The framework and the value concepts have direct pragmatic implications, and the value profiles so measured may be used for ensuring implementation

success and for the design and adoption of information system development methodologies (see section 1.3).

7.3 Comparison of the ISD-PVQ and MAVF Methodologies

In chapters IV and VI we developed two different methodologies for eliciting the value structures of the participants in the system development process. Chapter IV discussed a PVQ (England (1967)) based methodology for determining the value profiles of individuals and groups. Chapter VI developed a multi attribute value theory based methodology for determining the MAV function of individual participants. This section compares the two methodologies. Section 7.3.1 discusses the relative ease of application and the situational appropriateness of the two methodologies. Section 7.3.2 discusses the comparability of the value profiles measured by the two methods.

7.3.1 Using the Two Methodologies; ISD-PVQ vs. MAVF

The ISD-PVQ was designed to be a survey instrument to collect large amounts of data on a large sample of subjects. The questionnaire may be administered either to individual subjects or to a group subjects at the same time. The instrument itself takes approximately 30 to 50 minutes to administer, and has been found to give reliable and valid results.

On the other hand the MAVF methodology was designed to perform an in depth analysis of individual subject's value preferences, and is very time and effort intensive, both on the part of the interviewer and the subject. The continuous interaction between the interviewer and the subject means that this method can only be used for one-on-one interviewing. The interview duration for our small sample ranged from a low of two hours to a high of four and a half hours. Therefore we would not recommend the use of this technique for surveying the

ISD value profiles of a large department or a complete organization. On the other hand, if we could get access to a few key people in the organization, and get their strong committment, then the technique is viable for structuring their value preferences.

7.3.2 Comparison of the ISD-PVQ and the MAVF Value Profiles

While developing the hierarchical structure for ISD-value attributes in section 6.1, we reduced and aggregated the 86 concepts value list developed for the ISD-PVQ in section 3.1. Therefore the MAVF attribute hierarchy is only generally comparable to the value list used in the ISD-PVQ.

In order to compare the reults from the ISD-PVQ with the MAVF results, we needed to aggregate the ISD-PVQ results at levels comparable to that of the MAVF hierarchy. This aggregation was done at the overall MAV function level. To perform this aggregation, we utilized a weighting scheme suggested by England, Dhingra and Agarwal (1974). This scheme gives a weight of three to operative values, a weight of two to intended values and a weight of one to the adopted values. The non-relevant values on the PVQ get a weight of zero. An ISD-PVQ was administered to each of the three subjects, and their value concepts were classified into the operative, intended, adopted and non-relevant categories according to the rules given in chapter 4. The categories were then replaced by their respective weights, and these weights were summed and averaged for each of the economic, technical and socio-political-psychological classes of values. This provided us with a score on the ISD-PVQ for each of these value classes. Table 24 presents the comparison of these scores with the corressponding scaling weights determined for the MultiAttribute Value functions.

The negative correlations between the MAVF scaling constants and the ISD-PVQ scores indicate that the two instruments are not equivalent. Though a

Table 24: Comparison of ISD-PVQ Results with MAVF Results

	ALPHA		DELTA		SIGMA	
	MAVF	PVQ	MAVF	PVQ	MAVF	PVQ
TECHNICAL	0.2	2.69	0.2	1.86	0.3	2.81
ECONOMIC	0.4	2.85	0.4	2.08	0.6	2.23
SPP	0.4	1.87	0.45	1.57	0.6	2.16
Correlation btwn. MAVF and ISD-PVQ Scores	-0.3624		-0.2759		-0.9952	

Overall Correlation: -0.22721

small sample (3 sample points), precludes us from making any strong assertions about the reasons for this lack of equivalence, some possible explanations are:

1. Fischer (1979) has suggested that as the number of attributes increases, systematic discrepancies between rational aggregation and the actual holistic preference behavior are observed. As in MAVF evaluation we are asking the respondents to intuitively combine the lower level objectives into some fairly coarse higher level attributes, there could be discrepancies between this holistic aggregation, and the aggregation of the detailed value concepts in the PVQ.

2. It is possible that the concept list that an individual intuitively considers to be part of a higher level concept such as economic, or socio-political-psychological is different than the detailed concept list used in the ISD-PVQ. As the MAVF methodology works with the intuitively aggre-

gated higher level concepts, this could account for some of the differences between the MAVF results and the aggregation of the detailed ISD-PVQ results.

7.4 Future Research

In chapter I section 1.3 we discussed the importance of this research in values from the two perspectives of system implementation and system development methodologies. Now that we have operationalized the concept of information systems relevant values and have found ways of measuring and explicating the value structures of the participants in the development process, we can use them to further research in these two areas.

From the implementation perspective, the participant values elicited may be used to form a stakeholder driven definition of system implementation success and failure. The measured gaps in the value profiles of sytem developers and system users could be correlated with other implementation success measures, thereby producing a predictor of implementation risk. Finally, the value measurements may be useful in determining education and sensitization needs for both users and developers.

From the methodological perspective, research needs to be done in finding ways of matching an organization's value profile to system development methodologies. However before such research is undertaken we would need to develop a methodology to explicate the underlying values in a system development methodology. The value framework developed in chapter III, in conjunction with Welke's work on methodologies (Welke (1980), Welke (1981)), Mattessich's work on the values embedded in a system (Mattessich (1974), and Mattessich (1978)), and Kumar's work on methodology comparison (Kumar (1981)), could provide the theoretical basis for such a methodology.

The value gap model presented in chapter I, (Figure 2.0), provides a description of value gaps which may exist in a system development context. Further research is needed to study the implications of these gaps, both for the success of the system and the management of the systems development function.

Appendix A

LIST OF VALUES

EV-A = End Value - Aspect

EV-N = End Value - Normative

MV = Means Value

- TECHNICAL

1. Input/ Output processing (data collection, update, retreival and reporting) (EV-A).
2. Data Stores (files and databases) (EV-A).
3. Data flows and messages (input forms, reports, screens etc.) (EV-A).
4. Computer programs and procedures (EV-A).
5. Manual Procedures (EV-A).
6. Computer Hardware and system software (DBMS, TP Monitors etc.) (EV-A).
7. Decision making and judgemental tasks done by users (EV-A).
8. Controls (automated and procedural) for the system (EV-A).
9. System Documentation (EV-A).
10. System response time (EV-N).
11. Timeliness of information supplied by the system (EV-N).

12. Currency or recency of information supplied (EV-N).
13. Security of update/ retreival access to information (EV-N).
14. Accuracy and Consistency of data (EV-N).
15. Adequacy and completeness of stored data (EV-N).
16. Relevance of supplied information to the decision or task (EV-N).
17. Maintainability of procedures (ease of finding and correcting errors in procedures) (EV-N).
18. Ease of altering system procedures (modifiability) (EV-N).
19. Ability of resulting system to accept change without altering system procedures (flexibility) (EV-N).
20. Possibility of human errors in data processing (EV-N).
21. Level of Sophistication of hardware and system software (EV-N).
22. Centralization of Hardware and software (EV-N).
23. Computer support for decision making and judgemental tasks (EV-N).
24. Alignment of the system's mode of interaction and display to individual user's style of performing decision and operating tasks (EV-N).
25. Useability (accuracy, understandability and completeness) of the documentation by the users (EV-N).
26. Reliability of the system (EV-N).
27. System throughput (i.e. it's capacity to handle the volume of input, output and inquiry transactions) (EV-N).
28. Compatibility with interfacing manual and computer systems and procedures (EV-N).
29. Promptness in responding to development requests (MV)
30. Flexible and modifiable development standards and procedures (MV).

31. Level of analyst induced errors in design (MV).
32. Use of latest methodologies in the development project (MV).
33. Use of computer based efficiency tools for development support (MV).
34. Ease of producing and maintaining documentation (MV).
35. Useability (accuracy, understandabilty and completeness) of the documentation for the system development project team (MV).
36. degree of consistency between work done by different analysts (MV).

o SOCIO-POLITICAL-PSYCHOLOGICAL

1. Design of user jobs and resulting job satisfaction (EV-A).
2. Organizational Structure (reporting, authority and responsibility relationships in user areas) (EV-A).
3. Organization's goals and objectives (EV-A).
4. Communication Structure (i.e. who sends information to whom) (EV-A).
5. The effect of the system on the Primary Client of the organization (e.g. customers, vendors etc.) (EV-A).
6. Other people in the society who may be affected by the system (e.g. unions, consumer groups etc.) (EV-A).
7. Amount of routine repetitive processing by people (EV-N).
8. Alignment of user's salaries relative to their job description (EV-N).
9. Physical health, safety and comfort of the users (EV-N).
10. Variety of tasks in the user's job description (EV-N).
11. Job Security for the users (EV-N).

12. User's sense of making important contribution to the organization (EV-N).
13. Provision for growth and learning on user jobs (EV-N).
14. Status of user jobs in organization (EV-N).
15. User's autonomy in performing tasks (EV-N).
16. Proportion of more challenging to simple tasks in user jobs (EV-N).
17. Job-induced mental stress on the user (EV-N).
18. Interpersonal relationships and social contact on the job (EV-N).
19. Centralization of authority, power and decision making in the organization (EV-N).
20. Assignment, clarification and formalization of responsibility in the user areas (EV-N).
21. Support for Organization's goals and objectives (EV-N).
22. Communication between organizational units (EV-N).
23. Privacy of data for those people on whom the system keeps information (EV-N).
24. System's responsiveness (flexibility, friendliness, ease of interacting) to the primary clients (EV-N).
25. Amount of routine, repetitive and mechanical analysis and design tasks (MV).
26. Variety of analysis and design tasks in the project (MV).
27. Learning new skills during the development project (MV).
28. Proportion of challenging to simple tasks in the analyst's job during the development project (MV).
29. Social contact and interpersonal relationships for the analyst on the project (MV).

30. Analyst's autonomy in planning and performing his/ her sequence of tasks (MV).
31. Participation of user area managers in design decisions (MV).
32. Participation of user clerical and operating staff in design decisions (MV).
33. User understanding of the development plan (MV).
34. User understanding of the overall system design (MV).
35. User understanding of the technical system design (MV).
36. Formal and definite assignment of responsibilities to individuals in the project (MV).
37. Frequency of user reviews of the system design (MV).

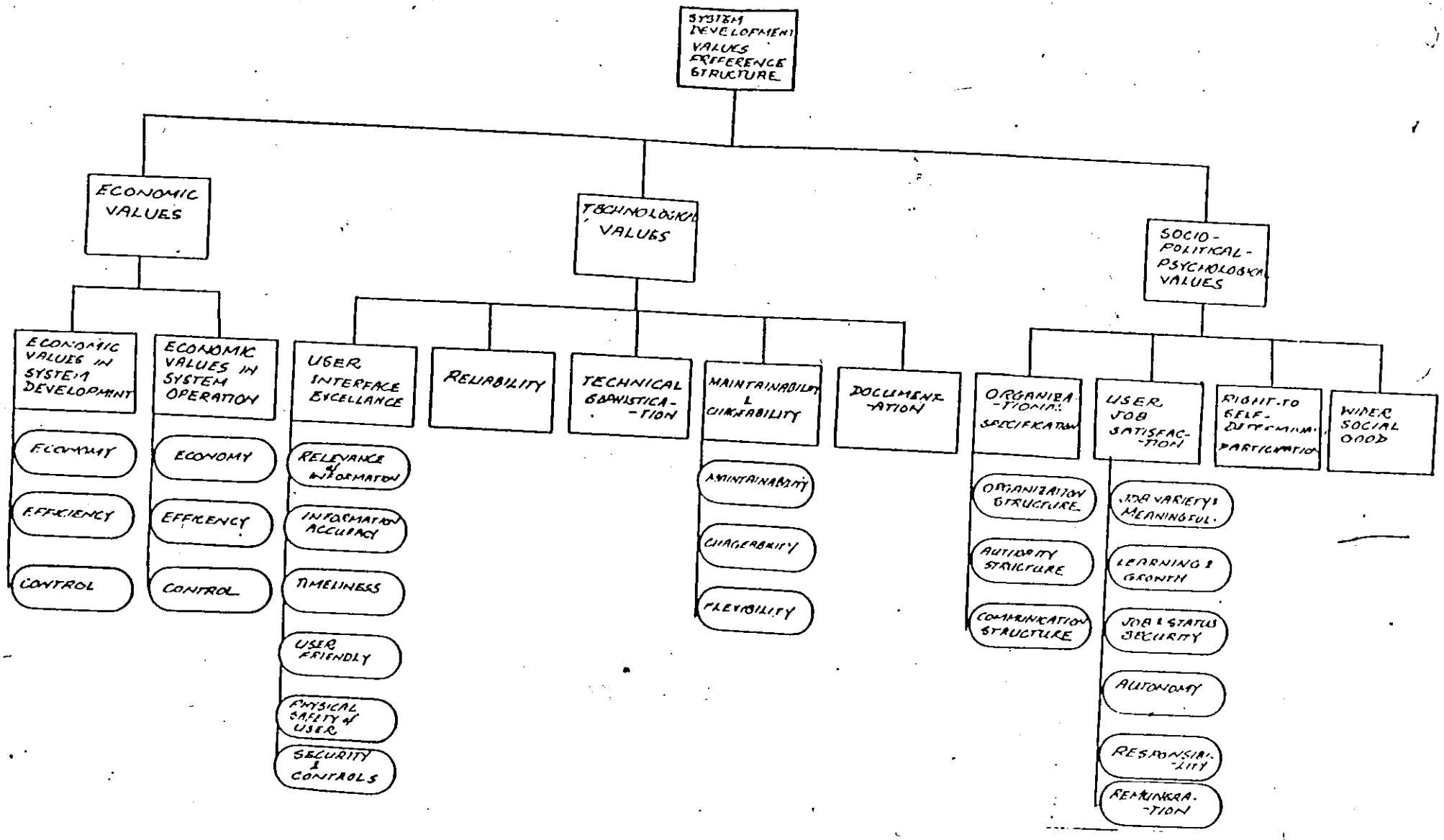
o ECONOMIC

1. Flow and Consumption of Organizational Resources (manpower, materials, space, money etc.) in the operation of the organization (End-Value Aspect (EV-A)).
2. User Manpower requirements for Operating the system (End-Value Normative (EV-N)).
3. Operating costs of the system (EV-N).
4. Control of Organization's resources (EV-N).
5. Monitoring and control of clerical and operating activities (EV-N).
6. System Development Costs (Means Value (MV)).
7. Level of required skills for system analysis and design (MV).
8. System development manpower requirements (MV).
9. User manpower requirements for the project (MV).
10. Elapsed time for the development project (MV).
11. Development project on Schedule (MV).
12. Development project within Budget (MV).
13. Planning and Control of the development project (MV).

Appendix B

THE ISD VALUE HIERARCHY

Fig 1 Values Hierarchy



Appendix C

THE ISD-PVQ QUESTIONAIRE EMPLOYED IN THE SURVEY

Are there any other objectives of systems development that you think are important and should have been included in this survey? If so, please use this space to list them and to indicate the level of importance you attach to them.

Also any comments you wish to make that you think may help us in future efforts to understand the objectives and priorities of system development will be appreciated, either here or on a separate letter.

Your contribution to this study is greatly appreciated. If you would like a summary of results, please mail a request on your organization's letterhead to:

Dr. Richard J. Welke
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Faculty of Business
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Hamilton, Ontario
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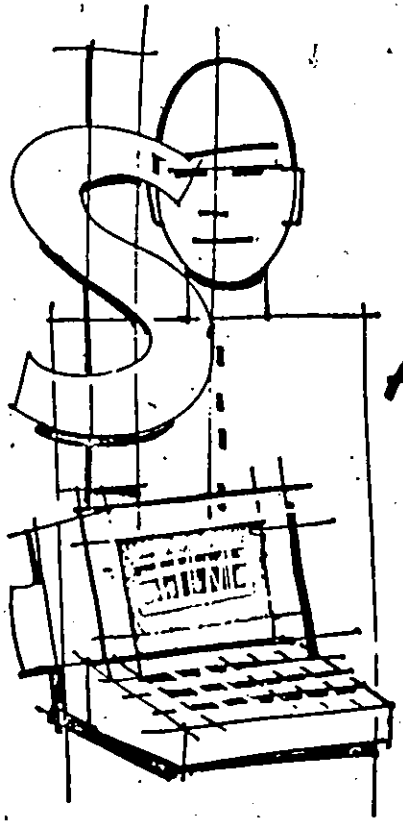
McMaster University Faculty of Business
Management Science and Information Systems



A study of System Development Objectives

What do You think is Important?

A study to determine what you think is important in developing computer based information systems:

- What aspects of the system should be examined and designed?
- What should be the criteria for a good system?
- What is the best way of developing a system?

Individual responses will be kept strictly confidential. Under no circumstances will your individual response be made available to anyone except the members of the research team.

A STUDY OF SYSTEM DEVELOPMENT OBJECTIVES

Instructions for Responding to the Study Questionaire

In this study we have listed a set of concepts which have been suggested as possible areas of concerns and objectives for system development.

- In Section I of the study you are requested to indicate (a) the degree of importance you attach to each concept and (b) the primary meaning you attach to each concept
- In Sections II and III of the study, in addition to the Importance Ratings and the Meaning you are also requested to indicate your preference for the direction of improvement in the concept (i.e. would you like the level of the concept to be maintained, increased or decreased)

In completing this questionaire, please make your judgements on the basis of what these topics mean to you as an individual, rather than what you perceive to be your department's or your organization's priorities.

We suggest the following procedure:

ALL SECTIONS

(1) First rate how important a concept is to you by placing an "x" in the appropriate box [ ] (labelled "Very low" importance to "Very high" importance). The following interpretation scale may be useful for interpreting the meaning of relative terms such as "very high", "high", "low" etc.:

Rating	Interpretation
Very High	No system should be designed unless this concept is considered or attained
High	Some deficiency in considering/ attaining this concept is acceptable some of the time
Medium	Average level of emphasis on considering/ attaining this
Low	May examine this or attempt to acheive this if there are no other better things to do
Very Low	A complete waste of time

(2) Next, specify which one of the three descriptions (successful, pleasant and right), best approximates the meaning of this topic to you by placing an "x" in the appropriate box [ ] on the same line. These descriptions could be interpreted as:

Success: something which you think as contributing to your personal success (recognition, good reviews, promotions etc.) (SUCC)

Pleasant: something which you personally find pleasant (PLSNT)

Right: something which you think is moral or right (RGHT)

For some of the concepts you may feel that more than one of these descriptions apply. In such cases please indicate the one which in your opinion is the most appropriate. On the other hand for some of the concepts you may feel that none of these descriptions apply. In this case you may begin by deciding which description least indicates the concept's meaning for you, and thus by backward elimination arrive at the most probable meaning of the concept to you.

SECTIONS II & III Only: The Direction of Improvement

For the concepts listed in sections II and III please specify the direction in which you would like the concept to improve. The possible directions are:

Increase in the level of the concept (INC)
Decrease in the level of the concept (DCR)
Maintain the level of the concept, i.e. neither increase nor decrease. (M)

EXAMPLES

1) For example you may consider that it is very important to consider computer procedures and programs during the analysis and design phase, and the primary meaning you attach to this concept is success:

	IMPORTANCE RATING					MEANING		
	VERY LOW	LOW	MED	HIGH	VERY HIGH	SUCC	RGHT	PLSNT
	1	2	3	4	5	1	2	3
Computer Procedures and Programs	[ ]	[ ]	[ ]	[ ]	[x]	[x]	[ ]	[ ]

2) In Sections II and III you may prefer that the level of the status of user's job in the organization remain the same when the new system is implemented (i.e. be maintained), you attach low importance to the consideration of the job status, and the meaning you attach to this concept is "right" (i.e. it is right to cosider it):

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
Status of the user's job in the organization	[ ]	[x]	[ ]	[ ]	[x]	[ ]	[ ]	[ ]	[ ]	[x]	[ ]

SECTION I: System analysis involves an explicit or implicit decision about what kind of "things" (aspects) within the system will be the subject of investigation and analysis. This section measures the level of importance you attach, to the consideration of the following "aspects" of the system being developed, during the system analysis and design phases. For each of the following aspects, please indicate the level of importance you attach to the concept, and indicate the primary meaning you attach to this concept.

	IMPORTANCE RATING					MEANING		
	VERY LOW 1	LOW 2	MED 3	HIGH 4	VERY HIGH 5	SUCC 1	RGHT 2	PLSNT 3
1. Input/output processing (data collection, update retreival and reporting)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. Data stores (files and databases)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. Data flows and messages input forms, reports, screens etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. Computer programs and procedures	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. Manual procedures	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. Computer hardware and system software (DBMS TP Monitors etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. Flow and consumption of organizational resources (manpower, materials, space money etc.) in the operation of the organization	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. Design of user jobs and resulting job satisfaction	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION I (continued): Aspects to be considered during development

	IMPORTANCE RATING					MEANING		
	VERY LOW 1	LOW 2	MED 3	HIGH 4	VERY HIGH 5	SUCC 1	RGHT 2	PLSNT 3
9. Decision making and judgemental tasks done by the users	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
10. Organizational structure (reporting, authority and responsibility relationships in user areas)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11. Organization's goals and objectives	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. Communication structure (i.e who sends information to whom in the organization)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. Controls (automated or procedural) for the system	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14. The effect of the system on the primary client of the organization (e.g. customers, vendors etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15. Other people in society who may be affected by the system. (e.g. unions, consumer groups etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16. System documentation	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION II: Having decided which aspects of the system to examine and/or develop, the next question deals with the direction in which development should take place (the "Norms" of development). This section measures the level of importance you attach to each of these norms or criteria. For each of the norms listed below, please indicate:

a) the direction of improvement you prefer for this norm (i.e. would you like to have it increase(INC) or decrease(DCR) or maintained at the same level (M).

b) the level of importance you attach to it, and

c) primary meaning (i.e. success, right or pleasant) you attach to this norm or criteria

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
1.System response time	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2.Timeliness of information supplied by the system	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3.Currency or recency of information supplied	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4.Security of update/ retreival access to information	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5.Accuracy and consistency of data	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6.Adequacy and completeness of stored data	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7.Relevance of the supplied information to the decision or task	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8.Maintainability of procedures (ease of finding and correcting errors in procedures)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION II (continued): Norms and Directions for improvement

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
9.Ease of altering system procedures (Modifiability)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
10.Ability of resulting system to accept change without altering system procedures (Flexibility)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11.Possibility of human errors in data processing	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12.Amount of routine, repetitive processing by people	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13.Level of sophistication of hardware and system software	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14.Centralization of hardware and software	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15.User Manpower requirements for operating the system	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16.Operating costs of the system	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17.Control of organization's resources	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
18.Monitoring and control of clerical and operating activities	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
19.Alignment of the users' salaries relative to their job description	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION II (continued): Norms and Directions for Improvement

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
20. Physical health, safety and comfort of users	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
21. Variety of tasks in user's job description	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
22. Job Security for the users	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
23. User's sense of making important contribution to the organization	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
24. Provision for growth and learning in user jobs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
25. Status of the user's job in the organization	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
26. User's autonomy in planning and performing his/her tasks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
27. Proportion of more challenging tasks to simple tasks in user jobs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
28. Job-induced mental stress on the user	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
29. Interpersonal relations and social contact among users	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
30. Computer support for decision making and judgemental tasks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
31. Alignment of the system's mode of interaction and display to individual user's style of performing decision and operating tasks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION II (continued): Norms and Directions for Improvement

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
32. Centralization of authority, power and decision making in the organization	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
33. Assignment, clarification and formalization of responsibility in the user areas	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
34. Support for organization's objectives and goals	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
35. Communication between organizational units	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
36. Privacy of data for those people on whom the system keeps information	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
37. System's responsiveness (flexibility, friendliness, ease of interacting) to the primary clients and others	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
38. Compatibility with interfacing manual and computer systems and procedures	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
39. Useability (accuracy understandability, and completeness) of the documentation by the users.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
40. Reliability of the system	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
41. System throughput (i.e. it's capacity to handle the volume of input, output and inquiry transactions)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION III: This section measures your preferences regarding the different means for developing a computer based information system. It is therefore an indicator of your preferences regarding the development process itself (as opposed to the specific choices concerned with the system which is being developed). For each of the following concepts please indicate the desired direction of improvement (INCrease, DeCRease or Maintain), the level of importance and the meaning you attach to the concept.

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
1. Promptness in responding to development requests	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. Flexible and modifiable development standards and procedures	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. Level of analyst induced errors in analysis and design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. Amount of routine repetitive and mechanical analysis and design tasks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. Use of latest methodologies, in the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. Use of computer based efficiency tools for development support	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. System development costs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. Level of required skills for analysis and design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. System development manpower requirements for analysis and design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION III (continued): Means for Development (The Development Project)

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	SUCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
10. User manpower requirements for the project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11. Elapsed time for the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. Development project on schedule	Not Applicable			[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. Development project within budjet	Not Applicable			[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14. Planning and control of the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15. Variety of analysis and design tasks in the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16. Learning new skills during the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17. Proportion of more challenging tasks and simple tasks in the analyst's job during the development project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
18. Social contact and interpersonal relationships for the analyst on the project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
19. Analyst's autonomy in planning and performing his/ her sequence of tasks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
20. Participation of user-area managers in design decisions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION III (continued): Means for Development (The Development Project)

	DIRECTION			IMPORTANCE RATING					MEANING		
	INC	M	DCR	V. LO	LO	MED	HI	V. HI	INCC	RGHT	PLSN
	1	2	3	1	2	3	4	5	1	2	3
21. Participation of user clerical and operating staff in design decisions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
22. User understanding of the development plan	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
23. User understanding of the overall system design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
24. User understanding of the technical system design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
25. Formal and definite assignment of responsibilities to individuals in the project	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
26. Frequency of user reviews of the system design	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
27. Ease of producing and maintaining documentation	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
28. Useability (accuracy relevance, understandability and completeness) of the documentation by the system development project team	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
29. Degree of consistency between the work done by different analysts	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION IV: It is commonly believed that a person's background determines, to a large extent, what he/ she may consider to be an important objective. In this section we have included some questions about your personal background which may have some bearing on the way you have answered the above questions. Please answer each question as suggested:

1., Your present age ? (Circle number)

1 20 TO 24 YEARS
2 25 TO 29 YEARS
3 30 TO 34 YEARS
4 35 TO 39 YEARS
5 40 TO 44 YEARS
6 45 TO 49 YEARS
7 50 TO 59 YEARS
8 60 OR OVER

2. Your Sex ? (Circle Number)

1 FEMALE
2 MALE

3. What is the highest level of formal education you have attained? (Circle the number corressponding to the highest level completed)

1 HIGH SCHOOL OR LESS
2 SOME COLLEGE OR UNIVERSITY
3 COLLEGE/ TECHNICAL CERTIFICATE
4 UNIVERSITY DEGREE (BACHELORS)
5 SOME POST-GRADUATE WORK
6 POST-GRADUATE DEGREE

4. Do you hold a professional certification (CDP, CGA, CA, RIA, Other)?

1 YES
2 NO

5. What were the major areas of your education? (Circle all applicable areas)

1 HUMANITIES ARTS AND SOCIAL SCIENCES
2 PHYSICAL & NATURAL SCIENCES
3 BUSINESS ADMINISTRATION
4 ACCOUNTING
5 ENGINEERING
6 COMPUTER SCIENCES
7 MATHEMATICS
8 OTHER (Specify _____)

6. What is the nature of your current job? (Circle one)

1 USER OF INFORMATION SYSTEMS
2 DEVELOPER OF INFORMATION SYSTEMS

IF YOU ARE A SYSTEM DEVELOPER SKIP FROM HERE TO Q-9 ON THIS PAGE AND CONTINUE.

IF YOU ARE A USER CONTINUE WITH Q-7.

7. Which of the following most closely describes your present position in terms of the level of responsibility? (Circle one)

1 PRESIDENT/ C.E.O.
2 VICE-PRESIDENT/ DIVISIONAL MANAGER
3 MANAGER/ DEPARTMENT HEAD
4 SUPERVISOR/ SECTION HEAD
5 PROFESSIONAL/ MANAGERIAL STAFF
6 CLERICAL/ OPERATIONAL STAFF
7 OTHER (specify) _____

8. Have you in the past, worked as a member of a system development project team? (Circle one)

1 YES
2 NO

Thank you for your co-operation and time in answering these questions. Please proceed to the back cover in order to complete the survey.

NOTE:

The remaining questions are addressed only to those individuals who either develop (i.e. analyse and design) information systems or manage the staff responsible for developing information systems.

9. Which of the following job categories most closely describes your present responsibilities? (Circle one)

1 VICE-PRESIDENT SYSTEMS/ ADMIN.
2 DIRECTOR INFORMATION SYSTEMS
3 MANAGER SYSTEMS DEVELOPMENT
4 PROJECT-MANAGER/ SUPERVISOR
5 PROJECT LEADER & SYSTEMS ANALYST
6 SR. SYSTEMS ANALYST/ ARCHITECT
7 SYSTEMS ANALYST
8 PROGRAMMER ANALYST
9 PROGRAMMER

10. Please indicate the total number of years you have worked either as a systems analyst/ designer and/or have managed systems development. (Circle one)

1 LESS THAN 1 YEAR
2 1 TO 2 YEARS
3 2 TO 5 YEARS
4 5 TO 10 YEARS
5 10 TO 15 YEARS
6 15 TO 20 YEARS
7 MORE THAN 20 YEARS

11. Your work background prior to working as a systems analyst?

1 NO PRIOR WORK EXPERIENCE
2 COMPUTER OPERATIONS
3 COMPUTER PROGRAMMING
4 METHODS ANALYST
5 SYSTEM USER
6 OTHER (specify) _____

12. Total number of years worked in all positions? (Circle one)

1 LESS THAN 1 YEAR
2 1 TO 2 YEARS
3 2 TO 5 YEARS
4 5 TO 10 YEARS
5 10 TO 15 YEARS
6 15 TO 20 YEARS
7 20 TO 30 YEARS
8 MORE THAN 30 YEARS

13. Would you be interested in participating in future studies on the process and objectives of system development?

1 YES
2 NO

IF NO PLEASE CONTINUE TO THE NEXT PAGE

IF YES

Your: Name _____

Address _____

_____

_____

Telephone ( ) - _____

PLEASE CONTINUE TO THE NEXT PAGE

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