PROBLEM STRUCTURING:

A PERSONAL CONSTRUCT THEORY PERSPECTIVE

by

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(ABSTRACT)

Why problem structuring is a crucial activity in policy analysis is discussed making references to literature. The shortcomings of the rational model of decision making and problem solving are pointed out. A theoretical perspective with its ontological and epistemological assumptions are elaborated and developed as an alternative to the rational model. Problem structuring is defined as a cognitive process, and George Kelly's personal construct psychology is adopted as the theoretical basis to develop a problem structuring method. The method developed uses Kelly's repertory grid technique in a particular form that is modified for the specific needs of problem structuring in groups. A computer software developed particularly for this method is used interactively in elicitation of personal constructs and their analyses. The applications of the method are illustrated in two group cases, and the implications for theory and further applications are discussed.

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I. Introduction

According to Dunn (1981, pp. 6-7), public policy analysis is a process of knowledge production that deals with "policy problems." Harold Laswell suggested that the basic emphasis of the policy approach was to be on "the fundamental problems of man in society." (Lerner and Laswell, 1951, p. 8) Although there are terminological differences among the theorists, e.g., policy problems, social problems, problem solving, problem resolving, problem succession, problem dissolving, they all agree that dealing with "problems" is the subject matter of public policy analysis.

Since "problems" are at the focus of public policy analysis, one can expect that the nature of problems would be at the center of the discussion in the literature. Although there are some discussions on the issue, they are limited both in their number and scope. Only those who use the terms "problem structuring," "problem definition" or "problem formulation" deal with the nature of problems. Others, usually, take "problems" as givens and suggest ways to "analyze" or "solve" them.

This dissertation focuses on the nature of problems and how they are structured in policy analysis and decision making processes in general. The "nature" of problems needs to be studied and understood at multiple levels of theorization. What is a problem? Is it an ontological entity or an epistemological category? Is it an individual cognitive process or a part of social reality? Are problems created by "social conditions" or are they "social constructions?" How are they structured

in groups and in individual minds? Can these individual and group processes be improved? How? These questions and many others need to be addressed when dealing with the nature of problems.

This dissertation does not attempt to answer all those questions. Yet, it does approach the issue at multiple levels. It argues that the problem of problems should be discussed, first, at the ontological and epistemological levels. Therefore, any work on problems must, at least, take a stand and clarify and elaborate its position at these levels. This dissertation discusses the ontological and epistemological issues and attempts to clarify its position on them in the next two chapters.

However, that would not be enough. Dealing with problems is a very practical activity. The ontological, epistemological statements also have practical implications. Or, to put it the other way around, practical suggestions have underlying ontological, epistemological assumptions. Therefore, this dissertation not only deals with the philosophical questions. I also adopt a psychological theory, George Kelly's Personal Construct Psychology, and propose a method of problem structuring based on it, with some modifications. I also demonstrate in two case studies how the method proposed can be used in practice.

This dissertation is not a rigorous philosophical discussion, nor is it the report of an experiment in cognitive psychology, in the strict sense of the term. I attempt to formulate a position based on the discussions at both philosophical, theoretical and practical levels. I follow the principle I set at the beginning throughout the dissertation: An understanding of problems in policy analysis or decision making should get involved in discussions and formulate its position at the multiple levels of theory and practice. In this dissertation, I attempt to clarify my philosophical position and develop practical tools consistent with that position. In this sense this is nothing more than a self-reflexive exercise.

The case illustrations do not aim, directly, proving the theoretical points raised in the theoretical chapters. They demonstrate how a problem structuring method based on Kelly's theory and technique work in practice. However, these real-life cases also will help demonstrate some of my theoretical points, although they will not attempt to "prove" those points.

While developing my own theoretical position, I did not conduct a social-historical analysis of the theories discussed in this dissertation, though I believe that is crucial for a "strongly-reflexive"

theory development, as Holland suggests.[1] One consequence of this lack of social, historical analysis is that my discussions of the works of each theorist become selective and sometimes eclectic, and I disregard the integrity of his theory. Although this approach is neither strongly-reflexive nor fair to the theorists, it becomes necessary, given the framework of the dissertation.

My exercise in formulating a perspective for problem structuring focuses mainly on George Kelly's Personal Construct Theory and the methods he developed. I think Kelly's theory and practical methodology can provide us with some conceptual and practical tools to understand and improve problem structuring. I disagree with Kelly on several grounds, but, I still think that his theory and method can be a solid basis for problem structuring. I demonstrate in this dissertation how it can be done, without suggesting that the methods I am proposing are the only possible ways of using Kelly's perspective for problem structuring.

In Chapter I, I discuss the problem of problems in policy analysis and decision making. The chapter begins with an evaluation of the "rational model" of decision making and problem solving. It is the rational model that is the main reference frame of most discussions in policy analysis, even if the discussants do not agree with it. The discussion of the rational model in the next chapter opens up the issues that need to be dealt with in relation to the issue of problems in decision making.

In another section of Chapter I, I elaborate and discuss the perspectives of some theorists on the nature of problems. The issues of problem complexity, models of problems and creativity are discussed in separate sections. I also formulate my position on problem structuring in the last section of the next chapter.

Chapter III summarizes George Kelly's philosophy and theory. I elaborate and criticize Kelly's theory in this chapter.

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[1] Holland distinguishes "strong reflexivity" from "weak reflexivity" (1981, p. 25). In his conceptualization, weak reflexivity means a person's awareness of his own assumptions, motives and desires. Strong reflexivity goes beyond that, and also includes an understanding of the social and historical conditions and processes in which person's assumptions, motives and desires are shaped. In other words, Holland's strong self reflexivity means a sociology of knowledge at the personal level. I am in complete agreement with this conceptualization.

Chapter IV presents and elaborates the problem structuring method I am proposing. This method is based on Kelly's Repertory Grid Technique.

I illustrate and discuss the two cases in which I applied the method of problem structuring, in Chapter V. In this chapter, I discuss some implications of these case illustrations for the theoretical arguments I made Chapter II. However, the main objective of this chapter is to demonstrate how the problem structuring method proposed in Chapter IV would work in practice.

In the conclusion chapter, I discuss the implications of these two cases within the context of the theoretical perspective developed in Chapter II.

II. The Problem of Problems

I begin this chapter with a discussion of the rational model of decision making and problem solving. This will help locate the issue of problems and problem structuring in a larger process of decision making. It also will help show how and why the issue of problem structuring is ignored in this model. Thus, it will help build a basis for an alternative in which problem structuring will be a central issue. In the following sections I will discuss the sociological perspectives and the socio-cognitive approaches to problems and structuring problems. The issues of the complexity of problems, models of problems and creativity are discussed in separate sections, due to their special implications for problem structuring.

The Rational Model of Decision Making and Problem Solving

The concept of "the rational model of decision making and problem solving" is quite elusive. This elusiveness creates some difficulties in dealing with it. First of all, it is difficult to find a direct

theoretical defense of such a model. Almost every theorist who mentions the rational model refers to it as a model defined and defended by someone else. It seems that there are very few owners of this model at the theoretical level. Second, it is defined with very abstract and general terms by everyone. Another difficulty is that there is no terminological agreement among the discussants. The terms like "the synoptic ideal," "rational-scientific model," "the rationalist dictum," "practical rationality" and "the economic rationality" are used among others. I will prefer to use the term "the rational model" in this section unless I refer to a specific usage by a theorist.

Despite these conceptual and terminological difficulties, it is still possible to characterize "the rational model" based on the definitions that can be found in the literature. Such a characterization will help to clarify issues related to the conceptualizations of problems.

"The rational model" adopts the principles of "formal rationality" or "procedural rationality of the scientific method," as defined by Max Weber (Fischer, 1986, p. 316). This procedurality is seen in the steps defined for the rational decision making procedure. The aim of this procedure is setting up the "means-ends chains" or causality relationships among the events under consideration (Simon, 1976, p. 62 and Dror, 1968, p. 16). The ultimate ends are the "goals" that are defined by "values." The means to reach those ends are selected from among a group of alternatives. Simon writes, "rationality is concerned with the selection of preferred behavior alternatives in terms of some system of values whereby the consequences of behavior can be evaluated" (1976, p. 75).

The means-ends chains are set up through the steps of analysis. Although there are different formulations of the steps of the rational model, the whole logic can be summarized with the following three questions. In the rational model, these three questions are asked and answered at three distinct steps (McKenna, 1980, pp. 4-5):

1. What is the problem?
2. What are the alternatives?
3. Which is the best alternative?[2]

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[2] McKenna cites these steps mentioning that they were formulated by John Dewey. In my reading of his work (Dewey, 1910, ch.8) I did not find these three steps reflecting Dewey's conceptualization. I do not think that his discussion in Chapter 8 of the book, from which these three steps are derived by others, can

These steps also correspond to and summarize the more elaborate versions of the rational model defined by Dror (1968) and Souder (1980) among many others.

One common aspect of these characterizations is that a rational problem solving or decision making process starts with a "definition of the problem." This may seem like that the rational model places an emphasis on problem definition, because it suggests that the process does not start without it. However, what is meant by "problem definition" is "problem identification." The notion of "problem identification" reflects an empiricist epistemology that assumes a simplistic knowing process. Consequently, the notion of "problem identification" inevitably simplifies and de-emphasizes problem definition. The rational model sees problems as "empirical gaps" to be closed.

Problems As Empirical Gaps

In McKenna's definition, "a need is recognized, and that need is formulated as a problem" (1980, p.4). Dery mentions that the "rationalistic dictum identifies goals first, and defines problems as the gaps between what is and what ought to be" (1984, p. 7). According to Kepner and Tregoe, who are two of the rare examples of the proponents of the rational model, a problem must be defined exactly before it is elaborated and worked on, and it can be defined as a "deviation statement," deviation of the actual state of affairs and the desired state of affairs (1981, pp. 37-38). Rivlin argues that problems are objective entities to be measured, diagnosed and assessed (1971, p. 9).

Whether a problem is defined as a "need," a "gap" or a "deviation," the underlying assumption is that there is a clearly defined goal or a desired state of affairs that is set prior to the definition of a problem. A goal is one of the two parameters that define a problem as a gap. The other parameter is "the present state of affairs." Thus the problem definition in the rational model is nothing more

be a basis for the rational model. However, I cited this because some authors, like McKenna, consider it as the most succinct summary of the logic of the rational model. Although I think this is a wrong interpretation of Dewey, I agree with the suggestion that the three-step model is a good summary of the rational model.

than simply "identifying" (or in the case of availability of quantitative values, "measuring") the distance between the two parameters called "the goal" and "the present state of affairs."

The notion of "problem identification" of the rational model is a reflection of the empiricist epistemological assumptions on which this model is built. Empiricism regards knowledge as a reflection of reality in mind. There may be some distortions in this reflection, though it still is nothing more than a mirror image. The mirror image of a problem is composed of the present and desired states of affairs. The present state of affairs reflects itself into the mind of a knowing subject as it is. In this reflection, there is essentially no role played by the subjectivities of the knowing subject.

On the other hand, when the desired state of affairs is considered, the role of the knowing subject becomes undeniable. He is the one who desires or aims. This heavy involvement of the knowing subject in the knowledge process of problem solving, complicates the task of empiricism in this area, much more than in the area of "science." A scientist can claim that he is detached from "facts," and can attribute an objectivity to his knowledge of them more easily. In problem solving, because of the prospective nature of knowledge production (involvement of desires and goals), a claim for detachment of the problem solver becomes less convincing.

Nevertheless, this does not mean that the empiricist argument breaks down at this point. The desires and goals are placed in the realm of "values," which is distinct from the realm of "facts." This is nothing but an extension of the notion of distinction between "science" and "metaphysics." Empiricism limits the realm of science with what is apparent, visible and sensible by organs, and considers the elements of this realm as "facts/knowables." On the other hand, what is invisible, not sensible by organs, is considered to belong to the realm of "metaphysics/values/ unknowables" (Keat and Urry, 1982, p. 4). The goals and desires in problem solving belong to this second realm.

Paris and Reynolds call this position in policy analysis "ethical noncognitivism" (1983, p. 81). Dror summarizes it as follows:

> Final goals depend largely on the values and beliefs of the policy makers. Science can point out various implications of trying to achieve specific goals, can examine the conditions under which they can be achieved, and can deal with the relationships between different goals, which can, for example, exclude, compete with, or support one another. But the values and goals themselves are outside the domain of science, and are in principle axioms that are given for the process of pure-rationality policy-making. (Dror, 1968, p. 135).

Nagel is a proponent of the rational model and the fact/value distinction, although he does not discuss the issue theoretically. He defines public policy analysis as "determining which various alternative public or government policies will most achieve a given set of goals in light of relations between the policies and the goals." He also says, "The goals in public policy analysis are generally highly subjective, difficult to measure, and on different dimensions" (in Dunn 1986).

Simon, a self-declared logical positivist, seems to be a proponent of the fact/value distinction in his well-known book, "Administrative Behavior."[3] However, he is also aware of the practical difficulties created by this distinction. He defines "factual propositions" as "statements about the observable world and the way in which it operates" (1976, p.45). The process of validating a factual proposition is "quite distinct from the process of validation of a value judgement. The former is validated by its arrangement with the facts, the latter by human fiat" (p. 56). However in practice, separation between the factual and value propositions is not easy (p. 53). Especially in decision making, Simon found, it was necessary to talk about a combination of both:

> Decisions are something more than factual propositions. To be sure, they are descriptive of a future state of affairs, and this description can be true or false in a strictly empirical sense; but they possess, in addition, an imperative quality - they select one future state of affairs in preference to another direct behavior toward the chosen alternative. In short, they have an ethical as well as a factual content. (1976, p. 46).

What we understand from Simon is that facts and values constitute separate realms, yet they can coexist and become "components" of a decision. He also suggests that value statements (ethical proposition) can be assessed within the realm of facts: "in order for an ethical proposition to be useful for rational decision making,..., the values taken as organizational objectives must be definite, so that their degree of realization in any situation can be assessed" (1976, p. 50). To be realized, goals must be pulled out of the realm of values and be projected into the realm of facts. How these projections are made between two incommensurable realms is highly problematic, and Simon does not deal with that.

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[3] Although Simon defends the fact/value distinction of logical positivism in this book, in his later works, as he begins to analyze the cognitive structures and processes of human mind, his explanations become less reconcilable with the fact/value distinction. As an example, I can cite the holistic understanding of human cognition as formulated in Newell and Simon's "Human Problem Solving" (1972). The holism in this approach is hardly reconcilable with the compartmentalist assumption of the fact/value distinction.

Braybrook and Lindblom (1963) raise two major objections to the fact/value distinction of the rational model, or "the synoptic ideal" as they call it. First, they argue that the "multiplicity of values" (p. 23) and the "instability and fluidity of values" (p. 26) complicate problem solving and constitute major stumbling blocks to Simon's requirement of "definiteness of objectives" and "clarity of values." Second, they object to the facts and values' occupying separate compartments in the synoptic ideal. They argue "..in actual practice, continued contemplation of alternative means [which are supposed to be in the realm of facts according to the empiricist rational model] is often empirically inseparable from continued contemplation of values" (p. 52).

Wildavsky is another critic of the fact/value distinction. He argues that facts and values are only intellectual constructs, and cannot be separated in action (1979, p. 13).

The practical difficulties caused by the fact/value separation is felt deeply by the analysts using the rational model, especially in program and policy evaluation. In the evaluation stage, the "desired state of affairs" becomes the "present state of affairs" that needs to be identified and measured to assess the success of a policy. Therefore, the desires that belong to another realm must somehow be projected into the realm of facts, knowables. This need creates a whole series of difficulties in "operationalisation," which are tougher in policy analysis, than in science. In science, both "theories" and "operational terms" are considered to belong to the same realm, i.e., facts/knowables. In policy evaluation, operationalisation is a process that takes place as a transfer between two distinct realms, which are not reducible to each other, by definition. This, I think, is a major difficulty that a rational policy evaluation faces in practice.

In sum, I think, the conceptualization of problems as the gaps between the desired and present state of affairs in the rational model, which is based on the fact/value distinction of the empiricist epistemology, is indefensible in theory (because of its inner contradictions in term) and inapplicable in practice. It is indefensible in theory, because it creates a dilemma for itself. Values and facts are said to constitute distinct, incommensurable realms. Yet, they should be understood in theory as commensurable regions in a decision situation. This self-inflicted dilemma forces the theorists like Simon to find a way out. However, they are not successful in getting out of the dilemma. It is not

applicable in practice, because of the difficulties of transferring "values" into the presumably distinct realm of "facts," as I discussed above.

Problems As Static Gaps

The gap that defines a problem is a static one in the rational model. It is assumed that goals or desired states of affairs are unchanging. Therefore, what needs to be done to "solve" a problem is simply to close the gap. This is supposed to be done by searching for the alternative ways of action and picking one of them, which are the last two steps of the three steps of the rational model I cited above. It should be emphasized that these two steps are distinct from the first, problem identification, step. Once a gap is identified as a problem, it is considered to be a fixed, unchanging definition.

The rational model excludes even the possibility of changing goals and desires in the process, which are admittedly subjective, let alone the possibility of changing knowledge of present state of affairs. The rational model has been criticized because of its conception of static problem definitions. Both Wildavsky and Schon argue against this conception.

Wildavsky criticizes the "paradigm of rationality" for its acceptance of goals and their order of preferences as "immutable." In the real-life policy analysis, according to Wildavsky, the analyst's acceptance of objectives as givens is not realistic. "...policy analysis is a social process of relating objectives to resources by interaction as well as by cogitation, constrained by dogma as well as criticized by skepticism, inevitably changes preferences as well as possibilities" (1979, p. 404).

Schon criticizes the one-shot problem definition of the "practical rationality." He argues that the problem solver is not a technician, but an "agent/experient in conversation with the situation of which he is a part. Based on the appreciation of his situation, which the inquirer takes action, to which the situation responds by 'talking back,' revealing new problems, surfacing new and sometimes conflicting purposes... In case of backtalk, a restructuring of the problem may be necessary" (1985, p. 249).

I agree with Wildavsky's and Schon's criticisms and Dunn's suggestion that "the process of formulating problems occurs throughout the policy making [or problem solving] process" (Dunn, 1988, p. 5). The acceptance of the dynamism of problem formulations is one of the essential points that constitutes the basis for the conceptualization of "problem structuring," rather than "problem identification."

Analyzing Problems

Some proponents of the rational model suggest we "analyze problems" before searching for alternatives for a solution. Although this may look more sophisticated than the simplistic notion of "identifying" problems as "gaps," the problem analyses in the framework of the rational model do not go beyond the empiricist logic.

These analyses aim to find out "the cause(s)" of a problem. These causalities are conceptualized as linear relationships between the events that are objective and external to the knowing subject. In a network of linear relationships an event is singled out, or a group of them are "identified" as the cause(s) of the gap existing between the desired and the present state of affairs.

Kepner and Tregoe, developers of one of the most sophisticated rationalist models, define problem analysis as finding the (one, single) cause of the problem. In their scheme, all that needs to be done is to search for possible causes and eventually to pin down "the true cause of the problem" (1981, ch. 2). They do not even consider the social, psychological or cognitive factors that may get in the way of "identifying the cause." Their technique involves the following steps:

1. Definition of the problem,
2. Description of the problem on four dimensions that Kepner and Tregoe argue to be universal for all sorts of problems: identity, location, timing and magnitude,
3. Extraction of key information on the four dimensions to generate possible causes,
4. Testing for most probable cause,

5. Verification of the true cause (1981, p. 38).

These five steps indicate that problem analysis for Kepner and Tregoe is a completely objective exercise aimed at finding the cause based on some universal parameters.

Petak and Atkinson (1982), in their application of the rational model in "natural hazards policy planning and administration," adopt the same cause-effect logic for problem analysis. However, they consider the causalities in "systemic relationships" (p. 359). They suggest searching for the "multiple causes" of a problem in these systemic relationships, rather than for the single "true cause" as suggested by Kepner and Tregoe. Also, unlike Kepner and Tregoe, Petak and Atkinson recognize the importance of "values" in definition of problems. However, they analyze values and "the relationships between events," i.e., factual causalities, separately. Thus they remain loyal to the a basic premises of the rational model.

Sociological Discussions

The discussions of "social problems" in the journals of sociology are examples of the theoretical disputes between the objectivist/empiricist arguments, which are on the same line as the rational model, and the social/cultural constructivist arguments. In this sense, a summary of these discussions will help lay the groundwork for understanding the socio-cognitive approaches, which I will discuss in the next section.

The functionalist social theory conceptualizes problems as objective conditions. Both Merton (1976) and Manis (1976) argue that there are real social conditions that could be judged objectively as detrimental to the wellbeing of society. They call these conditions "social problems."

Merton formulates a definition similar to that of the rational model: "A social problem is a perceived discrepancy between what is and what people think ought to be - between actual conditions and social values and norms - that is regarded as remediable." Merton also makes clear that

in his understanding social problems are ontological categories, i.e., they belong to the realm of the structure of society: "Social problems result from identifiable social circumstances, so it can be said that the very structure of society is a source of social problems. It is their social consequences, however, that define social problems, whatever their origins" (1976, p. 40). Although problems are ontological entities, their recognition by the knowing subject is as important as their existence. He makes a distinction between "latent" and "manifest" social problems to emphasize that some problems may not be recognized or known. "Manifest social problems are those generally recognized as problems. Latent social problems are conditions not widely identified as problems even though in fact they are at odds with people's interests and values" (1976, p. 41).

Manis criticizes "the paradigm that takes popular values as the bases of definitions of social problems." He argues that this approach mistakes the "trivial or imaginary troubles" for "real problems" (Manis, 1976, p. 4). According to Manis, social problems are either "social conditions" or "social values" that are "detrimental to the wellbeing of human societies," and that are "identified by science." The problems identified by individuals or groups are "perceived social problems," and they may be "real" or "spurious" (1976, p. 4).

The social/cultural constructivist position, i.e., the paradigm that takes popular values as the bases of definitions of social problems, is represented by Blumer, Fuller and Myers, and Spector and Kitsuse.

According to Blumer, "social problems have their being in a process of collective definitions" (1971, p. 298). "Social problems are not the results of an intrinsic malfunctioning of a society, but are the results of a process of definition in which a given condition is picked out and identified as a social problem" (1971, p. 301).

Fuller and Myer's approach is similar. "A social problem is a condition which is defined by a considerable number of persons as a deviation from some social norm which they cherish" (Fuller and Myers, 1941).

Spector and Kitsuse argue that "the process by which members of groups or societies through assertions of grievances and claims, define a putative condition as a social problem" (1973, p. 145).

The social/cultural constructivist position has its repercussions in the policy analysis and decision making literature. In the next section, I discuss the perspectives in this literature which emphasize the social and cognitive nature of problem structuring.

Socio-Cognitive Perspectives

Most of the socio-cognitive theories adopt John Dewey's classical separation between "problematic situation" and "problems" (Rein and Schon, 1977, p. 238). In other words, they agree that external world is represented in human mind as problems. However, these are not simple reflections of reality, unlike the conceptualization of the objectivist-empiricist approaches. These representations are determined by a variety of factors. There are some differences between Ackoff, Simon, Lindblom, Wildavsky, Eden, et.al, Dery and Dunn on these factors, as well as on the nature of complexity of problems, which I will discuss below. The nature of problem structuring is also conceptualized differently from the rational model by these theorists. Unlike the rational model's "problem identification" step, problems are not considered to be structured in a distinct step, as a one- shot activity. It is a process. Problems are restructured, reformulated during the problem solving process.

Ackoff adopts Dewey's distinction between "problematic situation" and "problem." What we are experiencing are the problematic situations, according to Ackoff, not problems. Problems are conceptual constructs (1974, p.21). The decision maker must develop a concept - a representation or model - of the problematic situation he is facing, before attempting to solve it. His conceptualization may not be reflecting the problematic situation as it is. It may be a "wrong" representation. If the representation is wrong, the solution to the problem as conceived may not solve the problem as it exists (1978, p. 13). Ackoff does not explain how the cognitive representations of problematic situations are developed and how they may be right or wrong.

Newell and Simon elaborate extensively and theorize the cognitive mechanisms of problem representation and problem solving. They define a problem from the perspective of a person. "A person is confronted with a problem when he wants something and does not know immediately what series of actions he can perform to get it" (1972, p. 72). A problem is defined in the human mind. The problem solver has to have some information at the beginning, about what is desired, what the conditions and the tools are, etc. Then he transforms this information into a "problem representation." Problem representations are the symbol structures in human cognition (p. 73). Problem representations are not mere reflections of external reality. They are formed by the previous cognitive structures of the problem solver, as well as the incoming information. Newell and Simon says that the previous cognitive structures are of two types: the "internal general knowledge" of the problem solver and the "methods of problem solving stored in human memory," i.e., algorithms of information processing (pp. 73-82).

The internal problem representation dictates, according to Newell and Simon, the means that are usable by a problem solving system (1972, p. 84; also in Simon, 1979). It determines the boundaries of the area in cognition in which the alternative ways of action toward solution can be found. At the same time, problem representation can determine, at least influence, the goals that are set by the problem solver, because the previous cognitive structures (i.e., problem solving methods) can shape the goals. Problem representation is a larger framework in which problems are "formulated." Problem formulation is a more specific, refined cognitive symbol structure (Newell and Simon, 1972, pp. 91-92).

In sum, problems are cognitive representations, which are not mere reflections of external environment in the human mind, according to Newell and Simon. This is different from the naive empiricist position. Simon emphasizes the "inexactness of representations of external environment" elsewhere, and mentions two reasons for that:

> First, it [a representation] must abstract from much (or most) of the detail of the actual physical environment. (It surely cannot represent the individual molecules and their interactions, and it must almost always ignore details that are much grosser and more important than those at the molecular level.) Second, the internal representation includes a representation of the changes that will be produced in the external environment by various actions upon it. (Simon, 1973, p. 195).

Newell and Simon argues that human minds have certain basic organizational features in common and identical memory parameters. These characteristics create commonalities in problem solving behavior. However, since people differ by virtue of culture, education or socio- economic class, the problem formulations and solutions they suggest will be different from each other. The differences in personal history determine the differences in human memory, especially the "long-term memory" in which the "general internal knowledge" and the "methods of problem solving" (algorithms) are stored. Nevertheless, the existence of individual differences does not mean randomness in problem solving behavior:

> ..[The] determinants of content are largely contingent upon the detail of the individual's life history. This does not mean that the determining processes are arbitrary or capricious or unlawful. It means that the contents can be as varied as the range of physical, biological, and social phenomena that surround the individual and from which he extracts them. (Newell and Simon, 1972, p. 866).

The notion of individuality and subjectivity in problem formulations is echoed in Wildavsky's perspective. Wildavsky does not discuss problems as parts of human cognition. However, he emphasizes the subjectivity and selectivity of human minds in formulations of problems. "Policy problems are man-made in that we choose among infinite possibilities to attack one sort of difficulty rather than another." (1979, p. 83)

Like Newell and Simon, Wildavsky sees close relationships between problem formulations and solutions suggested for those problems.

> Problems are defined by hypothetical solutions; the problem's formulation and the proposed solution are parts of the same hypothesis in which thought and action are profused. (1979, p.83).

> A problem in policy analysis .. cannot exist apart from a proposed solution, and its solution is part of an organization, a structure of incentives without which there can be no act. (1979, p. 26).

However, he does not attribute a determining role to problem formulations over solutions, unlike Newell and Simon.

> Problem finding is analogous to inventing or theorizing. In invention the task is not to compile a list of all unfulfilled human needs (or even the shorter list of those that deserve fulfillment), but to connect what might be wanted with what can be provided. The prizes in science go to those who choose problems that turn out to be interesting and solvable. So, too, in policy analysis, the most creative calculations concern finding problems for which solutions might be attempted. (1979, p.3)

Having formulated this problem-solution connection, Wildavsky also suggests a shift in the focus of policy analysis, from "problem solving" to "problem succession" (1979, p. 23).

Lindblom is another theorist emphasizing the subjectivity of problem solving processes (1959 and 1968). He argues that power plays the major role in problem formulation and solving in public policy analysis. Policy analysis is all subjective, according to Lindblom. This is partly due to the cognitive incapabilities we have (as Simon suggests), but mostly because of the political power relationships involved in the process. As a result, there cannot be an objective definition of a problem.

Braybrook and Lindblom criticize "the synoptic ideal" for its wholesale definition of policy problems. "The problem is in fact a cluster of interlocked problems with independent solutions," they argue (1963, p. 54). Braybrook and Lindblom call the problem formulations of the synoptic ideal "synthetic problems." The synthetic problems encompass a host of disparate but interlocked individual and group of problems. They quickly loose their synthetic character in practice, and the problem definitions are readjusted to the situations faced (p. 55).

> The consequence of focusing on a synthetic problem is that the problem is no longer a simple situation in which goal achievement is thwarted but an extremely complex adjustment of interest situation... Problem solving becomes a more continuous process than is ordinarily thought. (Braybrook and Lindblom, 1963, p. 55)

Eden, Jones and Sims conceptualize problems as "social-psychological entities" that have more to do with subjectivities and negotiated orientations than with objectives and organizational goals. They emphasize that the problems are predominantly set within politics, interpersonal considerations, idiosyncratic values, and personal perspectives. "Problems are idiosyncratic constructions that belong to individuals and not to the 'world out there'." Since problems are psychological entities they are often unclear and expressed as anxieties and concerns. Although most problems are expressions of negative feelings, some of them may be positive wishes for the situation to be different in a particular way (1983, p. x).

Dery and Dunn are the two theorists who put major emphases on the role of problem definition or problem structuring in policy analysis.

Dery wrote a book that deals exclusively with "problem definition." The reason he places so much emphasis on problem definition is that he thinks "problems are (implicitly or explicitly) defined to guide future policy, as well as retrospectively to make sense out of past action" (1983, p.

xxi). In other words, like Newell and Simon, he attributes a guiding role to the problem formulations in the policy process.

He argues that there is a substantive distinction between the terms "problem identification" and "problem definition." He argues, "the very notion of problem definition suggests a constructivist rather than an objectivist view [which is implied by the notion of "problem identification"]; that is problems do not exist 'out there'; they are not objective entities on their own right" (1984, p. xi). On the other hand, Dery does not want to put himself in a subjectivist/relativist position either.

> The rejection of objectivism as an approach to problems runs the risk of ending up with relativistic chaos; any problem setting is as "good," legitimate or adequate as any other. My approach is that of "qualified relativism," wherein many definitions may be considered adequate as long as they meet certain criteria. (1984, p. 21).

He strongly opposes the position of the rational model on the definition of problems. He objects to the "rationalist dictum," which suggests setting goals first and independently from analysis.

> To the extent that we may learn about goals through analysis, problem definition is a sense-making medium for future action. Given the limits of analysis, problem definition is often a framework for learning about goals through action, what Weick calls "retrospective sense making." (1984, p. 8).

> Problem definition... is a medium through which we discover what we realistically want and how we may go about obtaining it, and not merely an indication that certain means are inadequate to serve a given goal. (1984, p. 9).

He also criticizes the conceptualization of problems only as negativities. He thinks that problems can be "opportunities for improvement" as well as " a state of difficulty or undesirable conditions" (1984, p. 22). Following up on Wildavsky's conceptualization, Dery links problems to opportunities, and argues that we do not define a problem unless we point to an opportunity or what is interpreted to be an opportunity (1984, p. 10).

Dery's description of problem definition is a dynamic one: "Problem definition is ... a never-ending discourse with reality, to discover yet more facets, more dimensions of action, more opportunities for improvement" (1984, p. 7).

According to Dunn, "problem structuring is the most important, but least understood aspect of policy analysis." In fact, "much policy analysis is properly devoted to problem structuring only secondarily to problem solving" (1981, p. 106). Elsewhere, he says:

> ..seasoned analysts know well that the process of formulating problems occurs throughout the policy-making process...the process of formulating problems is not confined, temporarily or spatially, to those phases of policy making conventionally labelled 'problem formulation' or 'agenda setting.' Competing problem formulations are distributed throughout the policy making process. (1988, p. 5).

Dunn criticizes the naive view of the nature of policy problems which implies that "policy problems are objective conditions whose existence may be established simply by determining what the 'facts' are in a given case." The same 'facts' can be defined in conflicting perspectives, because of the "competing assumptions about human nature, government, and opportunities for social change through public action." Dunn also emphasizes the importance of power in the analysis process and the political nature of problem structuring (1981, pp. 97-98).

According to Dunn, policy problems are cognitive constructions. "Policy problems are simplified representations of selected aspects of a problematic situation constructed for particular purposes" (1981, p. 110).

There are four important characteristics of policy problems, according to Dunn:

1. Interdependence of policy problems... Systems of problems (messes) are difficult or impossible to resolve by using an analytical approach - that is, one that decomposes problems into their component elements or parts - since only rarely can problems be defined and resolved independently of one another... Systems of interdependent problems require a holistic approach.
2. Subjectivity of policy problems... Policy problems are products of thought acting on environments; they are elements of problematic situations that are abstracted from these situations by analysis.
3. Artificiality of policy problems... policy problems are socially constructed, maintained and changed. Problems have no existence apart from the individuals and society and groups who define them ...
4. Dynamics of policy problems. There are as many different solutions for a given problem as there are definitions of the problem... (1981, p. 99).

Complexity of Problems

The "ill-structured," "squishy," "messy" or "wicked" problems are popular issues widely discussed in the problem structuring literature (Simon, 1973; Rittel and Webber, 1973; Strauch, 1976; Ackoff, 1978; Lindblom and Cohen, 1979; Mitroff and Emshoff, 1979; Mason and Mitroff, 1981; Dunn, 1981; VanGundy, 1981; Dery, 1984; Dunn, 1988). Although it is generally agreed that problem structuring process is a complex one, what is meant by complexity and how it relates to the well- or ill-structuredness of problems are not the issues which are agreed upon.

I think complexity should be discussed as an ontological and epistemological question. Is the problematic situation itself complex, so that its reflection in the mind also becomes complex, and therefore, causes the ill-structuredness of problems? In other words, is the ill-structuredness an inevitable consequence of the complexity of the ontological existence? Or, is the structure and the limited capacities of our minds primarily responsible for the perceived complexity and the ill-structuredness of problems? In other words, is complexity and ill-structuredness an epistemological issue? Or, are complexity and ill-structuredness is a product of both the nature of reality and the structure of the mind?

Although the theorists do not ask and answer these questions directly, we can interpret their explanations to elicit their epistemological and ontological assumptions.

VanGundy argues that there are three types of problems: well-structured, semi-structured and ill- structured. Which category a problem belongs to depends on the "availability of information needed to close the gap" that constitutes the problem. If the information is fully available, a problem is well-structured. If it is partially available, the problem is a semi-structured one. f it is non-available, the problem belongs to the category of ill- structured problems (1981, p. 4) Therefore, increasing the amount of information will elevate the status of a problem from the ill-structured, through the semi-structured, up to the well-structured.

VanGundy's approach is clearly an empiricist one. He does not ask any question about the nature of reality. He assumes that the reality is simply reflected in the mind. He does not attribute

any role to the knowing mind in this process. It just receives the information passively. What really matters is the amount of information.

In Rittel and Webber's conceptualization, a problem is well-structured if it can be traced to "the locus of difficulty" or "the root cause." his can be done not only by increasing the amount of information, as VanGundy suggests, but also by taking as many "determinant variables" as possible into consideration (1973, p. 161). Therefore, for Rittel and Webber, a problem's being well- or ill-structured is a matter of both the amount of information and the number of variables.

Rittel and Webber's ontological and epistemological assumptions are not different from VanGundy's. They have the same empiricist notion of reflection of reality in mind. However, the inclusion of "variables" in the problem structuring process has the potential of raising some important questions. As many other positivist theorists, Rittel and Webber seem to assume that variables are inherently parts of external reality. The inclusion of variables in the texture of reality may imply that Rittel and Webber assume that "reality is complex," and that there are multiple factors affecting or determining the ones we are interested in.

According to Ackoff, the conception of a problem may be "right" or "wrong." (1978, p. 13) This categorical distinction between "right" and "wrong" definitions implies that every problem can potentially be defined well or structured appropriately so that it can reflect the reality to which it is corresponds. The implication of this conceptualization is that the reality, whether it is simple or complex, can be reflected as it is in the mind.

Like Rittel and Webber, Dunn's (1988) conceptualization of the issue of well- or ill-structuredness is a matter of the number of aspects of a problematic situation included in problem formulation. The well-structured problems are those whose "boundaries" are known well. Dunn calls these kinds of problems "first-order problems." They require "simple analytic methods." However, in the practice of policy analysis, most of the problems are not well-defined. Their "boundaries" are not known well. These are "second-order" problems, and require "complex analytic methods." By the complex analytic methods, Dunn means the methods of problem structuring. These are mainly to expand the boundaries of the problem formulation, so that it will include "the critical elements of a problem situation." If the boundaries are not large enough, and the critical

elements of the problematic situation are not included, policy analysts may run the risk of "formulating the wrong problem." Like Ackoff, Dunn sees the "right" and "wrong" problem formulations categorically different from each other.

Dunn seems to agree with the empiricist assumption that reality is reflected in the mind with these conceptualizations. However, it also can be said that he has some recognition of the active role of the knowing subject. His recognition of this role, and the subjectivities involved in the knowing process become more apparent in other lines.

Dunn mentions "the complexity arising from the mutual construction of policy problems" (1988, p. 6) The competing problem formulations are "socially constructed, distributed and dynamic" (1988, p.7) Problems are owned by "diverse stakeholders" who alter their problem formulations in their incremental policy learning process. The subjectivities acknowledged by Dunn do not seem to be reconcilable with the notion that there can be a categorically "right" problem formulation. How do we know in which construction "the right formulation" lies? Is there really a "right" formulation? Dunn attributes the role of the judge in the analysis process to the policy analyst. The analyst will face "a larger tangled network of competing problem formulations" (1988, p.7) throughout the analysis process. His central task is to "structure a problem of problems, a second-order entity which may be defined as the class of all first-order problems, which are its members." If the analyst does this second-order job appropriately, he can formulate the "right" problem.

In Simon's perspective there can be no definitely right or definitely wrong problem formulations. The rights and wrongs cannot be distinguished, because he argues, "there is no real boundary between well-structured problems and ill-structured problems" (1973, p.182) In fact, he thinks that any problem solving process will appear ill- structured, if "the problem solver has access to a very large long-term memory of potentially relevant information, and/or access to a very large external memory that provides information about the consequences of problem solving actions" (1973, p. 181).

> ..definiteness of problem structure is largely an illusion that arises when we systematically confound the idealized problem that is presented to an idealized (and unlimitedly powerful) problem solver with the actual problem that is to be attacked by a problem solver with limited (even if large) computa-

tional capacities. If formal completeness and decidability are rare properties in the world of complex formal systems, effective definability is equally rare in the world of large problems.

In general, the problems presented to problem solvers by the world are best regarded as ill-structured problems.... It is not problems, only ill-structured problems that have been formalized for problem solvers. (1973,p. 186).

In sum, according to Simon, the rightness or wrongness, the ill- or well-structuredness are matters of degree, and depend on the cognitive structure of a person. Also he assumes that reality is inherently and infinitely complex. Then the epistemological question becomes that of a degree. The knowledge of reality is always an approximation at some degree.

Lindblom and Cohen emphasize the subjectivity of problem definitions and state that of all the attempts to define "the" or "a" problem, none is correct or incorrect. They write, "We do not discover a problem 'out there.' We make a choice about how we want to formulate a problem" (1979, p. 50) Therefore, complexity - simplicity, and well- and ill-structuredness are all subjective constructions, which do not belong to external reality. In Lindblom and Cohen's conceptualization there is no ontological question. All that matters is epistemology, and it is all subjective.

Dery's position on the complexity of problems is similar to Lindblom and Cohen's. He sees complexity and simplicity as mental constructs:

Readers who accept that 'problems are not objective entities' will readily recognize problem complexity as a construct - mental, organizational, social or political - rather than as an objective attribute of something (i.e., a problem), which does not have an objective existence. A problem is rendered 'complex' when we seek, through solution, to pursue incompatible values... complexity is a function of choice to pursue conflicting or incompatible values. (1984, p. xii).

The arguments on complexity and simplicity have some underlying assumptions as I have tried to show. We can see similar assumptions in the discussions of models of problems.

Models of Problems

Models are mental images. Then, what are the nature and functions of these mental images in the problem solving process? According to Laswell, models are maps guiding analysis: "a contextual map.. is an indispensable preliminary to the examination of any particular problem" (1971, p. 39).

Dunn mentions two types of models: descriptive and normative. The purpose of descriptive models is to explain and/or predict the causes and consequences of policy choices, e.g., the annual list of social indicators of OMB. The normative models do not only explain and/or predict but also provide rules and recommendations for optimizing the attainment of some utility, e.g., benefit-cost models (1981, p.111).

The descriptive-normative distinction in Dunn's conceptualization seems to be two functions of models, rather than being two distinct categories of models. Dunn defines "policy models" as "simplified representations of selected aspects of a problematic situation constructed for particular purposes" (1981, p. 110). The models also advocate courses of actions to resolve problems. Although models are representations of reality, they do not correspond to it on a one-to-one basis. They are artificial reconstructions of 'reality'." Although they are artificial reconstructions they "help distinguish essential from nonessential features of a problematic situation, highlight relationships among important factors and variables" (1981, p. 110). Therefore, models have some correspondence to reality.

It can be said that Dunn's discussion does not clarify his position on the correspondence issue. However, his discussion helps lay out the issues that need to be discussed. His suggestion that "policy models may also play a self-critical and creative role in policy analysis by forcing analysts to make their own assumptions explicit and to challenge conventional ideas and methods of analysis" (1981, pp. 110-111), is particularly interesting with its emphasis on self-reflection and creativity, that I will discuss below.

Simon places the emphasis on the representation function of models. He thinks that models are abstractions from reality, and abstractions are simplifications. These abstractions may be at various degrees. Too much abstraction can make constructed problems easy to solve in terms of computations; however, they may lose all semblance of reality. On the other hand, less abstracted, more satisficing models may create mathematically intractable problems, because they will be too close to reality and unmanageable due to their complexities (1960, p. 18 and 1979b, p. 498).

Strauch takes a step away from the representation perspective, and mentions that there may be two different ways of using models: 1. as surrogates of the problem, 2. as a perspective of the

problem (1975). He thinks that a model's being a surrogate or a perspective "resides in the head of the analyst - in the ways he thinks about the model and its relationship to the problem [..atic situation], in whether he accepts the models as the problem and forgets what else he knows for purposes of analysis, or carries along that additional knowledge and uses it to guide his use of the model and his interpretation of the results it produces" (1975).

In Checkland's conceptualization the term "mental representation" takes on a different meaning. He considers it to be heavily influenced by a person's world view.

> We can go no nearer to 'reality' than the mental representations we make of it. Those mental representations will derive to a large extent from our cultural endowment, from the Weltanschauungen we learn to adopt - and do not question - through our membership of specific social groups and of a specific society. (1984, p. 8).

Eden, Jones and Sims take a subjectivist stand on the issue of models. They oppose Systems Dynamics Modelling, because they argue that it aims "to model the underlying structure of some 'objective' reality" (1983, p. 91). Instead, they see modelling (or "cognitive mapping," to use their own terminology) as a way to portray ideas, beliefs, values and attitudes and their relationships one to another. They consider a model as what an individual "intends to convey about his world" (1983, p. 39) They argue that cognitive mapping gives the opportunity and encouragement to articulate thinking, and see it reflexively in a model which relates ideas, and can release anxiety about the issue and open up creative opportunities (1983, p. 43).

A kind of model in policy analysis and decision making that deserves special attention, is the mathematical or "quantitative" (Strauch, 1976) or "symbolic" (Dunn, 1981, p. 113) model. This kind is a manifestation of a certain approach in policy analysis, rather than being a choice among alternative ways of modelling.

As Strauch correctly points out, quantification is considered by some "as the natural extension of rationality and the scientific method" (1976). In this approach, which Strauch calls "quantificationism," quantification is a value per se. A quantitative answer is a priori better than the qualitative one. This approach uses models as surrogates of real problems, not as perspectives. According to Strauch, these models become pseudo-surrogates in case of "squishy" problems. An important characteristic of this approach is that no personal responsibility is attributed to the results

of the analysis. Quantificationism, in Dreyfus's words, creates "an illusion of detached scientific clarity" (1984, p. 64).

I think this illusion, especially in quantitative policy analyses is an important issue, with which problem structuring can and should deal with. The inherent acceptance of the involvement of the knowing subject in the knowledge production of problem structuring is a challenge to this illusion. A problem structuring method should help the problem solver see that he cannot detach himself from the model (mental image) of the problematic situation he has created.

Creativity

What is the role of creativity of the human mind in structuring problems? Problem representations, formulations and models are not exact pictures of reality. The previous structure of the mind plays a role in these formulations. Individual minds may, and usually do, formulate problems differently. Creativity is said to be fostered by these differences.

Then it becomes important to understand the mechanisms and processes of creativity. We need to understand the role of creativity in problem structuring to understand the problem structuring process itself. Understanding creativity also can help illuminate the epistemological questions that I have been discussing. Furthermore, problem structuring is a proactive process; the actions resulting from these processes will create new realities. Therefore, a discussion of the creative construction of images in mind becomes important in terms of the construction of future.

There are two polar arguments in the discussions of creativity. All arguments can be placed somewhere on the spectrum between these two poles. The first argument is that creativity is inherently inexplicable. Perkins cites Rothenberg and Hausman as arguing that creativity is "ineffable," it cannot be determined (1988, p. 312). Also, Lesgold argues that there can be no theory of creativity, because it cannot be understood (1988, p. 209). This is an agnostic view that essentially reduces creativity to randomness. The second argument is that creativity is simply learning, thinking

differently only due to new incoming information (Maier, 1970, p. 5). This argument is an empiricist one.

The theories of creativity that take the cognitive theories of "associative memories" and "associative thinking" as their bases are closer to the "inexplicability" pole of the spectrum. They favor the unpredictabilities in associations in the mind as the sources of creativity. However, there are some differences among them, in their understandings of associativity.

Perkins mentions that there are some theories which suggest that there is a hierarchy of associations in mind. People with remote associative abilities are considered to be more creative (1988, pp. 321-322). Conversely, Maier and Burke see associativity as a stumbling block to creativity. They suggest that some people tend to retain "associative bonds" among close related elements in their minds, whereas some others tend to violate these associative bonds by regrouping elements (Maier, 1970, p. 43). These regrouping processes are the sources of creativity.

Adams suggests that stereotyping, which is inherent in the mind, and that is a form of associative thinking, is a stumbling block for creativity. He sees creativity as "combining of seemingly disparate parts into a functioning and useful whole" (1979, pp. 14-15).

Whatever the position of each theorist on the associativity-creativity relationship is, they all rely on the theories of the neurophysiological structure of the human brain. This is made of neurons whose connections are not serial or linear, but tangled and complex. Crick calls this structure "associative nets" (1979). Hubel calls it "cross-linked circuits" of neurons (1979). This tangled and complex biological structure is consider either the source of or a hindrance to creativity, among these theorists.

Gendlin, et.al., see more than associativity in creativity. They mention that many definitions of creativity involve "freedom of being 'stimulus bound', that is the individual's ability to hold his constructs 'loosely'... to see a problem differently from what the first sight might suggest. This is only half the creative process they suggest. The other half involves evolving the first felt impression into meaningful statements, questions or specific perceptions (1968, pp. 233-234).

Simon agrees that human memory is organized in an associative fashion, but the associations are structured, not randomly distributed (Simon , 1969, p. 53). This is essentially a function of

storing information in long-term memory in symbol structures, each consisting of a set of symbols connected by relations (Newell and Simon, 1972, p. 792).

Simon does not see creativity as essentially different from other functions of the mind. He argues against "the split brain hypothesis," which divides the functions of the mind into "creative" and "analytical," and attributes these functions separately to the right and left hemispheres of the human brain respectively (Simon, 1987). His rejection of a distinct biological area for creativity and the consideration of creativity as a function of long-term memory puts him away from the "inexplicability" pole of the spectrum and closer to the "learning" pole.

Some theorists see creativity as a function of social/ cultural conditioning, which is another form of learning.

Perkins mentions that larger values shape the direction of a person's endeavors. Those who cherish originality, tolerate ambiguity and complexity, think in negations contraries and opposites, tend to be more creative (1988, p. 317, 324, 328). He also reports the findings of Getzel and Csikzentmihayli (1976) that there is a correlation between "creativity" and "problem finding behavior" (1988, p. 324). These values and behavior types may be acquired in some social, cultural environments more than others.

John-Steiner's approach to creativity is both social and cognitive. He sees creativity as a dynamic and ongoing process. The features of the creative process, according to John-Steiner are "the long apprenticeship, the continuous interaction of person and society, the varied languages or modalities of creative thought, and the importance of character in sustaining patient, disciplined hard work." (1985, p. ix)

Although I do not aim to and cannot resolve the discussions on creativity here, it seems to be important to emphasize that there are social, biological and cognitive sources of creative thinking.

My Position

In this section, I want to define my position on the issues pertinent to problem structuring, which I laid out in the previous sections.

I see problems ("social problems," "policy problems," etc.) as epistemological categories rather than being ontological ones. They are structured and restructured in the knowing process that takes place in the cognition of the individual human being as well as in social interactions at various levels, i.e., group decision making, organizational and larger-political policy making, and production and reproduction of ideologies in societies. In this study I focus on the individual cognitive and group decision-making levels, not necessarily because these are the most important levels in the structuring of a problem, but because I made the deliberate choice of focusing on these levels.

Although problem formulations are epistemological categories, they come into being, and are altered, in interactions with ontological realities. I find Dewey's distinction between "problematic situation" and "problems" useful. A "problem" which is an epistemological category, represents a problematic situation, i.e., an ontological category. However, this representation is far from being a mere reflection, or a mirror image of reality in the mind. Knowledge of reality is produced and reproduced, i.e., problems are structured and restructured in the process.

I disagree with the definition inherent in the rational model that problems are simple and static gaps between "what is" and "what ought to be." I discussed above the difficulties the rational model faces at the philosophical and practical levels because of its simplistic notion of problems. I can agree with the argument that problems are defined as "gaps," but only in human cognition. In other words, these are "cognitive gaps" not "gaps in reality," as suggested by the rational model. Human cognition usually simplifies the external reality in the process of knowledge production. Defining problems as gaps is such a simplification.

However simplified they may be, problem formulations are not as simple as being measurable distances between two signposts. As Mason and Mitroff (1981), and Newell and Simon (1972) suggest, there are various components in problem definitions, e.g., underlying assumptions and

conceived means of achieving goals. These components of a problem constitute a complex structure in human cognition. These structures are, by no means, static ones. The components of the structures are not frozen epistemological categories. In the process of the mind's interaction with the external, everchanging reality, these relationships are modified. As Dunn (1988) and Dery (1984) emphasizes, the structuring and restructuring of these components, i.e., "problem structuring" or "problem definition," take place throughout all the stages of policy analysis. The analyst keeps changing his problem formulation as he interacts with his environment.

How do these cognitive transformations take place? What are mechanisms of problem structuring? What is the nature of reality that problem definitions aim to represent and alter?

I propose Althusser's formulation of the materialistic dialectic and the "Chaos" perspective as two basic frameworks to answer these questions. I think Althusser's formulation of Marx's dialectical method can explain the epistemological process of problem structuring. The ontological and epistemological implications of the Chaos perspective can be complementary to Althusser's formulation. In the following paragraphs I will discuss these two perspectives. I think George Kelly's Personal Construct Theory can be integrated with these two perspectives. I will summarize and discuss Kelly's theory and technique in the following chapters of this dissertation.

Marx (1970, pp. 205-208) and Althusser (1969, part 6) argue that there are basically two levels of knowledge: abstract and concrete. The abstract concepts are not the "abstractions of empirical reality," as empiricism would suggest. Althusser rejects the idea that abstraction is the "extraction of the pure essence of concrete reality" (1969, p. 191). The abstractions are rather the beginning points, the "raw materials" of knowledge production. The mind transforms these abstract concepts and synthesizes them into "concrete concepts." This transformation and synthesis do not take place independently from external "concrete reality," but "assimilates" it. In Marx's and Althusser's conceptualizations there are two kinds of concretes: "concrete reality" and "concrete-in-thought" (or "thought concretum"). Concrete-in-thought is the product of the synthesis of abstractions. Concrete-in-thought, not abstract concepts, corresponds to concrete reality. Abstract concepts are the tools and raw materials of the mind, which are produced as transformations of images and perceptions. They are simple and simplistic by definition. They do not correspond to concrete re-

ality, which is a complex whole of multiple determinations of events. Althusser summarizes the relationship between concrete reality, abstract concepts and concrete-in-thought, by rephrasing Marx, as follows:

> The concrete is concrete because it is the synthesis of many determinations, and therefore a unity of diversity. That is why it appears in thought as a process of synthesis, as a result, not as a point of departure... [in scientific method] abstract determinations lead to the reproduction of the concrete via the path of thought... the method which consists of rising from the abstract to the concrete is merely the way thought appropriates the concrete and reproduces it as a concrete-in-thought. (Althusser, 1969, p. 186).

Marx recognizes that the thought process may take the opposite direction, from concrete-in-thought to abstract concepts, as well (1970, pp. 205-206).

Althusser defines a third type of thought process, the "theory of science" or the theory of how we know (1969, pp. 188-191). This is, in other words, the knowledge of the self and its relations with the others and concrete reality. If I use Holland's terms once more (1981, p. 25), Althusser's theory of science corresponds to "strong self- reflexivity," which involves an understanding of the social and historical conditions and processes in which a person's thought processes are shaped. Since the Marxist dialectics do not recognize a self reflexivity (self awareness) separate from an understanding of a person's social and historical conditions, there is no equivalent of Holland's "weak self-reflexivity," (person's being aware of his assumptions, motives and desires) in Althusser's theory.

What are the implications of this perspective for problem structuring? It suggests that problem structuring is a knowledge production process that is composed of three main components, i.e., abstraction, reproduction of concrete-in-thought and (strong and weak) reflexivity. Such a conceptualization is a strong alternative to the simplistic empiricist notions of the rational model. This perspective is also an alternative to the social and individual constructivist perspectives that consider knowledge and problem definitions merely as subjectivities which are detached from reality.

Dewey's "problems" and "problematic situations," I think, correspond to "concretes-in-thought" and "concrete reality" respectively. Problems, in this sense, are not "abstractions" of reality, as Simon suggests (1973, p. 195), but reconstructions of problematic situations as concretes-in-thought. These concretes-in-thought are "synthetic problems," to use Braybrook and Lindblom's term (1963, pp. 54-55). Unlike Braybrook and Lindblom, I do not think that this synthetic char-

acter of problem definitions is erroneous. On the contrary, since concrete reality is "the synthesis of many determinations" it can be represented only as a synthesis in thought. Therefore, I agree with Dunn that problem structuring should involve a "holistic approach" (1981, p. 99).

"Models" are the most complex forms of problem formulations. Models attempt to "reconstruct reality" (Dunn, 1981, p. 110) by synthesizing the abstract elements and relationships into wholes. However, not all models are equally successful in synthesizing abstract elements and relationships.

Empiricist methodologies assume that the variables and the quantitative categories (i.e., numbers) used in analyses are the "extractions of the pure essence of concrete reality." As such, they are used as the direct components of the models. Multiple regression models are examples of this form of usage. In these models, variables are linked to each other in terms of quantitative relationships, which is another form of abstraction. The resultant model is not a concrete-in-thought, but simply a multiplicity of abstractions.

I think the quantitative methods of analysis and the other research methods of social and natural inquiry are only the tool that can help generate abstract concepts. It is the human mind that can synthesize those abstractions into concretes-in-thought. How does this process of synthesis take place? What are the mechanism of it? A detailed discussion of these questions is beyond the scope of this dissertation. However, I should mention that there is an area of research and a body of literature focusing on these and similar other questions. This area is called, by some, "Cognitive Science" (Gardner, 1987).

If it is the human mind which synthesizes and constructs the concrete-in-thought, then the previous cognitive structure of the knowing subject, e.g., the assumptions and algorithms of problem solving, become very important in the process. They shape the resultant model (concrete-in-thought) to an extent. Therefore, the models which are constructed belong to the knowing subject, not to the concrete reality.

Models can be tools for self-reflexivity, as suggested by Dunn (1981, pp. 110-111). Models can help the analysts make their own assumptions (previous cognitive structures) explicit. This would be a "weakly self-reflexive" exercise. I think, that is all we can expect from an individual or group

problem structuring exercise. "Strong self- reflexivity" can take place in larger contexts and in longer time periods.

The synthesis of the concrete-in-thought may involve creative combinations. A person develops new forms of understanding, i.e., assumptions and cognitive algorithms, in his incessant interaction with reality and the understanding of others. In the face of a new problematic situation, he can synthesize the "raw materials," i.e., abstractions, into a novel model.

However, creativity cannot only be a one-way process of construing models from abstract concepts. As Marx recognizes, there are reverse processes, too; that is, the de-construction of the previous models in mind into abstract concepts. I think these reverse processes are as important for creativity as the construction of models. As Gendlin and his colleagues (1968) suggest, holding mental constructs "loosely" is the first phase of creative thought. Later should come the formulation of meaningful statements, questions or specific perceptions. As I will discuss in detail in the next chapter, George Kelly suggests that "loosening" and "tightening" of constructions are two essential phases of creativity (Kelly, 1955).

Kelly's conceptions of "loosening" and "tightening" are supported by the recent research on the chaotic behaviors of the human brain. Paul Rapp suggests that both "turbulence" (or "randomness") and determinism are the characteristics of the functions of the human brain. He remarks, "it is extremely disordered, but [at the same time]... a deterministic system" (NOVA, 1989). It can be said that the chaotic structure and functioning of the brain constitutes a basis for the two phases of creativity, loosening and tightening (specificity), as Gendlin, et. al. and Kelly suggest.

If so, can we say that creativity is simply a characteristic of the human mind and does not pertain to external (concrete) reality? I think reality itself has something to do with creativity as well. The role of creativity in the reconstruction of problematic situations as problems is twofold:

First, creativity can help understand concrete reality better. Second, the construction of future state of affairs in mind requires creativity. The role of creativity in constructing a future state of affairs is obvious. However, how does it help understand concrete reality better?

The answer to this question lies in the nature of reality. Although reality is external to and independent from the knowing subject, it is by no means simple or one- fold or unchanging. If we

take the Universe as reality, it is a continuum which is infinitely complex and incessantly changing. This universal reality cannot be known in its entirety.

In policy analysis, problem solving or scientific inquiry we deal with segments of the Universal reality relevant to the knowing subjects. We deal with events and regularities among these events in a segment which we "bracket" from the continuum of the universal reality.

Empiricism seeks regularities among observable, discrete events. The assumption is that, if a phenomenon or a relationship exists it will manifest itself in these regularities. These regularities are expressed in terms of "Newtonian determinism," that is the relationships between events are linear, or perfectly predictable.[4] Whatever is nonlinear, or does not fit to the scheme of perfect predictability, is considered to be "aberration," "erratic behavior," "noise" or "random."

I do not agree with the narrow definition of reality by empiricism. I think there are regularities beyond the immediate appearance, i.e., nonlinear regularities that are not perfectly predictable, as well as infinitely complex structures.

I will more specifically suggest the perspective of Chaos to describe the nature of reality. The Chaos perspective rejects the notion of randomness (Gleick, 1987). Chaos also suggests that there are unpredictabilities within predictabilities. There are creative processes in nature.

> Those studying chaotic dynamics discovered that the disorderly behavior of simple systems acted as creative processes. It generated complexity: richly organized patterns, sometimes stable, and sometimes unstable, sometimes finite and sometimes infinite, but always with the fascination of living things. (Gleick, 1987, p. 43).

Regularity, and therefore predictability are not absolutes. Chaos rejects the Newtonian determinism in the relationships between events.

Such a complex reality cannot be reflected as a mirror image in the human mind. In the first place, even a small segment of reality affects and is affected by an infinite number of others. As a result, attempts to know an aspect of relationships in reality will require a large number of other aspects to be taken into consideration. Complexity is not only a multiplicity of factors, events and

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[4] I am using the terms "predictability" and "linearity" in the sense that is used by the theorists of the Chaos perspective. In this perspective linearity means a relationship which is strictly proportional, and such a relationship can be captured with a straight line on a graph. A linear relationship makes events perfectly predictable, according to this definition. (Gleick, 1987, especially pp. 23-24).

variables taken into consideration, either. Most events in reality are nonlinear and are not completely predictable ones.

The human mind has to use its nonlinear mechanisms and processes to be able to grasp - at least to an extent - these multiplicities and non-linearities in the reality with which it is dealing. In other words, a knowledge of the "creative," i.e., nonlinear, complex, reality requres creativity in thought.

The position that I have developed to this point is a general formulation. George Kelly's theory will provide the conceptual tools to specify my approach in problem structuring. In the next chapter I will discuss Kelly's theory and in the following one I will propose a practical method of problem structuring based on Kelly Repertory Grid Technique.

III. George Kelly's Theoretical Perspective

George Kelly developed a theoretical position which extended from ontological and epistemological arguments to practical applications in psychotherapy. He presented and elaborated his position at all levels of theoretical discourse in his two volume book, "The Psychology of Personal Constructs." He calls his philosophical position "Constructive Alternativism." The personality theory he formulated is called "Personal Construct Theory." The most popular part of his work is the technique he developed for elicitation of personal constructs, which is called the "Repertory Grid Technique."

Kelly's theoretical position has some uniquenesses, and its relations with other philosophical positions and psychological theories have been subjects of controversy. In this chapter I discuss his theory in the context of the perspective I proposed for problem structuring.

I must mention that Kelly's Repertory Grid Technique has been used widely not only by the followers of his theoretical line, but also many others who ignore his theory. It appears that the Repertory Grid Technique is separable from its theoretical roots. This is conceivable, because it provides highly sophisticated mathematical, statistical tools that are attractive even for those who do not understand or do not care to consider Kelly's theoretical position. These tools can be particularly attractive for statistically-inclined behaviorists.

On the other hand, there are some theoretical arguments against taking his theory seriously. Bruner argued that Kelly did not recognize his theoretical ancestry in psychology, e.g., Lewin, Piaget, Allport, Werner and Sullivan, who were theoretically on his side. Therefore, he hardly deserves a consideration for his theoretical work (Bruner, 1956). Holland argues that the widespread disregard of his philosophy and theory in the literature is because of its "inherent weaknesses" (Holland, 1970, p. 115). Holland also demonstrates that Kelly's self positioning vis-a-vis Existentialism, Phenomenology and Marxism was based on "the stereotyped American view" of these philosophies (Holland, 1970, pp.119-123).

Although I tend to agree with Holland that Kelly's evaluation of other philosophical positions were stereotypical ones, and in that sense his philosophy was weak, I do not think that his whole philosophy and theory can be labeled "inherently weak." There are two crucial points to be considered when evaluating Kelly's philosophy: first, he tried to formulate his position in the context of his contemporaneous theories, particularly behaviorism in psychology. As Warren argues, Kelly's philosophical position was at odds with the philosophies of his times; and it is better alignable with the contemporary developments in philosophy (Warren, 1985, p.264). This Kelly created some difficulties for him in articulating his theory. Second, Kelly formulated his position in such a way that it was consistent with the main argument of his philosophy. He formulated his philosophy in a loose way. He thought that loosening of a person's construction system was a necessary component of creativity. He also theorized that any theoretical construct was subject to change, and made his theory amenable to such a change. As Holland suggests, "George Kelly invited us to go beyond him" (Holland, 1981, p. 29). In one of his retrospective evaluations of his position, Kelly stated: "Indeed, our theory is frankly designed to contribute effectively to its own eventual overthrow and displacement" (Maher, 1969, p. 66).

I am arguing for an elaboration of Kelly's philosophy and theory, not because I agree completely with him, nor that I think his position from the philosophical to operational is consistent throughout. However, there is an important premise of his approach that I totally agree with: any scientific inquiry (perspective, theory, research, etc.) should be conducted with the awareness that it is operating at all levels of knowledge process, and the inquirer should try to raise this to his

consciousness and try to be consistent at all levels. This is the message of Kelly's Personal Construct Theory (more particularly his "organization corollary," which I will discuss below), and he lives up to it in his formulation of the theory.

Constructive Alternativism

Kelly declares himself as being "against realism" (Kelly, 1955, p.16). However, this self-positioning is questionable. His self-declared position vis-a-vis phenomenology is not a clear one either. He both criticizes phenomenology (Maher, 1969, p. 23-24), and says that his position is a combination of the "neo-phenomenological approaches" and "more conventional methodology."

According to Kelly, the universe (physical reality) exists. Is the reality of nature independent from man's knowledge of it? Is this reality orderly and lawful? He accepts the existence of reality independent from its knowledge. However, he tends to argue against the self- orderliness and self-lawfulness of the universe. He says that the universe is "essentially active" and everchanging (Kelly, 1955, p. 19). The reality of universe is not divided into independent events, it is an essential continuity (1955, p.20). Kelly sides himself with Heraclitus's notion of "active universe," and argues against Aristotle for "putting science in pigeonholes," i.e., construing reality as discrete events or phenomena (1955, p. 156).

One following argument is that since reality is not discrete or composed of independent events, lawfulness and determinism is not essential to the analogy of the universe. Lawfulness and determinism are defined by the mainstream science as observed repetitions in phenomena. However,"no event actually doubles back on itself" (1955, p.21). Therefore, "concretely, the new events are unique; it is only by abstracting them that person finds what is replicated" (1955, p.73). In other words, repetition is nothing but a construct. Then, why does man use this construct called "repetitions?" Because, it is convenient and gives man a capacity to manage his world. Man has gained this construct through his experience.

> The notion of an organized and potentially lawful universe has not been easy for man to accept... In spite of the personal hazards and the difficulties of construing the succession of events which make up his universe, man has gradually extended his construct of orderliness through the centuries... man's widening of awareness of the universe as an orderly unfolding of events gave him increasing capacity to predict and made his world more and more manageable. Even rare cataclysms assumed the familiarity of deja vu. Man gradually discovered that he could lay a sight on the future through the experience of the past. (Kelly, 1955, pp.74-75).

One can argue that Kelly's position on the existence of the Universe is an ambivalent and even contradictory one. It can be said that the argument against the existence of discrete events or phenomena and the notion that orderliness and repetitions are nothing but constructs, eventually boil down to the rejection of an independent existence of reality. On the other hand, Kelly says that he accepts the existence of reality, and recognizes the manageability of reality. How would reality be manageable if repetition and orderliness were mere constructs? How would those mental tools (constructs) be used if they did not correspond to anything? He does not answer these questions.

There are difficulties in Kelly's ontological position. However, it should be kept in mind that he was in a dialogue with the positivist behaviorists of his time. As Warren reminds us, Kelly was at odds with these theories (Warren, 1985, pp.264). However, he could not develop a sound alternative to them. I think Kelly's arguments will become more meaningful and consistent in themselves if they are related to the ontological implications of the Chaos perspective.

Kelly argued against "putting science in pigeonholes," which was an approach based on the assumption that the events in the external reality are discrete. His position contrary to this was that reality was an "essential continuity." He was against the notion of orderliness and lawfulness of phenomena, because he was in a dialogue with the naive realism, which argued that there were "iron laws" in reality which were expressed in linear causalities. Those linear causalities were supposed to assure "perfect predictability." Kelly was not comfortable with such a deterministic notion of science. Chaos changes the meaning of orderliness and predictability and suggests that most of the natural phenomena are non-linear and only partially predictable. Kelly would have been more comfortable with this notion of orderliness and predictability. He also would have found compatibility between his notion of essentially active and everchanging universe and these ontological implications of Chaos.

Had he been familiar with the Althusserian framework that I described in the previous chapter, he might have liked the formulations that concreteness is reconstructed in thought, and each concrete-in-thought is unique, like its counterpart in reality. In fact, Kelly's Repertory Grid Technique aims to reconstruct such concretes-in-mind, but does not call them that way.

Had Kelly been familiar with the perspectives of the Chaos and the dialectical materialism, he could have formulated his theory more consistently. However he was not, and therefore one can see the ongoing tensions between different, even opposing ontological and epistemological assumptions in his theory. Those inconsistencies and contradictions draw criticisms from his followers as well as his critics.

According to Hinkle, who is one of the most prominent developers of the personal construct theory after Kelly, "the persistent dialectic tension between a man who engages in intentional actions, yet whose behavior is lawfully locked into an integral universe, permeates Construct theory" (Hinkle, 1970, p. 95). This tension can be observed, sometimes in the form of contradictions, in Kelly's notion of personal constructs and their relations to reality and his self-positioning vis-a-vis Phenomenology and Existentialism.

According to Kelly, "the universe is existing and man is coming to know it" (Kelly, 1955, p.170). However, knowing is not simply a reflection of reality in human mind. "The universe is real, but it is not inexorable unless he [man] chooses to construe it that way." (1955, p.8) In the knowing process man is a proactive being.

> Man can play active roles in the shaping of events. How they can be free to do this and still themselves be construed as lawful beings is a basic issue in any psychological theory.
>
> The answer lies, first of all, in our recognition of the essentially active nature of the universe... The truths, the theories attempt to fix are successive approximations to the larger scheme of things that slowly they help to unfold. Thus a theory is a tentative expression of what man has seen as a regular pattern in the surging events of life. (Kelly, 1955, p.19)

In this interactive process of man's relationship with reality, Kelly argues that constructions of those realities by man play an important role. Man looks at his world through transparent patterns or templates which Kelly calls "constructs." "Man creates his own ways of seeing the world by placing constructions on it" (Kelly, 1955, p.170).

> A theory [which is a "construct" in Kelly's terminology] binds or determines the events which are subordinated to it. It is not determined by the events themselves; it is determined by the

superordinating point of view of the theorist. Yet it must conform to events in order to predict them. (Kelly, 1955, p. 19).

For Kelly, the superordinating view of the theorist, not the information coming from reality, determines the nature of construing. Therefore, "reality is subject to many alternative constructions" (Maher, 1969, p. 96). However, among the "various ways in which the world is construed, some of them are undoubtedly better than others" (Kelly, 1955, p. 15). The question of which can be better can be determined by testing them in terms of their "predictive efficiencies" (Kelly, 1955, p.12).

These points may seem contradicting each other. Oliver does not see a contradiction in his interpretations of Kelly's philosophy: "Reality has that much structure, enough to exclude some perceptions or interpretations of it; but it is 'tolerant' of a variety of construals and an individual in construing freshly is exhibiting his creativity" (Oliver, 1970, p. 188).

Kelly places special emphasis on man's responsibility in the creation of constructs. In fact, his usage of the word "construct" has a specific meaning. He does not use the word "concept" deliberately, because, "concept" "is too likely to be presumed a latent category of nature - something of man's diligence to discover rather than for his ingenuity to contrive" (Maher, 1969, p. 10).[5] As Holland suggests, Kelly's clear distinction between concept and construct introduces the criterion of "responsibility." "We are responsible for our construing, since this is the formative structure of our choosing." This is a notion, Holland argues, that Kelly shares with Existentialists (Holland, 1970, p. 125).

Kelly's self-positioning vis-a-vis phenomenology and existentialism is far from being clear. He argues that his position is a combination of certain features of the "neo- phenomenological approaches" and "more conventional methodology" (Kelly, 1955, p. 42). On the other hand, he tries to distance himself from phenomenology and existentialism. He criticizes phenomenology for denying any existence to reality, except as a figment of man's imagination (Maher, 1969, pp.23-24). According to Kelly, those who choose existentialism or phenomenology do so because of their

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[5] I did not use the term "concept" as a latent category of nature in my discussion in the previous chapter. In Marx's and Althusser's usages "concept" means very much like what Kelly means by "construct." However, to be consistent with Kelly's terminology, I am switching to his usage of the terms at this point.

disillusionments with "naive realism" (Maher, 1969, p.25). Kelly sees himself out of this meaningless dichotomy of naive realism and phenomenology: "Phenomenology's abandonment of all hope of finding substantial explanations of the behavior of man need not be man's own final answer (Maher, 1969, p. 25).

Holland sees Kelly's criticism of phenomenology as a result of his not knowing much about European phenomenology and existentialism, and argues that Kelly was a "naive existentialist." Holland suggests that there are two similarities between Kelly's theory and Existentialism: "Kelly's attitude toward labels in general, ... and the importance he gives to a person's unique structuring of the world by impressing his perceptions upon it" (Holland, 1970, p. 124).

According to Holland, Kelly attributes the sole responsibility of his actions to the individual, and thus neglects the role played by the social processes.

> ...Kelly produces descriptive models which are useful for describing a utopian creature - the man as a scientist, testing, modifying and elaborating his constructs; communicating with and understanding others by construing their construction processes - but he misses those very powerful psychological and social forces which make men terrorize, dominate, misunderstand, mystify and kill each other." (Holland, 1970, p. 129-130).

A basic problem with Kelly's philosophy is, as Holland points out, his conception of man as a "utopian creature," an abstract a-historic being. In his writings it never becomes clear whether he means an individual man or a species. As Holland points out, there is no place for social forces in Kelly's philosophy and theory. Although the change, action and flow of universe are basic postulates in his philosophy, he does not mention any concrete history. In fact, he admits that his theory is a- historical.

This is understandable when his primary emphasis on individual person and his construction is considered. Any mentioning of history and society would be a recognition of constraints imposed upon individuals and possibility of being determined by some external forces. That would not have been Kelly's position. However, Kelly, does not close the door to the effects of social processes in the construing process. He states that construction systems of individual persons can be "communicated and widely shared" (Kelly, 1955, p.9).

I do not agree with the individual-centeredness of his theory in general. However, since in this dissertation I am focusing on the individual and group processes in problem structuring, I think Kelly's perspective is valuable to understand these aspects of the process.

Furthermore, as I argued in the previous chapter, self-reflexivity should be an important aspect of problem structuring. Kelly's emphasis on personal construction and putting responsibility on the construing, help a person establish a theoretical link between problem formulations and the persons making these formulations. His Repertory Grid Technique is an instrument that supports self-reflexivity as well.

The Fundamental Postulate and Its Corollaries

Kelly formulated his Personal Construct Theory as a fundamental postulate and its eleven corollaries.

Kelly's Fundamental Postulate says "A person's processes are psychologically channelized by the ways he anticipates events" (1955, p.46). We can see the two key notions of Kelly's philosophy in the fundamental postulate: individual responsibility and change.

By "person" Kelly means individual person. This abstract individual person is at the core of his theory. He does not see the person as an object who is temporarily in a moving state, but rather as a form of motion. By "channelize" he means a network of pathways which both facilitate and restricts a person's range of psychological action. Fist of all, these pathways guide a person's interpretation of external realities. His construction corollary says: "A person anticipates events by construing their replications" (1955, p.50). Kelly's usage of the term "replications" ties back to the discussions on his ontology and epistemology, above: "Time does not double back on itself. But after a succession of time man is able to detect a recurrent theme in terms of the rising and the setting of the sun. Moreover, the same theme does not recur when time is segmented in other ways. Thus, the concept of day is erected along the incessant stream of time" (1955, p.53).

These replications are the bases for "predictions" : "Once events have been given their beginning and endings, and their similarities and contrasts construed, it becomes feasible to try to predict them" (1955, p.53).

There are two instruments used in the construing process, "constructs" and "elements." A construct is a bipolar dimension (e.g., good - bad; inclined - not inclined, things that I like - things that I do not like), reference frames, templates through which a person sees the continuous reality and brackets it, frames it. Constructs are abstractions of reality.

> Man looks at his world through transparent patterns or templates which he creates and then attempts to fit over the realities of which the world is composed. The fit is not always very good. Yet without such patterns the world appears to be such an undifferentiated homogeneity that man is unable to make any sense out of it. Even a poor fit is more helpful to him than nothing at all.
>
> We call these patterns 'constructs.' These are the ways of construing the world." (Kelly, 1955, pp. 8-9).

Elements are more concrete. They can be placed on construct dimensions. "Elements are things or events which are abstracted by a construct" (Kelly, 1955, p.137). As Hinkle suggests, elements are constructs themselves, being an element of another construct (Ten Kate, 1981, p. 167). They are also abstractions, but abstractions of lesser degree.[6]

Characteristics of Constructs

Three of Kelly's eleven corollaries characterize the nature of constructs. Those are the "dichotomy," "range" and "choice corollaries."

Dichotomy corollary: "A person's construction system is composed of a finite number of dichotomous constructions" (1955, p.59).

This corollary formulates one of the most distinctive aspects of Kelly's theory. The dichotomous bi-polar character of constructs distinguish them from concepts, according to Kelly.

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[6] Kelly's conceptualization is close to the empiricist notion that since reality is concerete, whatever is closer to it is also concrete. Kelly assumes that "elements" correspond directly to objects, therefore they are concrete. "Constructs," on the other hand, are farther from objective reality, therefore they are abstractions. I think, both elements and constructs are abstractions at various degrees and forms. A person uses these abstractions to reconstruct his concrete-in-thought, which is a whole composed of both elements and constructs.

The term concept does not assume bi- polarity. The dichotomous nature of a construct suggests more than bi-polarity of a dimension. Kelly makes it clear that constructs are not continuous, in other words, they are not composed of gradations (Kelly, 1955, p.299). However, an abstract, dichotomous construct can be used to create an array of elements. This array of elements constitutes a concrete explication of constructs (Maher, 1969, p.103).[7]

The choice corollary suggests: "A person chooses for himself that alternative in a dichotomized construct through which he anticipates the greater possibilities for extension and definition of his system" (Kelly, 1955, p.64). In other words: " .. whenever a person is confronted with the opportunity for making a choice, he will tend to make that choice in favor of the alternative which seems to provide the best basis for anticipating events" (1955, p.64). This corollary will be a basic assumption in the model building method that I will discuss below.

Kelly's range corollary suggests a contextuality and finiteness to the functions of constructs: "A construct is convenient for the anticipation of a finite range of events only" (1955, p.68). "Kelly argued that a construct (or a subsystem of constructs) operates always within a context and that there are a finite number of elements to which it can be applied by a given person, at a given time" (Fransella and Bannister, 1977, p.6). This is what Kelly calls the "range of convenience."

As I will discuss below, the range of convenience will become an important issue, especially in a group situation in which each member of a group uses constructs generated collectively.

Individual vs. Social

One of the recurrent tensions in Kelly's theory is between his views on individual vs. social. As I mentioned above, he considers construing as an individual process. On the other hand, he recognizes "commonality" and "sociality" in the construing process. There are three corollaries in

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[7] Kelly's notion of the "array of objects (elements) being a concrete explication of constructs" comes close to the Althusserian notion of concrete-in-thought. A construct which is explicated as such becomes a whole with its elements, which is a kind of reconstruction of external reality, but only on one dimension.

which he defines the roles of the individual and the social: "individuality," "commonality" and "sociality corollaries."

The individuality corollary says: "Persons differ from each other in their construction of events" (1955, p.55). As Fransella and Bannister emphasize, in Kelly's theory "even the most 'public' constructs are personal in that each of us must individually give them a meaning and make them part of our total system" (Fransella and Bannister, 1977, p.7).

However, there is a room for commonality in construction, too. Kelly's commonality corollary suggests: "To the extent that one person employs a construction of experience which is similar to that employed by another, his psychological processes are similar to those of the other person" (1955, p. 90). It should be emphasized that the assumption here is different from that of the stimulus- response theory. Some conditions (external reality) may be construed differently, they may lead to different anticipation of events, and therefore persons may act differently. On the other hand, different situations may be construed as the same (or similar) by two people and their actions may be same. What is important is not how the external reality actually is, but how it is experienced (construed).

> When one lives in a community in which the commonality of personal constructs is extensive, one finds people behaving similarly, because they tend to expect the same things. In this sense, the expectancies which are common to the group actually operate as the validators against which the individual tends to verify the predictive efficiency of his own constructs. Broadly, this is what we mean by saying that group expectancies are validators of personal constructs. (Kelly, 1955, p. 176).

Elsewhere, Kelly emphasizes that commonality or individuality is a matter of degree (Kelly, 1955, pp. 91- 92).

Although Kelly accepts the possibility of common constructions, he also mentions that commonality in semantics may not mean commonality in construing:

> By construction of experience we do not necessarily refer to highly verbalized interpretations... Even those constructions which are symbolized by words are not necessarily similar just because the words are similar. Conversely, two persons may be using essentially the same constructions of their experience, although, they express themselves in quite different terms. (Kelly, 1955, p.92).

In his sociality corollary Kelly suggests: "To the extent that one person construes the construction process of another he may play a role in a social process involving the other person" (1955, p. 95). One important implication of this corollary is that one person may not share the construct of another one, while he may understand other's construct, subsuming it. In other words, he may

be able to construe other's construct. Understanding someone else's constructs is not a one-way relationship:

> This mutual adjustment to each other's viewpoint takes place, ..., because to some extent, our construction system subsumes the construction system of others and theirs, in part, subsume ours. Understanding does not have to be a one-way proposition; it can be mutual. (Kelly, 1955, p. 96).

Despite his heavy emphasis on person and his idiosyncratic construction, Kelly's commonality and sociality corollaries suggest a possibility of shared understanding, which will be an important issue in problem structuring in groups.

Characterization of Construction System

In Kelly's theory constructs are not independent dimensions. They are related to each other, and constitute a whole, which is the person's construction system.

His organization corollary says: "Each person characteristically evolves for his convenience in anticipating events, a construction system embracing ordinal relationships between constructs" (1955, p.56).

The first important point here is that constructs of a person are organized, that is they are related to each other in a relatively stable set of relationships. I will elaborate the notion of organization in a system below, when discussing "personal space." This corollary suggests more than systemic relationships. It also says that there is a hierarchical relationship among constructs. Some constructs are "superordinate" in this systemic hierarchy whereas others are "subordinate." Kelly also uses the analogy of "centrality of constructs," and considers superordinate constructs as more central to the construction system of a person.

According to Kelly, a person is in need of setting up a consistent hierarchy of constructs. However, this is not a consistency for consistency's sake, unlike Festinger's notion of inherent tendency toward "cognitive consonance" (Festinger, 1957). It is rather "to anticipate the whole world of events and thus relate himself to them that best explains his psychological processes. If he acts to preserve the system, it is because the system is an essential chart for his personal adven-

tures, not because it is a self-contained island of meaning in an ocean of inconsequentialities" (1955, p.59).

A person's construction system is a dynamic one, it changes as the person construes his experiences. The experience corollary suggests: "A person's construction system varies as he successively construes the replication of events" (1955, p.72). Personal constructs change as one continues having experiences. This implies an interaction with environment. However, that does not mean simple reflection of external reality into a person's construct system. A person has an active role in the changes of his constructs.

Person's previous construction system plays an active role in the construing of new events. " One does not learn certain things merely from the nature of the stimuli which play upon him; he learns only what his framework is designed to permit him to see in the stimuli" (1955, p.79).

More particularly, the "permeability" of previous constructs is one of the major determinants of a continuous process, as he suggests in his modulation corollary: "The variation in a person's construction system is limited by the permeability of the constructs within whose range of convenience the variants lie" (1955, p.77).

Kelly defines "permeability" as follows:

> A construct is permeable if it will admit to its range of convenience new elements which are not yet construed within its framework...permeability refers to a particular kind of plasticity, the capacity to embrace new elements. (1955, pp. 79-80).

Permeability is a crucial characteristic that determines both the integrity and changeability of a construction system. Adams-Webber emphasizes the importance of readjusting the superordinate constructs:

> ..it is only within the context of the most permeable aspects of the superordinate structures that overall consistency can be maintained. Further developmental change is possible only when no damage to the functional integrity of the system as a whole will result from extending its range of convenience to subsume new substructures. In order to systematically incorporate new components of structure it is essential that an individual be able to continually readjust his superordinate constructs so as to minimize incompatibilities and inconsistencies at the highest level of abstraction. (Adams-Webber, 1970, p.42).

Kelly points out the consequences of impermeability of constructs:

> Since the variation in a person's construction system is subordinate to certain more permeable aspects of his system, each time his behaviors or his ideas undergo a change he must invoke, in some way or another, the permeable construct which provides the thread of consistency in his behaviors. If that permeable construct is not too clearly patterned, or if it is not permeable, he may have to abandon its use and seek frantically for new ways of making sense out of life. These frantic attempts at new

> large concept formation may yield some weirdly new constructs, as he attempts to find the respects in which the events of life have definite likenesses and differences. (1955, p.89).

These new formations may create inconsistencies in the construction system. The fragmentation corollary says: "A person may successively employ a variety of construction systems which are inferentially incompatible with each other" (1955, p. 83).

This corollary countervails the organization corollary. It leaves the possibility of inconsistencies open in a person's construct system. However, according to Kelly, what one man sees as inconsistent another may see as consistent. Consistency is a construct and a personal one (1955, pp.86-87).

The Person's Psychological Space

A person's psychological space is defined by Kelly as a geometrical space composed of personal construct dimensions. A person is a process in which this space of constructs evolves. Kelly states that his conceptualization has some similarities to Lewin's "life space" and Osgood's "semantic space" (Kelly, 1955, p. 279).

There are four issues that need to be discussed under this conceptualization of personal space:

1. The psychological space is a whole (a unity).

2. It is a mathematical space, quantifiable and represented with geometrical terms.

3. The differentiation and complexity of this system can be measured mathematically.

4. The space is a dynamic one; it changes in time. One of the dimensions of change in this space is "loosening" and "tightening."

A Person's Psychological Space is a Whole

Kelly rejects the notion that human psychology can be divided into separate realms. He suggests that Personal Construct Psychology covers both the conscious and the unconscious (Kelly, 1955, pp. 174-175). He rejects the classical tricothomy of psychology, that is cognition (intellect), affection (emotion) and conation (action). Although his theory is considered by some others as being in the realm of cognitive psychology (Neimeyer, 1985, p. 159), he does not accept that, and considers his theory as a theory of personality which is a whole.

> The psychology of personal constructs is upon an intellectual model, to be sure, but its application is not intended to be limited to what which is ordinarily called intellectual or cognitive... The classical threefold division of psychology into cognition, affection and conation has been completely abandoned in the psychology of personal constructs. (Kelly, 1955, p. 130).

Fransella and Bannister support the idea of the unity of psychology and the wholeness of personality, and think that Personal Construct Theory is a unifying theory:

> Personal construct theory provides an integrated view of the person by seeing 'emotion' as neither more nor less than construing in transition. Thus the person is seen as a unity within a unified psychology. Equally, cognitive psychology is trapped by the rigid nature of its instruments (formal psychological tests) and by its lack of developed theory, into working in terms of the conventional segments of 'cognition', functions such as 'memory' and 'perception' or areas such as 'number' or 'language'. Kelly, by providing more imaginative ways of exploring our construing (repertory grid method and self characterization) and by developing a view of our constructs as hierarchical and patterned into subsystems, liberated psychology from what he called 'the dread disease of hardening of categories.' (Bannister and Fransella, 1986, p. viii).

Although Kelly rejects separate realms in human psychology, he suggests that there are "subsystems" in a person's psychological space. These subsystems can be relatively autonomous from each other, as the fragmentation corollary suggests. They also evolve through experience, as the experience corollary suggests.

Quantification and Geometry of Psychological Space

From the perspective of personal construct theory, a person is perceived as the intersect of many personal construct dimensions (Kelly, 1955, p. 298). These dimensions can be analyzed

mathematically and represented geometrically. However, the kind of geometry Kelly suggests is different from the Euclidian geometry. He suggests a different notion of dimension:

> Let us keep in mind that we are talking about dimensions rather than lines in space. By a dimension we refer to an infinite grouping of lines of all which are parallel to each other. Lines which are not parallel to those in such a given group must necessarily belong to another dimension. Viewed in this manner, it is possible to conceive of an infinite number of dimensional intersects. (Kelly, 1955, p. 299).

Elsewhere Kelly states that his geometry is a geometry of dichotomies and non-linear relationships in which computations are non-parametric and digital.

> ..our psychological geometry is a geometry of dichotomies rather than the geometry of areas envisioned by the classical logic of concepts, or the geometry of lines envisioned by classical mathematical geometries.
>
> In this kind of geometrically structured world there are no distances. Each axis of reference represents not a line or continuum, as in analytical geometry, but one, and only one distinction... Thus our psychological space is a space without distance, and, as in the case of non-Euclidian geometry, the relationship between directions change with the context.
>
> ..the computation is essentially digital rather than analogical, non-parametric rather than parametric. (Maher, 1969, pp. 104-105).

It seems that Kelly shares the perspective of Kurt Lewin, that psychology needs a different kind of geometry. Lewin argued that psychology had to develop a non-Euclidian geometry. The relations in the "life space" could be defined by the "hodological space" of "topological geometry," which would be a geometry of regions, not of points, unlike the Euclidian geometry (Lewin, 1938, ch. II).

Kelly's approach has important implications in terms of the use of quantitative analyses in psychology. It helps demystify "quantificationism." Kelly's suggestion for personal space being the basis of his geometry links the use of geometric and quantitative techniques to the person. This idiographic approach rejects the nomothetic generalizations which are based on and justified by the use of quantitative, statistical methods in behaviorist studies. In nomothetic approaches quantification is considered as an external and neutral instrument. In Kelly's approach quantitative data have a meaning in the context of person's psychological space. These quantities, which are generated during the elicitation of constructs and in the process of rating elements on constructs, and tied to the whole of that person.

Kelly personalizes quantitative methods and geometry not only by conceptualizing it as such, but also with his notion of dichotomous constructs and binary computations. Person makes a

choice between the dichotomous alternatives, and that choice constitutes a quantity. In its original form Kelly's Repertory Grid was a binary technique which used the Non-parametric factor Analysis which was also developed by Kelly. The binary and non-parametric nature of this technique was consistent with his theory.

However, this basic notion of Kelly's approach has been largely ignored by his followers. Parametric, correlational statistical analyses, and interval level ratings are being used widely by the Rep Grid users. His non-parametric factor analysis has been abandoned completely. There is not much discussion in the literature on why the original Repertory Grid was abandoned and the parametric techniques began to be used in the analyses. In two of the few accounts of the issue Rathod argues the abandonment of the "dichotomy corollary" has been due to its inconveniences and restrictiveness (1981, p.118), and Fransella and Bannister mentions some technical difficulties in the use of Kelly's non-parametric technique (1977, p. 74).

It seems to me that there are two main reasons for the shift from the non-parametric to parametric techniques. First, the parametric factor analyses have reached high levels of sophistication, and become widely available for computer users. Second, Kelly's theory has not been taken too seriously by the users of his technique. This was partly due to its incongruence with the mainstream behaviorist theories and methodologies. More importantly, the "loose construction" of the theory did not appear to be a strong alternative to behaviorism, even among the followers of Kelly. Consequently, not the theory but the technique has become popular and its use has been easily integrated with the commercially available and powerful computerized techniques.

Whatever the reasons for the use of parametric factor analytic methods these practices introduce the notions of linearity in relationships and interval level measurement, which are rejected by Kelly, and end up utilizing Euclidian geometric tools in their displays of the results of analyses. Being aware of these theoretical incongruencies, some users of Kelly's technique prefer non-metric methods like Multidimensional Scaling (Fransella and Bannister, 1977, pp. 76-77; Van der Kloot, 1981, pp. 177-188). Some others have developed Cluster Analytic methods for Repertory Grids (Shaw, 1980).

As I will discuss extensively in the next chapter, I used Cluster Analysis in the applications of the method of problem structuring that I am proposing. However, I think the factor analytic methods also can be used in a process of problem structuring. The parametric, linear assumptions of both cluster and factor analyses get into interaction with the non-linearities of the human mind in the interpretations of the results of these kinds of analyses.[8] The involvement of the mind through interpretations, I think, "dissolve" the initial parametric, linear assumptions of these analyses, and the techniques become usable in Kelly's theoretical perspective.

Differentiation and Complexity of Psychological Space

Kelly's organization and fragmentation corollaries describe two countervailing tendencies in a person's construction system: integration and differentiation. In Adams-Webber's words:

> From the standpoint of personal construct theory, all psychological development involves not only progressive differentiation among subsystems, but also increasing integration of constructs both within and between subsystems. Differentiation serves the specialization of subsystems, whereas integration serves the unity of each subsystem and that of the entire system as an operational whole. (Adams-Webber, 1970, p. 51).

After Kelly, these notions of differentiation and integration became the bases of the discussions on the complexity of a person's construction system. The initial conceptualizations of complexity in the literature took only differentiation into their considerations. It was thought that a more differentiated set of constructs would constitute a more complex construct system. However, this initial conceptualization was mixing up complexity with schizophrenic thought, as it was realized later. According to Fransella and Bannister, the construct system of a schizophrenic was largely random in its organization, and randomness was considered to be the most complex mathematical state of affairs (1977, p. 62).

Bannister and Crockett introduced the notion of "integration" into the definition of complexity. Bannister argued that "consistency" had to supplement differentiation in the definition of com-

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[8] The cluster and factor analyses do not give conclusive results. The "end products" of these analyses still need to be interpreted by the human mind to attach them "meanings."

plexity. This would separate "complex normals" from schizophrenics. Complex normals would repeat the pattern of their structure when tested on a second occasion, while disordered schizophrenics would not (Fransella and Bannister, 1977, p. 61). Crockett proposed the "level of hierarchic integration of constructs," instead of Bannister's "consistency" for the definition of complexity of a construct system. He defined hierarchic integration in terms of the pattern of logical relationships between constructs and the extent to which subsystems are interrelated by superordinate constructs (Crockett, 1965).

The discussion on the complexity of construct system has not been resolved. However, even the loosely defined framework of this discussion has important implications for problem structuring. A cognitively complex person may be capable of construing broader aspects of reality and reconstruing concrete reality in more creative ways. In policy analysis particularly, at least part of the reality to be construed is social. According to Bieri, complexity involves construing social behavior in a multidimensional way. Therefore, a more cognitively complex person has more cognitively complex constructs available for perceiving the behaviors of others (Bieri, et.al., 1966). Adams-Webber sees the function of complexity not in terms of perception of behavior, but in terms of Kelly's "sociality corollary." She argues that relatively cognitively complex person will exhibit more skill than relatively cognitively simple person in inferring the personal constructs of others in social situations (Adams-Webber, 1969).

Kelly's Repertory Grid provides some practical instruments to understand the complexity of a person's construct system and compare it with others. I will discuss some practical issues involved in the measurement of complexity in the following chapters.

Loosening - Tightening and Creativity Cycle

Complexity and differentiation of a personal construct system are not stable states. A construct system changes as a person interacts with his environment. One of the dimensions of change is "loosening and tightening" of construction.

> Loosening is defined as characteristic of those constructs leading to varying predictions, while a tight construct holds its elements firmly in their prescribed contexts. Under loose construction an element classified at one pole of a construct on one occasion is envisioned at the contrast pole on the other. Thus a loose construct tends to be elastic, relating itself to its elements only tenuously; yet it retains its identity as a personal construct in the client's system. (Kelly, 1955, pp. 1029-1030).

This definition by Kelly makes it look like loosening and tightening are the relationships between a construct and its elements. However, some other parts of Kelly's works can be interpreted to mean that loosening and tightening define the relationships between constructs as well. It can be said that Kelly did not make himself clear on this issue.[9] His followers picked up the issue and usually suggested that both the construct-element and construct-construct relationships are subject to loosening and tightening, e.g., DeBoeck (1981, p. 212) and Hinkle, who is cited in Ten Kate (1981, p.167).

In the Althusserian framework which I have adopted, both elements and constructs would be abstractions at varying degrees. Such a conceptualization renders the distinction between element-construct and construct- construct relationships obsolete. Conceptualizing both elements and constructs as forms of abstraction also will be more meaningful in the context of Kelly's conceptualization that a construct system is a whole. In this system of constructs and elements we can talk about the loosening and tightening of the relationships among these components, i.e., elements and constructs.

When does loosening occur? Adams-Webber summarizes Kelly's perspective as follows:

> In the normal course of development of a personal construct system, according to Kelly, it is the ambiguity of new experience within the context of current psychological structure which routinely leads to progressive changes in its organization and content... when we are confronted with events which lie outside the ranges of convenience of our construct systems as they are currently constituted, which is Kelly's definition of anxiety, we normally make specific changes in the form and content of our construing in order to accommodate it to those events more adequately. (Adams- Webber, 1981, p. 55).

According to Adams-Webber, cognitive complexity or simplicity has something to do with a person's ability to loosen his construction system. "..persons with relatively monolithic (or 'cognitively simple') conceptual structures will tend to resist change in the face of ambiguity in order to avoid further confusion and anxiety...even minor changes in a tightly organized construct system can present a prospect of impending chaos" (1981, p. 55).

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[9] As I will discuss below, this lack of clarity is also reflected in his conceptualization of the two cycles of the construing process.

Bannister's explanation is that a person loosens his construction of events in the face of repeated predictive failure. He calls this phenomenon "serial invalidation." Person loosens the relationships between his constructs in order to minimize the "reverbatory" impact of further invalidation. Although this loosening of construct relationships is presumably undertaken to conserve the system, "progressive loosening," without corresponding integration, eventually would lead to the collapse of the entire conceptual structure (Bannister, et. al., 1975). The "corresponding integration" process is what Kelly calls "tightening."

> ..productive thinking follows a Creativity Cycle. There is a shift to a new topic. The thinking about that topic becomes loose and fluid. The shifting conceptualization begins to fall into place under some new forms of superordinate construction. Now the conceptualization begins to become more precise, more tight. The person begins to construe more explicitly. The constructs become more stable. Elements in the construct contexts become identifying symbols, standing not only for themselves but for the classes of which they are constituent members, or the properties which bind the class into the group. (Kelly, 1955, p.1050).

According to Kelly, in the loosening phase a person may recall some events neglected before. New elements come into his field of attention. This makes constructs more "permeable," i.e., more ready to change through accepting new elements on their dimensions. A person may "shuffle some ideas into new combinations" (Kelly, 1955, p. 1030). Tightening, on the other hand, stabilizes construction and facilitates the organization of the ordinal relationships in a construct system (Kelly, 1955, p. 1063). In other words, both the reconstruction of reality in person's mind and his preferences pertinent to that reality become "clear," in the tightening process.

Kelly defines another cycle in the construing process. That is the "Circumspection-Preemption-Control Cycle." There are three phases of this cycle:

> Circumspection: constructs are handled propositionally. The matter is viewed from a variety of angles (multiple dimensions).
>
> Pre-emption: one construct is given priority. This is the selection of the relevant issue. It establishes the alternatives.
>
> Control: the person commits himself to a choice. Control is a superordination in Kelly's theory (Kelly, pp.515-517).

According to Kelly, the phases of the Creativity Cycle are different from these phases. The Creativity Cycle starts with loose construction rather than propositional construction. In that case, there is a single construct shaping up. In the propositional phase of the Circumspection-Preemption-Control cycle, however, there may be an array of constructs (1955, p. 1061).

I do not think that Kelly's conceptualization of two separate cycles is justified. His distinction is based on his element-construct differentiation which he did not explain very well. As I mentioned above, Hinkle dissolved this unnecessary distinction between elements and constructs. Bannister does not agree with Kelly's differentiation between the two cycles, and sees the three phases of the Circumspection-Preemption-Control cycle as more elaborate forms of loosening and tightening:

> Kelly argued that construct systems are elaborated and new interpretations of a person's world are developed first circumspecting, i.e., construing loosely and imaginatively, feeling and dreaming, so that at this stage the nature of the problem is not defined but all kinds of possibilities are explored. Eventually, the person is enabled to move into the preemption phase in which he chooses the terms in which he will try and solve 'the problem', i.e., he will decide what kind of problem he is faced with, what are the issues, what are the alternative choices. Finally, move into the control phase in which he selects the actual path he will go down, selects the pole of the construct in terms of which he will operate, specifies the alternative he will select. As the experiment (behavior) which the control phase of the cycle generates, brings in its mixture of affirming, negating and downright irrelevant data, the person will eventually be forced back into new circumspection and the cycle begins again.
>
> Such a cycle can be viewed as characterized initially by loose and ultimately tight construing. Kelly defines a tight construct which leads to unvarying predictions whereas a loose construct is one which can lead to varying predictions, but which, nevertheless, can be identified as a continuing interpretation. (Bannister, 1970, p. 58-59).

I agree with Bannister's formulation. In the method of problem structuring which I am proposing I take the two phases of the Creativity Cycle ("loosening" and "tightening") as the basis of my procedure, and consider the Circumspection-Preemption-Control Cycle as a more elaborate form of the Creativity Cycle.

Shaw and Gaines emphasize the social aspects of the Creativity Cycle. Although the constructs are essentially personal, there are some constructs, or some areas of construction which are shared with others. Loosening occurs due to the need for validation of construction, and validation can take place in a social context. "If this validation is in relation to the constructions of others then we may see this cycle as one of creating shared meaning" (Shaw and Gaines, 1982).

I agree with Shaw and Gaines. I used a group process in problem structuring having the assumption that "creating shared meaning" in a social (group) context would enhance the potential for creativity. I will discuss this in the next chapter.

Relevance of Personal Construct Theory to Problem Structuring

Kelly's theory is full of thought provoking and inspiring ideas and formulations for understanding and improving the problem structuring process. I think his overall perspective, most of his corollaries and his notions of "personal construct space" and "creativity cycle" can be integrated into the Althusserian framework that I defined in the last chapter. Kelly's theory and his Repertory Grid technique can be used to operationalize the problem structuring perspective that I am proposing.

I find three aspects of Kelly's theory and technique particularly important: first, Kelly's theory is a self- reflexive one, and his technique contributes to the process of "weak self-reflexivity." As I mentioned in the last chapter, this kind of reflexivity is the only one which we can expect to achieve in a problem structuring process. Second, Kelly's technique uses quantification in a such a way that it can prevent mystification and reification of quantities, and can make quantitative analyses part of a self-reflexive process. Third, Kelly's conceptualization of the Creativity Cycle, which, I think, was complemented by Bannister, helps us understand creativity and provides us with the conceptual tools to improve it.

I must mention that this study is not the first one using Kelly's technique in problem structuring or in related areas. Kelly's theory and techniques have been utilized by others before. Eden, Jones and Sims (1983) used it for "problem structuring." Dunn, Cahill, Dukes and Ginsberg (1986) experimented with groups using Repertory Grids to "draw boundaries of a policy system." Shaw's application aimed to develop "mutual understanding of problem domain in groups." In a related effort Shaw and Gaines (1988) developed the repertory grids for "recognition of consensus, correspondence, conflict and contrast in a knowledge acquisition system" in groups. Burgoyne (1981) developed some mathematical methods to analyze decision making processes, as the basis of the personal construct theory and repertory grids. I borrowed ideas from some of these previous studies

for my method. However, I take Kelly's theory and its implications more seriously and use them to a fuller extend in my method.

The repertory grid can be, and has been, used for analytical purposes. That is to say that it can be utilized to understand the construct system of a person or those of a group of people. Its second usage is being a medium of the self-reflexive and creative process of personal construction. The method proposed in the next chapter aims to do both, but mainly the second one. I have developed a specific procedure of problem structuring based on the repertory grid technique. As I will illustrate in Chapter V, this procedure helps create a systematic and creative problem structuring process. I also will demonstrate with the cases in the same chapter, how the repertory grid can be used to understand the problem structuring process.

My analyses and discussions in that chapter will exemplify some of the theoretical points I raised in Chapter II. However, it is not my aim to "prove" those points with the case illustrations. Therefore, my discussions and elaborations will be limited in their scope. My primary emphasis will be on demonstrating how such a problem structuring procedure would work in practice.

IV. The Proposed Method of Problem Structuring

Rationale of the Method Proposed

The theoretical basis of the method I am proposing is Kelly's Personal Construct Theory, and the main instruments have been developed from his Repertory Grid Technique. There are also some commonalities with Mason and Mitroff's Assumptional Analysis, or Strategic Assumption Surfacing and Testing (Mason and Mitroff, 1981, 1985; Mitroff and Emshoff, 1979; Mitroff and Mason, 1979) as well.

A method that would help a person in his/her construing process should have three qualities:

1. It should help a person elicit his constructs, which are the abstractions or "templates" he uses to know about concrete reality, or more specifically, the problematic situation he is facing. The construct elicitation technique should have the mechanisms to help relate constructs to each other as well. Such a construct elicitation process will help the person reflect upon his own construction system and make him aware that he is attempting to describe reality through his own eyes.

2. It should provide the person with the mechanisms that will help him go through the phases of the creativity cycle, i.e., loosening and tightening of construction. By doing so, the method will help the person reconstruct the concretes of present and future realities in thought, in novel, different and creative ways.

3. Both the abstractions (constructs) and concretes-in- thought should be in forms communicable to other persons. Interpersonal communication of abstract constructs and concretes-in-thought will stimulate more creativity. It also may generate consensual constructions of problematic situations that people can act upon.

Kelly's Repertory Test initially was a technique designed to elicit the idiosyncratic personal constructs. It was self- reflexive, because it could show the person what his constructs were, how elements were related to those constructs, and to some extend how constructs were related to each other. However, these used to be done with the help of an expert and the succeeding analyses took the expert a long period. With the advent of computers it became possible to design interactive construct elicitation procedures. These advances made the user capable of eliciting his own constructs, seeing the relationship among the constructs and modifying them, all with a little help by an expert. Slater's (1977) and Shaw's (1980) systems are good examples of these advances. The new technical capabilities increased the self-reflexive potential of the process and the possibilities for creative "shuffling" of ideas. Especially with highly interactive computer software like Shaw's, the user had the capability of modifying his element-construct relationships and seeing the consequent combinations immediately.

Software like Shaw's have a shortcoming, especially for problem structuring. It helps a person loosen his construction. However, it falls short of tightening the construction adequately, that is, generating a verbal structure or a visual picture. Those verbal structures or visual pictures would constitute wholes, i.e., concretes- in-thoughts, which would complete the creativity cycle and the "product" would be more communicable to other people.

Eden, Jones and Sims (1983) suggest a "model building procedure at the end of which a quite well-developed and communicable concrete-in-thought emerges. However, their model building

procedure is independent from the Repertory Grid, and therefore, does not use the important "loosening" and "shuffling" capacities of this technique.

The method I am proposing attempts to integrate the positive aspects of the developments in the Personal Construct Theory and the Repertory Grid Technique into a process that will be self-reflexive, creative and generate communicable results. Having these considerations in mind, I set up a procedure that uses an interactive software program developed by Dickey. However, not all the procedure is computerized. The software only helps structure some steps of the procedure, speeds up the necessary computations, and feeds the results back to the user. The model building procedure is not computerized at all. The interpretation of results and the discussion of them in a group are obviously non-computerized processes and involve some person to person interactions, either between the problem structuring person and the expert or among the group members.

Summary of the Procedure

The method involves a procedure of 7 steps. In the first step a list is made of all the "elements" (people, physical objects, factors, variables, etc.) that characterize the problematic situation. From these elements are elicited "problem dimensions" (Step 2). In Step 3 each element is rated on each dimension. These ratings allow for statistical clustering of the elements and problem dimensions into a smaller number of homogeneous groups (Step 4). The user interprets the results of cluster analyses in Step 5. In Step 6 a model of the problematic situation can be built using a specific procedure as described below. In the last step the results are discussed in the group. Figure 1 summarizes the procedure.

It can be seen in that figure that the model building step does not necessarily come after the interpretation of results of analysis. Model building is, in fact, a procedure in itself. However, it is initiated by the elicitation of "problem dimensions" (constructs), and can be integrated into the process before the group discussion. I must mention that the model building procedure is still in

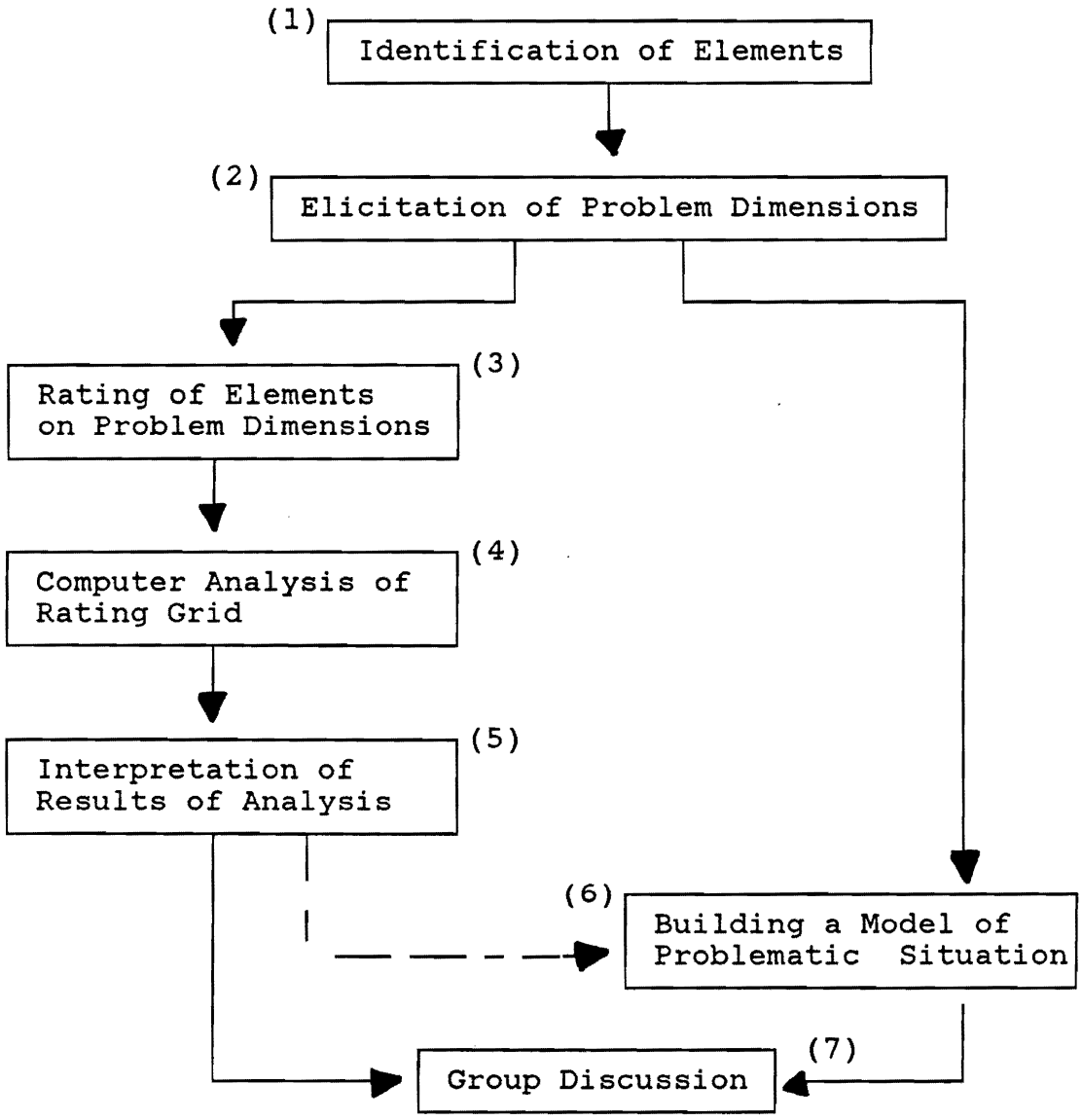

Figure 1. Algorithmic Chart of the Proposed Method of Problem Structuring

the process of development and has been tested only in few cases. In some of those cases it was related to the results interpreted in Step 6; in some others it was kept separate from those interpretations.

The procedure also can be summarized in three phases. The first phase involves group interactions. The elements are identified in a group process which is a combination of the Nominal Group Technique and interactive discussions. The elicitation of problem dimensions also can be carried out in the group, although this is not a preferred way of eliciting problem dimensions for reasons I will mention below. In the second phase, each individual goes through several steps: eliciting problem dimensions, rating elements on problem dimensions, analyzing and interpreting grids, and building a model of problematic situation. The group discusses all the individual results in the third phase.

The steps in the problem structuring procedure are described and discussed in the following sections.

Identification of Elements

The first step is to make a list of "elements" of the problematic situation in the group. This step has a major function in the process, because as Shaw and Gaines (1986b) suggest, "elements determine the universe of discourse." In other words, the elements listed will draw the boundaries of the cognitive activities that will take place in the succeeding steps.

To help the person draw his cognitive boundaries as large as possible, we give him some guidelines. He is reminded of some categories of elements, which were adapted from Mason and Mitroff's (1981) Strategic Assumption Surfacing and Testing Technique. These categories include nonhuman factors, such as natural forces, natural resources, animals, plants, ecological conditions and technological factors likely to have some effect on, or be affected by, the situation. The ele-

ments also can be any organizations, departments, or units that may be related to the situation. Also included may be individuals or groups of people who:

- have an interest in the situation,
- are likely to act to have an impact on the situation or on the other elements,
- are in formal positions in the organizations involved,
- may be affected by the situation, such as interest groups, racial groups, gender categories, occupational groups, religious groups, people living in certain regions of the country, social classes, etc.,
- are opinion leaders in groups or in society.

Making a long list of elements and making it in a group stimulates the creativities of individuals. Kelly suggests that accepting new elements into one person's construct system is an important aspect of the loosening of construction (1955, p.1033). New elements will stimulate new associations in mind, which may cause formation of new constructs or new combinations of old constructs (Kelly, 1955, pp. 161-162). Forming new constructs is essential for seeing the problematic situation from different perspectives and consequently for creative thinking, i.e., finding novel ways of approaching the situation and finding new solutions. Generating a list of elements in a group can remind group members of new elements and foster creativity.

On the other hand, there is a risk of generating a long list of elements in a group. That is because some elements on the list may not be within the "range of convenience" of some members of the group. According to Kelly, elements should be within the range of convenience of the construction system of the person (Kelly, 1955, p.108). In other words, the elements generated should be known to the person, and should be relevant to the problematic situation in the perception of the person.

Whether an element will be within this range is an empirical question. The possibility of having some elements out of the ranges of some members depends on the structure of the group. This may be a difficulty especially in newly formed groups with members from diverse backgrounds. In such, the likelihood of any person having unshared construct dimensions will be high. However,

interpersonal interaction and clarification of the meanings of constructs can bring some into the ranges of members.

One practical concern about the long list of elements is that generating such lists will make the subsequent steps and the whole process lengthier. This may very well be a serious hinderance. Prioritization of elements by taking votes among the group members may be a method of cutting out some elements.

What kinds of group processes can be used in this first step? Two main kinds have been discussed in the literature: nominal and interactive. Delbecq and Van de Ven (1971), and Delbecq, Van de Ven and Gustafson (1975) compare interactive groups with nominal groups (e.g., Nominal Group Technique and Delphi) and argue that the nominal groups are better to ensure participation of every member of the group, to prevent domination of a few members and a tendency toward conformity, and to foster creativity. On the other hand, the Nominal Group Technique and Delphi procedures are lengthier in comparison to interactive group discussions. This is an important consideration in many situations. Also, group interaction is necessary for communication of why these elements are being proposed and hence for changing a person's construction system, which is essential for loosening. Souder (1977 and 1980) argues for nominal-interactive mixtures. Such seem to be needed for problem structuring procedures as well. However, there is no ideal ratio of nominal to interactive that could be recommended in general. The style of meeting should be flexible to fit the structures of relationships within specific groups.

Elicitation of Problem Dimensions

In this step bipolar construct dimensions are elicited. I call these "problem dimensions," in the context of Problem Structuring. The specific technique used at this step is "triad elicitation," as Kelly calls it.

Three of the elements on the list generated in the previous stage are selected randomly by the computer or user. The person asks the following question of himself about this triad of elements:

In what way are two of these three elements alike and the third one different?

Similarities and differences can be formulated in a variety of ways. There is no limitation to a person's conceptualization Each likeness and difference constitutes a dichotomous construct, which can be considered as a dimension in the person's construction of the problematic situation.

The person continues with the next randomly-selected triad of elements. If he does not see any meaningful likeness and difference, he can skip that triad.

Random selection of elements may continue until all possible combinations of elements have been exhausted. However, the person does not have to go through all these. After some trials, as Kelly suggests, the person will notice that he will be repeating himself. This is because he has reached the boundaries of the subsystem in his construct system, which is relevant to his construction of the problematic situation he is facing. The person may stop eliciting constructs when he feels that he has reached that point.

Kelly's assumption underlying the triad elicitation technique is that "The minimum context for a construct is three things. We cannot express a construct either explicitly or implicitly, without involving at least two things which have a likeness and one which is, by the same token, different" (Kelly, 1955, pp. 111-112). Kelly calls the likeness and difference the "likeness end" and the "difference end" of a construct (1955, p. 137).

Of these two poles, Kelly considers the likeness pole as the "emergent pole" of the construct. "The emergent pole of a construct is that which embraces most of the immediately perceived context" (1955, p.138). The likeness embraces 2/3 of the context because it characterizes 2 of the 3 elements in the context. Kelly considers the "difference pole" as the "implicit" pole. The "emergence" and "implicitness" can be seen more clearly in some constructs than others. In some cases the difference is expressed as non-existence of the likeness. Instead of formulating his construct as "good - bad," for example, one might see it as "good - not good." In this second case, the emergence of "goodness" becomes more explicit and the opposite becomes only a null category of goodness.

There will be examples of this kind of constructs, i.e., construct in the cases I will illustrate in the next chapter.

Kelly's "individuality corollary" states that people differ from each other in their constructions of events, and that each construct is idiosyncratic because it belongs to a specific person. Therefore, construct elicitation should be an individual process, not a collective one, even in the case of a group process (Shaw, 1980, p. 110). However, in one of the two group cases which I will illustrate in the next chapter, the constructs were elicited collectively in the group. This was a violation of one of the basic premises of Kelly's theory. On the other hand, collective generation may help remind each group member some new aspects or dimensions of the problematic situation. Thus it may broaden each person's construction system.

Rating Elements on Problem Dimensions

At this step the person gives a score to each element on each problem dimension. The scores range between 1 and 5. It can be any integer, (e.g., 2, 3 or 4) or any real number to the nearest tenth (e.g., 3.4 or 4.7).

If the person thinks that the element is closer to the first pole of the dimension, his score should be 1 or 2 (or any real number between 1 and 3), depending on his perception of that closeness. The scores 4 and 5 (or any real number between 3 and 5) indicate closeness to the second pole. Each possible integer score can be interpreted as follows:

1 is at the first pole,

2 is close to the first pole, but not at the pole,

3 is at the middle point,

4 is close to the second pole, but not at the pole,

5 is at the second pole.

If an element is irrelevant on a dimension, the score should be 3. Several methods have been suggested in the literature to deal with this situation. I prefer using the mid-point, as does Shaw (1980, p. 158). Using the mid-point of the scale causes some theoretical problems, e.g., an irrelevant element cannot be between the two poles of a construct, neither conceptually nor geometrically. The practical applicability of a technique has a crucial importance however. More complicated instructions may confuse the person using the method. Moreover, the effects of the mid-score of the scale are minimal in statistical computations. Therefore, the harm of using the mid-score is balanced by its practical utility.

The objective at this stage is to evaluate elements with respect to each other on the dimensions. This evaluation is done by quantitative means. Elements are scored on construct dimensions.[10] By scoring elements on all dimensions, the person creates a multidimensional space (from the perspective of geometry) or a matrix (from the perspective of algebra). In the next step the computer is employed to analyze this matrix and give the summarized results on reduced multidimensional spaces.

Analysis of the Resultant Rating Grid

The objective at this step is to develop "clusters" of both elements and problem dimensions. The computer analysis simplifies the situation by reducing the number of elements and dimensions combining similar (homogeneous) items. The pattern of clusters resulting from this analysis will help the person to structure his thoughts about the problem situation, and probably will remind relationships that he has not considered before.

Both elements and problem dimensions are analyzed at this stage.

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[10] In the original form of the repertory grid, elements and constructs are placed on the columns and rows of a "grid" respectively, which is drawn on a piece of paper. The name "repertory grid" comes from this original grid shape. The computer software I used for my cases does not generate a grid on the screen. Rather, the pairs of elements and problem dimensions are displayed on the screen one by one.

The Repertory Grid analysts use both Cluster and Factor Analyses. The software created by Dickey to analyze Repertory Grids has both these options for both elements and constructs. I used only the Cluster Analysis results to feed them back to the participants of the cases.

The reason for this preference is that the results of the cluster analysis are more easily interpretable than those of factor analysis. As Shaw suggests, the latter is difficult to understand by people not knowledgeable about statistics (1980, p.33). In his comparison of cluster and factor analyses of Repertory Grids, Easterby-Smith suggests that the former can be used by the subject, while the latter can be applicable for research purposes (1980).

Slater (1977) proposes an algorithm for principal component analysis with which both elements and constructs can be plotted on the same principal components space. This algorithm provides a possibility of generating a comprehensive cognitive map of the problematic situation. That map could be used in problem structuring by feeding it back to the person. This could ease the interpretation of factor analysis results, and could create more opportunities for problem structuring. That is because displaying both elements and constructs gives a fuller picture of problematic situation. However, there is one major obstacle for the use of Slater's algorithm in problem structuring. In most cases people generate matrices which yield more than two important principal components. Slater, himself, mentions that people usually tend to express themselves in three major dimensions, i.e., 80-90% of the variance is explained by the first three principal components (1977, p. 75 and 106). In that case, it would not be possible to plot those dimensions on a plane without distortions. Slater proposes to use Mercator projection to display three dimensions on a flat surface. However, it is known that the Mercator projection is not free from visual distortions, and these distortions can become a major obstacle in problem structuring. An effective use of Slater's algorithm requires a three dimensional medium to represent elements and constructs. The hologram technology may, in the future, create opportunities for utilization of Slater's algorithm. However, even that could not help in the cases in which more than three principal components are generated.

Cluster analysis seems the best technique to utilize in problem structuring, at least with the available technological options.

The software developed by Dickey for analysis of Repertory Grids employs Cluster analysis to compute proximities among elements or problem dimensions and determine which ones should be put in the same "clusters" or groups. The overall proximity or homogeneity of items within clusters is measured statistically by the "G-Value." This ranges in size from 0 to 1. At one extreme, if each item being clustered is in its own group, there is no variation within that group, and thus there is maximum homogeneity (G = 1). At the other extreme, if all the items to be clustered are in a single group, there is the least possible homogeneity within the group, so G = 0.[11]

The clustering process starts with each item (in our case, an element or dimension) in its own cluster or group (Stage 1, with G = 1). It proceeds to combine groups a pair at a time. The pair selected at each stage in this process is the one giving the highest G-Value (homogeneity). The process continues until only one cluster or group remains (with all items in it, and G = 0). Each stage of the clustering process is displayed on the computer screen, and printed out successively.

Interpretation of the Clustering Patterns

Interpretation involves two steps. First, the person goes over the sequence of clustering of elements which are printed out by the computer. He tries to interpret why these elements are clustered in the same group at each stage, and naming the cluster formed at that stage. These interpretations will help him find the most meaningful clustering stage.

Second, he tries to find the stage where not only the elements grouped at that point, but the entire clustering structure, is meaningful to himself. The G-values, which are displayed on the top of each clustering stage and on a graph, may help to find this stage. A sharp decline in G- values

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[11] The computation of the G-Value is based on the algorithm explained in John W. Dickey and Thomas Watts, "Advanced Analytical Techniques" (unpublished manuscript). This algorithm gives similar grouping results as the K-means algorithm of J.A. Hortigan and M.A. Wang (Hortigan, 1975). The difference between the two is that Dickey and Watt's algorithm computes the ratio between Sum of Squares to Total Sum of Squares, while Hortigan and Wang's does that of Within Sum of Squares to Total Sum of Squares.

is usually considered to be the indicator that the two clustering stages are far apart. Therefore, the stage before the decline may be a meaningful stage.[12]

In the interpretation of the clusters of elements at the most meaningful clustering stage I used two different procedures in the two cases that I will discuss in the next chapter. In both of these, the aim was to "tighten construction," which is the second phase of Kelly's Creativity Cycle.

In the first procedure, which I used for the Virginia Cooperative Extension Service case, each group member answered the following questions successively: How would you name these clusters of elements? What are the problem areas that these clustering patterns suggest? What kinds of actions do these problem areas suggest?

The naming of clusters, formulation of problem areas and suggestion of actions can be considered as three successive stages in the tightening of construction. By naming element clusters, a person creates a "category" which may be considered as a pre-construct. This category may not have a clear dichotomous opposite at the moment it is formulated, i.e., the dichotomous opposite may be "implicit." As the person moves to identify a problem area, he tightens his construction. He does that by building some grammatical structures (phrases, sentences). Building grammatical structures is tantamount to setting up relationships between constructs (or elements) in that person's construct system. If he/she suggests an action, this will be a move to a causal understanding (in Kelly's formulation, "defining what is predicted"), which can be considered as further tightening.

In the second procedure, which I used in the Vocational Education case, each participant named the clusters at the meaningful clustering stage. Then he/she tried to formulate actions that would be needed to implement the goal implied by the naming of each cluster. He also tried to combine clusters into a small number of categories. Consequently, the person generated a tree-like structure with several hierarchical levels of abstractions (usually 3 or 4 levels). I call these hierarchical structures "problem structures."[13]

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[12] In the first, Virginia Cooperative Extension Service case, the interpretations were not done on the computer printouts. I used, instead, the "maps" on the basis of the clustering patterns of elements on the printouts. Then each of the grouping members interpreted his/her own map.

[13] These "problem structures" are similar to the "relevance trees" or "goal trees," which are extensively used in decision making. Problem structures, like relevance trees, depict the relationships between superordinate

The fist procedure aims to tighten construction for each named cluster separately. Thus it helps to complete the creativity cycle independently for each cluster. This procedure consequently generates lists of problem areas and suggested actions. The areas and actions remain independent from each other. They do not constitute a whole, a plan of strategy or action.

The second procedure helps to set up inter-connections between goals and actions at several levels of abstractions by eliciting the "superordinate" constructs, which are higher "values" in a person's construct system. In other words, these are the underlying assumptions or implicit goals for that person.

The resultant hierarchical picture in this procedure, i.e., "problem structure," becomes close to setting up a whole, a concrete-in-thought.[14] It sets up connections and reveals assumptions. Thus, the resultant picture becomes a whole and a picture of person's construction of the problematic situation. Because of this personal nature of the procedure it also helps self-reflexivity.

The same procedures for interpreting the clustering of elements were also used in the interpretation of clustering of problem dimensions. However, as I will discuss in the next chapter, interpretation of constructs created some difficulties, and did not contribute much to the structuring of problems.

The results obtained from clustering of the elements and problem dimensions can be elaborated, discussed and developed individually or in groups. Another option is to go through the model building procedure, which is described in the next section.

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and subordinate constructs. However, the former do not indicate quantitative values of "degrees of relevance," unlike the latter. (Andersen, et.al., 1981, p. 206).

[14] To me, the models built using the procedure I am proposing are better approximations to concrete-in-thought, because they are composed of more complex relationships.

Building a Model of the Problematic Situation

In this step, the person generates a holistic picture of the problematic situation. The constructs (problem dimensions) elicited in the second step of the problem structuring procedure are transformed into a holistic picture.

The model building procedure to be described below is not a highly structured one. Much room is left for individuality of approach and interpretation.

The process starts with the abstract characterizations and relationships as captured in the "problem dimensions." The person generates a chain of interrelated constructs by asking the simple questions of "why?" and "how?" to himself. By doing so he "bridges the gap" cognitively between the initial "problem dimension" and the ultimate goal (or ultimate solution of the problem). Then he merges these model segments into a whole in order to build a comprehensive model of the situation. This is his reconstructed concrete of the problematic situation.

The model building process comprises four stages:

1. Building "model segments" from problem dimensions;
2. Evaluating model segments, and rephrasing the "components" in model segments;
3. Merging model segments;
4. Scrutinizing and developing the model.

Building Model Segments from Problem Dimensions

The model building process involves four kinds of "cognitive operations," which are described below. These operations are repeated as many times as necessary.

1. The person takes each problem dimension individually. He writes down the first dimension on a piece of paper, and asks himself the question: Which one of the poles is preferable (more positive than the other) for solution of the problem or reaching the overall goal? He marks his preference on paper. His preference may be based on a hunch, or clear line of reasoning. It is the aim of the next step to clarify the basis of the choice.

2. Then he asks:

   - "Why is this pole preferable for solution of the problem or reaching the overall goal?" or:
   - "How would this preference help to solve the problem or reach the overall goal?"

   He writes his answer on the paper below the problem dimension. He connects the preferred pole of the dimension to his answer by drawing an arrow.

3. Is the answer clear enough? Does it fall short of reaching an ultimate goal? The person proceeds with asking the questions "why" and "how" until he reaches an ultimate goal in his situation. Each time, he connects his answers to each other with arrows. By doing so the person will generate a chain of constructs. We can call each of these constructs a "component" of the problematic situation. The chain he is generating will constitute a "model segment." He will later use model segments to build an overall model of the problematic situation.

4. While generating the chains of constructs ("model segments"), the user will probably need further clarification. If so, he should refer to the scores on his Rating Grid. The scores, which indicate relative proximities to the poles of each problem dimension, can help him to specify the "who" or "what" characterized by the constructs he has formulated. He thus can formulate the "components" in his model segments in more specific terms.

The person takes each problem dimension and goes through these "cognitive operations" for all of them, while asking the "why" and "how" questions. He may think that some of these dimen-

sions may not be suitable to generate model segments. If that is the case, he should drop that problem dimension.

The procedure described for building model segments is based on Kelly's "choice " and "organization corollaries," as well as the method developed by Hinkle on the basis of these corollaries. His method is called "laddering."

This method aims to elicit superordinate and subordinate constructs in a person's construction system. According to Kelly's choice corollary, a person has a preference of one of the poles of each of his constructs. Hinkle, therefore, begins by asking the person's preference (Honikman, 1976, p.174). To elicit superordinate constructs he asks the "Why ?" question. "How?" is asked to elicit subordinate constructs (Ten Kate, 1981, p.169).

In my procedure I use both "Why?" and "How?" questions. The reason for this is that we cannot know whether the problem dimension or the goal is a superordinate or a subordinate construct in one's personal construct system. Furthermore, we should not assume that the gap between the goal and the problem dimension is only on one dimension. The gap may be in a multi-dimensional space, in which it would be hard to predict the superordinacy relationship between two constructs. Therefore, it will be better to allow the person to switch between his dimensions, by asking both "Why?" and "How?" Still, this flexibility creates some unclarities in the procedure. It is very difficult to conduct this procedure without the guidance of a facilitator.

I adopted the idea of building models from Eden, Sims and Jones (1983). However, the procedure I am proposing has some differences from theirs. They use already formulated problems to build models, not constructs (problem dimensions). I prefer problem dimensions, because problem formulations are already tightened constructions. Starting up a model building procedure with problem formulations would tighten the construction in the Creativity Cycle immaturely.

Evaluating Model Segments and Rephrasing the Components

After generating model segments, a person should take a second look at them. He may find it useful or necessary to rephrase some of the "components" in the model segments.

Merging Model Segments

The user may see that there are some common components among the model segments. He can merge them by common components to build an integrated model of the problematic situation. This operation may require further rephrasing of the components in the segments; or it may remind new components that could be added to the model.

Developing and Scrutinizing the Overall Model

The user can elaborate, scrutinize, and further develop the model once it is constructed. A simplified version of the procedures of Assumptional Analysis, i.e., Assumption Surfacing and Assumption Challenging, (Mitroff and Emshoff, 1969) can be utilized for this purpose:

User should look at the connections he has drawn in the model and ask the following questions:

> What are the assumptions behind each of them? Is this assumption justified? Would the relationship constructed here change if an opposite, or any other assumption was adopted? How? Why? Why not?

Based on his answers he can make changes and rearrangements in his model.

The person also can bring some components to his model from the problem areas or suggested actions he formulated in Stage 5 of the Problem Structuring process, i.e., the interpretation of results of the analysis.

What the user obtains eventually is a visual map of the structure of the problematic situation. This can be a basis for further elaboration and searching for creative solutions.

The model he has developed also can be called a "model of strategy." He has developed "paths of strategy" for solution of the problem or for reaching the goal, while developing the model segments and merging them into a larger whole. In other words he has formed some guidelines for possible actions. Meanwhile in the process, the ultimate objective formulated at the beginning may be clarified or changed because of the emerging combinations of construct dimensions.

V. Illustration and Discussion of the Cases

I have applied the problem structuring procedure in several individual and group cases. In this chapter I present and discuss two group cases: The Virginia Cooperative Extension Service (VCES) case and the Division of Vocational and Technical Education (DVTE) case. There are some modifications in the applications of the details of the procedure in these cases, as I will indicate below. I compare these modifications and their consequences in the last section of this chapter.

I applied the model building procedure only with three individuals in each of these two groups. In the Virginia Cooperative Extension Service case, the one model built by one of the group members was kept separate from the group discussion. The models built in the Division of Vocational and Technical Education case were discussed in the group and contributed to the final product.

The Virginia Cooperative Extension Service Case

The first application of the problem structuring procedure was for the case of establishing a Human Resource Planning and Development System (HRPDS) in The Virginia Cooperative Ex-

tension Service (VCES). In this project the task of conducting assessment studies and designing the system was given to the Planning Evaluation and Professional Development (PEP) Unit of the Virginia Cooperative Extension Service. The PEP unit made a plan to complete the task in one year, between March 1988 and March 1989. The problem structuring exercise was done in October-November 1988, after the need assessment studies, i.e., interviews and surveys among the field personnel of VCES, had been completed, and before the design phase started. The four members of the PEP unit, Susan (group leader), John, Jim and Mary participated in the exercise. I and John W. Dickey facilitated the process throughout all its stages.

The procedure was conducted in five steps: In Step 1, the group met with the two facilitators to generate a list of "elements" of the problematic situation and to "elicit constructs" collectively. In Step 2, each group member rated the elements, individually, on the collective grid set up in the first step. These grids were analyzed, in Step 3, using John Dickey's program for the analysis of Repertory Grids. Each group member was asked to interpret the results of his own grid by naming clusters, formulating "problem areas" and "suggesting actions" (Step 4). The procedure was completed with the exchange of the interpreted results of individual grids, and discussion of those results among the group members (Step 5).

Mary built a model separately from the others. I will illustrate and discuss her case after the group case.

The Official Goal of the Project

The overall goal of the project, as formulated in official documents, was to initiate "an organizationally recognized, comprehensive process/effort that achieves a balance between individuals' career and life needs and the personnel requirements of the organization in support of the Virginia Cooperative Extension Service mission."

First Group Meeting

In the first meeting the group members generated a list of "elements" which they thought were involved in the problematic situation of establishing a HRPDS for VCES, as the first step. The second step was the elicitation of constructs collectively in the group.

It should be noted that both the generation of elements and elicitation of problem dimensions were carried out in interactive group discussions.

These were preferred over a nominal process mainly because of time limitations. The Nominal Group procedure is lengthier. Also, it was thought that the group members' long experience together and the collegial atmosphere of the intra-group relationships would help reduce the possible negative effects of interactive discussions.

The list of elements generated in the group meeting are shown in Table 1 below.

The elicitation of constructs was carried out as a collective process by the group. The technique adopted was the "triad elicitation" procedure. Each element was written on a card. Three elements were randomly selected and shown to the group. They were asked which two were similar and in what sense. The group members then formulated the constructs as the similarity between two elements and the difference with the third one. The constructs were suggested and agreed upon by the group members.

Certainly in this collective elicitation process not all the dimensions generated were equally agreed upon by all the group members, and the meaning of each was not necessarily the same to all. On the other hand, these collectively generated elements and constructs gave me an opportunity to make some direct quantitative comparisons of the grids of individuals.

The final list of constructs elicited are shown in Table 2.

Table 1. List of Elements Generated by Group Members in the Virginia Cooperative Extension Service Case

E1	Quantitative/ Qualitative Data
E2	Agents/Technicians
E3	Support Staff
E4	Administration
E5	Money
E6	Immediate Supervisors (Unit Directors, Department Heads)
E7	Management (Maintenance, Revision)
E8	Interface (Mainframe - PC)
E9	University Personnel Data Base
E10	Mission/Program Priorities
E11	Data Base Manager
E12	Consultants
E13	Confidentiality/Ethics
E14	Organizational Management
E15	PEP Group
E16	Secretaries
E17	Extension Faculty
E18	Data Aggregates
E19	Red Tape
E20	Volunteer Leaders

Rating Elements on Constructs

The next stage was rating each element on each construct. Each group member did the rating individually. He used the 1-5 scale which was explained in the previous chapter. By doing so the individual created a matrix which could be analyzed in the next stage.

The "range of convenience" issue, i.e., the possibility of some elements and constructs being out of the range of convenience of some members of the group (discussed in the previous chapter) can be observed in this, rating, stage of the process. If a person has difficulties in rating some elements on some constructs, this may indicate that those elements or constructs or both are irrelevant, i.e., out of the range of his/her convenience. If the number of such cases are high, this can undermine the validity of the constructed grids (matrices to be analyzed). In the VCES case, only Jim and Mary reported having difficulties in their ratings. Jim reported 3 and Mary reported 4 cells out of the total 340 cells of the grid that had found irrelevant. These figures were negligeable and did not constitute a serious problem in the next, analysis stage.

Table 2. List of Constructs Elicited from Group Members in the Virginia Cooperative Extension Service Case

C1	People -- Non-people
C2	Determines salary -- Does not determine salary
C3	Program Recipient -- Program Developer
C4	Outside -- Inside
C5	State -- Local
C6	Management -- Labor
C7	Management -- Application
C8	Builders -- Users
C9	Administrative Management -- Human Resource Management
C10	University-related -- Project-related
C11	Facilitates -- Hinders
C12	More Power -- Less Power
C13	Comprehensive -- Narrow
C14	Data -- Decision Making
C15	Effective -- Not Effective
C16	Broad Management -- Specific Management
C17	High Involvement -- Low Involvement

Computer Analyses

The software created by Dickey to analyze Repertory Grids has the options of cluster or principal components analyses of elements and constructs. In the VCES case, I analyzed the Grids with both. However, I preferred to feed back only the results of cluster analyses. This was because of the easiness of interpretation of cluster analyses, as I discussed in the last chapter. I used factor analysis for my own interpretations, as I will discuss below.

Interpretation of the Results of Cluster Analyses

The results were fed back in two different ways. For each member a "map" of the elements was drawn based on the clustering patterns of elements on the computer printouts, and he was asked to interpret his own map. These maps of group members can be seen in Appendix I. The aim in using these maps was to create visual images for making interpretations easier. On the other hand, the computer printouts of the analyses of constructs were used directly in the interpretations

by group members. The constructs were not mapped because of the technical difficulties in doing so. The problem areas and suggested actions were formulated in full sentences in the VCES case. These formulations were listed for each group member. The lists of problem areas and suggested actions are shown in Appendix II.

This method of listing problem areas and suggested actions as full sentences made each formulation tightened by itself. On the other hand, each formulation was not related to each other. In other words, a structured whole - a picture of the problematic situation for each member - did not emerge as a result of the process. In the perspective of Personal Construct Theory, each member generated a tight construction of each problem area and suggested an action. The relationships between these problem areas and suggested actions were loosely constructed, however.

In the second, DVTE group case, I changed the procedure to help group members to formulate the relationships between problem areas, as I will discuss below.

Group Discussion

I made four copies of each group member's element map and list of problem areas and suggested actions to hand out in the group meeting. Thus, each member had a copy of each other's map and interpretations. The group members explained their own maps and interpretations one by one, and the group engaged in an unstructured discussion.

This interaction revealed that there were considerable differences among the group members concerning the goal, scope and problems involved in the project. Susan made it clear that she was considering the Human Resources Planning and Development System (HRPDS) mainly in its relations to the VCES administration. She was concerned with the administration - organizational management mix-up. This could be an important hinderance for the HRPDS project. She also emphasized the importance of the power and advocacy of administration for the project. John's emphases were on the interpersonal relationships and the computerized information systems which would be parts of the prospective HRPDS. After a dialogue between Jim and Mary, it became clear

that for Jim the HRPDS was a project to be accomplished, while Mary was conceiving it as a part of the larger organizational processes in the VCES. Susan and John noticed a common point in their interpretations that the HRPDS project could lead to a restructuring in the VCES, and consequently to the dissolution of the PEP unit. The group, at the end, agreed that the HRPDS project had multiple aspects, and all the problem areas formulated and actions suggested would be considered in the next, design, phase of the project.

This group discussion helped the members to understand each other's construction of the task of establishing a HRPDS for the VCES. However, it did not generate a consensus document or a common picture of the problematic situation they were facing. This was partly due to the time limitations. It was probably also because of the procedure followed in the previous stages. It can be said that the immature tightening of problem areas and suggested actions as separate full sentences made it harder for the group to find commonalities among their constructions of the problematic situation.

My Interpretation of the Case

It can be seen in Appendix II that the group members formulated more problem areas and suggested more actions from their interpretations of their element maps than from that of their constructs. The only exception was Jim, who formulated his only problem area from the clustering of constructs. I have observed in other applications of the procedure that persons can formulate more problem areas from elements than constructs. This is probably because of the different levels of abstraction. Constructs are more abstract than elements, i.e., they are superordinate to elements in a person's construct hierarchy. Probably a person's mind faces some difficulties in formulating problem areas, which are quite specific, from the high level of abstractions of constructs.

In the VCES case, group members stopped at different stages of tightening of construction. Jim, for example, stopped after naming the groupings of elements on his map. However, he formulated one problem area and suggested an action in his interpretation of the constructs. John,

Susan and Mary formulated several problem areas and suggested actions for some of these. Mary suggested an action (#2) without formulating a problem area. This can be considered as a leap in tightening of construction.

The problem areas formulated and actions suggested by the group members were at different levels of generality and specificity. The most interesting case was Jim's. He formulated only one problem area and suggested one action. These formulations came from his interpretation of the clustering pattern of constructs. As I discussed above, constructs represent more abstract relationships and are more difficult to interpret for most people. That was not the case for Jim. He formulated a general problem area from the abstract relationships of constructs. However, he could not develop any from the elements, which were more specific. This was, probably, a reflection of his mental attitude, i.e., general, abstract and philosophical. This characteristic of his mind was also what I observed in my facilitation of his individual interpretation process and the remarks he made in the second group meeting. Susan was a contrast to Jim. Her interpretations were much more specific. She formulated more problem areas and suggested more actions in quantity than any other member. This comparison of the two members may be interpreted to mean that persons differ from each other in their skills to deal with different levels of abstractions in their construct systems, and that these differences are reflected in their formulations of problems.

The differences between the individual group members also can be seen in the issues they emphasized in their formulations. As indicated in Table 3 the problem areas identified were quite diverse among the group members. Also it is apparent in Appendix II that, among the problem areas formulated, only two of them are common to two members of the group: a possibility of restructuring the VCES (Susan's second problem area and John's second problem area) and the social and organizational distance between the administration and the field personnel (Susan's fifth problem area and Mary's first problem area).

The repertory grids of members can be analyzed quantitatively to make comparisons between them. In this case, the common elements and problem areas made these comparisons possible. These analyses also can be related to the problems formulated by each individual. Thus, such analyses help us understand better the processes of problem structuring of each and the group.

In my analysis, I first grouped the problem areas into four issue categories that I identified in my interpretation of the list of problem formulations: Human- Relational Issues, Administrative/Organizational Issues, Data Management Issues and Larger Political Issues. Table 3 shows that the problem areas formulated by the group members were quite diverse, even in terms of these issue categories. This is consistent with the diversity recognized by the group members themselves in their second meeting.

Susan's interest in the administrative/organizational issues can be seen in quantitative terms in the table. Four of her problem areas fall into the Administrative/ Organizational issues category. This is consistent with her own emphasis on the administrative relationships in the second group meeting that I mentioned above. The table also shows that John's emphasis was mainly in "human-relational" and "data management" areas. Again as I summarized above, these were the two areas he emphasized in the group meeting. Mary's favor of the human-relational issues are reflected by her remarks in the group discussion. It is difficult to find such a connection for Jim, because there was only one problem area formulated by him.

Since the group generated a common grid to be filled out in the first meeting, it was possible to compare the individual ratings of each group member. Shaw (1980, pp.75) and Slater (1977, pp. 139-157) developed computerized statistical methods to make such comparisons. I employed a method similar to the one Dunn, Cahill, Dukes and Ginsberg (1986) suggested to measure "construct centralities." I employed the communality estimates of elements computed by Q-factor analysis to determine the centralities of elements in each person's construction system. The underlying logic was that the higher the communality estimate of an element, the more central (important) it is in the construction system of the person. The rankings of the elements with the highest five communality estimates are shown in Table 4. This is a legitimate comparison, because all the Q-factor analyses yielded five factors with eigenvalues more than 1, and these five factors explain 79.4 to 83.2 percents of total variances for all group members.

Table 4 suggests that there are considerable differences between the group members in terms of the centralities of elements in each one's construct system. Also, each element can be interpreted as related to an issue category identified in Table 3. A comparison of Tables 3 and 4 indicates that,

Table 3. Problem Areas Formulated by Each Group Member In Each Issue Category in the Virginia Cooperative Extension Service Case

	Problem Areas Formulated by Each Group Member*				
Issue Category	Susan	John	Jim	Mary	Total Frequency
Human-Relational	6,7	3,4,5, 9	1	1,2,4	10
Administrative/ Organizational	2,3,4, 5	1,2			6
Data Management	1	6,7,8			4
Larger Political	8			3	2

* *The numbers in all categories correspond to the code numbers in Appendix B.*

for each person, there are matches between the issue categories represented by the problem areas and those represented by the central elements. In other words, element centrality measures from the Q-factor analyses also can be used to identify the issue categories which are more important to that person. Therefore, that person can be expected to emphasize these issue categories more in his formulation of the problem areas.

Three of the top five elements on Susan's list (1, 2, 5) are related to the Administrative/Organizational issues. Table 3 also indicates that the Administrative/ Organizational issues are the most important ones for Susan. John's top 3 elements are related to the Human- Relational issues. The 4. and 5. ones are associated with Data Management. These two issue categories are the most frequent ones in Table 3 as well. Jim's 1., 3. and 5. elements are in the Human Relations category, and the 2. and 4. are in Data Management. The problem area he formulated was in the Human Relations category in Table 3. Mary's 3. and 4. elements are related to Human Relations, and the 1. 2. and 5. are related to the Administrative/Organizational issues. Her highest frequency in Table 3 is in the Human-Relational issues.

Overall comparisons of the construct systems of the group members also can be made based on the communality estimates. The rank order correlation coefficients (Spearman Rho's) of the rankings of communality estimates of elements between the group members is a way of making

Table 4. Most Important Five Elements For Each Group Member in the Virginia Cooperative Extension Service Case

Susan	(5 factors explain 79.4% of total variance)
	1. Administration
	2. Money
	3. Quantitative/Qualitative Data
	4. Data Base Manager
	5. Red Tape
John	(5 factors explain 82.2% of total variance)
	1. Secretaries
	2. Volunteer Leaders
	3. Agents/Technicians
	4. Quantitative/Qualitative Data
	5. Confidentiality
Jim	(5 factors explain 80.1% of total variance)
	1. Secretaries
	2. Data Base Manager
	3. Volunteer Leaders
	4. Interface
	5. Immediate Supervisors
Mary	(5 factors explain 83.2% of total variance)
	1. PEP
	2. Mission/Program Priorities
	3. Secretaries
	4. Support Staff
	5. Administration

these overall comparisons. The coefficients computed for the PEP group in the VCES case are shown in Table 5.

Table 5 shows that there is no high correlation between any pair of the group members. These overall results are the quantitative confirmations of the dissimilarities among the group members in their constructions of the problematic situation.

However, these differences do not mean that their construct systems are completely different from each other. Some commonalities among the members can be identified. One way of identifying these is through ranking of the elements according to the average rankings of communality

Table 5. Spearman Rhos for the Rankings of Communalities of Elements in the Virginia Cooperative Extension Service Case

	Susan	John	Jim
Mary	-.287	.072	.264
Susan		-.207	-.352
John			.577

estimates for each group member. This ranking of centrality (importance) of elements for the group is shown in Table 6.

The top 3 elements in Table 6 are the ones which we classified above as related to Human-Relational issues. These are the most frequent ones for the group in Table 3 as well. In this project for establishing a Human Resources Planning and Development System, it is not a surprise to see the human relational issues to be the top concern of the group. Two of the elements ranking fourth are related to the Administrative/Organizational issues, which are the second most frequent ones in Table 3. "Data Base Manager" and the 7th and 8th elements are related to the Data Management issues, which is the third most frequent category in Table 3.

Model Building from Constructs

The model building stage was not carried out by all members of the PEP group. Therefore it was not integrated into the group process. However, Mary was willing to go through this process individually. The following is the illustration of her case.

Mary started with each of the 17 constructs elicited from the group members to generate chains of constructs, which I have called model segments. The procedure for generating these is based on asking successive questions to the model builder, as explained in the previous chapter. Mary picked one pole of each construct as an answer to the question: Which pole of this construct is more preferable in terms of reaching the overall goal (which was "Building a Human Resources Planning and Development System" in our case)? After picking a pole, she answered the question: "Why

Table 6. Ranking of Average Rankings of Communalities of Elements in the Virginia Cooperative Extension Service Case

1.	Agents/Technicians
2.	Secretaries
3.	Volunteer Leaders
4.	Administration
	Mission/ Program Priorities
	Data Base Manager
7.	Interface (Mainframe/PC)
8.	Quantitative/Qualitative Data
9.	Confidentiality/Ethics
10.	PEP
11.	Immediate Supervisors
	Consultants
13.	University Personnel Data Base
14.	Management (Maintenance, Revision)
	Data Aggregates
16.	Support Staff
17.	Money
	Organizational Management
19.	Red Tape
20.	Extension Faculty

is it preferable?" or "How would it help to reach the goal?" The answer she gave to the question constituted a component of a model segment. She answered the same questions until she reached a point she could not go any further.

In the second phase she merged these model segments into an overall model. The merging process reminded her of some other possibilities of formulating her constructs. Thus she made some modifications in her model. I facilitated the whole process by helping her merge model segments and reminding her of some alternative ways of formulating the constructs in the segments.

The resultant model segments Mary generated are shown in Appendix III. The overall model is presented in Figure 2 below.

This process was a highly heuristic one. Although I described an algorithmic procedure in the last chapter, that was insufficient to describe the iterative process gone through by Mary. The phrases used in the model components and the links between those were modified continuously in the process. The model segments shown in Appendix III are only the beginning stages of numerous iterations, while the overall model shown in Figure 2 is the final product of all those iterations.

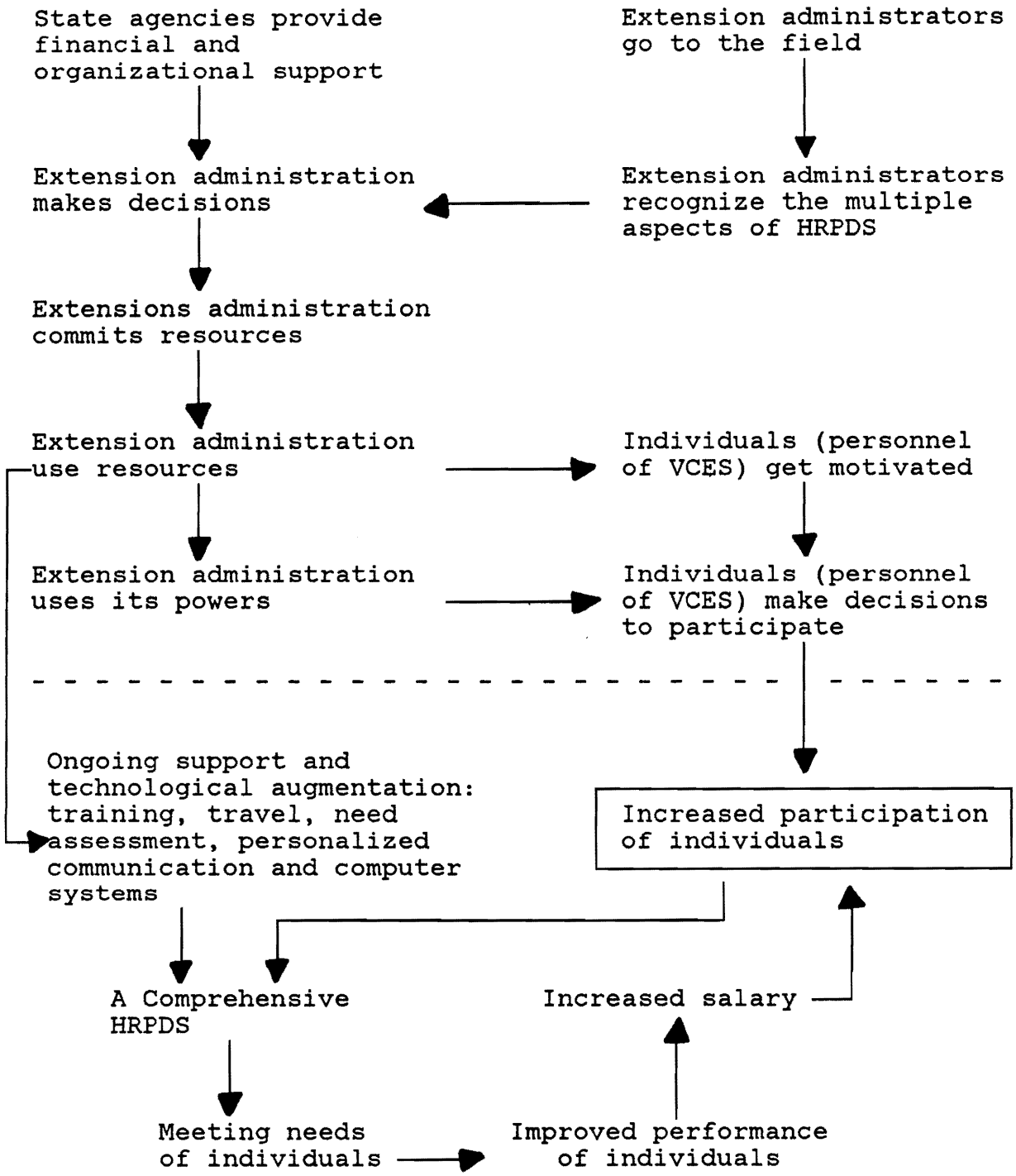

Figure 2. Mary's Model in the Virginia Cooperative Extension Service Case

One major difficulty in this case was that Mary did not use her own personal constructs in building her model. She rather used the collective constructs generated in the group. Some of those were not relevant to her. In other words, they were out of the range of her convenience. As a result, she was not able to generate any model segments from the constructs C7, C8 and C10.

In this case there are two examples of integrating the previously formulated problem areas into model building. Two components of her model, "State agencies provide financial and organizational support" and "Extension administrations go to the field" were derived from her earlier list of problem areas and suggested actions. The suggested action numbered 1 on her list was "the administrative staff should go to the field." She modified this as "Extension administrators go to the field." The statement "State agencies provide financial and organizational support" was derived from her problem area #3, which was "external factors like state agencies are important because they have some resources."

As I argued in the last chapter, a person can structure a problem better using the model building procedure. This is because the model comes closer to the concrete formulation of the problem in mind. A model not only "identifies" some problem areas (or components), but also integrates them into a whole. The model becomes complex with its multiple components and non-linear relationships like the concrete reality itself. The person goes through the "loosening" and "tightening" phases in the Creativity Cycle many times as he builds his model iteratively. The model is linked closely to the person who built it, because it "reveals" his emphases, preferences and their articulations into a whole.

It emerged in the process that the key issue for Mary was "to get people involved" or "to make them participate." For Mary, the problem of establishing a Human Resource Planning and Development System was almost tantamount to the problem of getting people to participate in organizational processes. The position of the component "Increased participation of individuals" in the overall model (Figure 2) reflects her emphasis on the participation issue.

The model building process also broadened the scope of the problem in Mary's case. According to the official definition, the goal of the project was establishing a HRPDS for VCES. In that conceptualization the HRPDS was supposed to be a product. However, Mary "realized" in her

model building process that she was considering the HRPDS as a process as well as a product. This conceptualization is reflected in her overall model. The area above the dashed line in Figure 2 represents the phase in which the HRPDS will be established; the area below the cyclical functioning of the system after it is built. Thus, Mary went beyond the original goal of the project and broadened the scope of "the problem."

The Division of Vocational and Technical Education Case

The second application of the problem structuring procedure I am proposing was done among five graduate students at the Division of Vocational and Technical Education of Virginia Polytechnic Institute and State University. The students were in a professional seminar class with Dr. Marion Asche. The initial group meeting, the individual interviews with the students, and the final group meeting were held in February and March 1989. The results of the problem structuring exercise were submitted to the head of the Division to be discussed in the Division's "Planning Retreat" in April 1989.

The Problem Posed

The question posed by Dr. Asche for this exercise was: "What should be the primary goals or directions this Division should pursue over the next five years?"

First Group Meeting

In the first meeting the students developed a list of elements. To generate and finalize the list they used the Nominal Group Technique. First, the group generated a long list of elements using a round robin procedure. This list is shown in Appendix IV. The elements were later elaborated, explained and some of them combined to generate new categories. Then each student voted for the 10 most important elements for him/herself. Those with the highest 10 votes became the final list. This is shown in Table 7 below.

The elements on both the initial, longer list and the final list have some differences from the ones generated in the VCES case. Most of the elements on both lists are not "elements" in the sense meant in the description of the procedure (chapter 2). That definition was of a human or non-human factor affecting the problematic situation as conceived by a person. However, in this case most of the elements listed (Appendix IV) were formulated rather as goals. This was due mostly to the question asked to initiate the process about "the goals to be pursued by the division." Although I, as the facilitator, reminded students about what was meant by an element, it seems that what it was overridden by the formulation of the question in their minds.

I did not attempt to force the students to change their formulations of elements. The initial list was a mixture, and it was difficult to sort out the "properly formulated" elements from the "improper" ones. Those like, "enrollment," "image" and "local area network" were "properly" formulated, because these were factors. However, "lifelong learning," "faculty development" and "growth of graduate program" could have been conceived as goals as well as factors. An intervention in the generation of a list of elements therefore would have created difficulties and confusion at the beginning of the process.

What is wrong with the formulation of elements as goals ? Shaw and Gaines (1986) argue that preconceptions about solutions should not be injected into problem definitions. From the perspective of personal construct theory, this is because goals are already tightened propositions. An early, immature tightening of construction may prevent loosening, which is the other phase of the

Table 7. **Final List of Elements in the Division of Vocational and Technical Education Case**

E1	Closer working relationships with business and industry
E2	Adequate Facilities
E3	Change degree to PhD
E4	Broadened, research-oriented program
E5	Increase in interdiscipline approach
E6	Faculty development
E7	Program instructors teach more grad courses
E8	Globalization
E9	Emphasis on excellence
E10	Socio-political-philosophical connections in VTE

Creativity Cycle. I will discuss the consequences of the immature tightening in the DVTE case below.

Interview Sessions with Individuals

After the list of elements were generated in the first group meeting I met with each one of the five students individually. In these sessions I used two different procedures. Three of the five used the computerized process to develop "problem structures," which resemble decision trees. The other two built models using pencil and paper.

Those who used the computerized procedure elicited constructs, rated the elements on their own constructs and interpreted the results on the computer printouts. The model builders went through the process I described in the last chapter.

Elicitation of Constructs

Jackie, Bob and Beth used the computer software to elicit their constructs. The software selects three elements at a time, according to a pre-set pattern, and displays them on the screen. For the three students the element pool from which the triads were selected were the same, and those elements were entered into the computer in the same order. Therefore, the triads were selected and

displayed in a pre-set pattern. This created a common basis for generating their constructs. As can be seen in Table 8, the constructs (problem dimensions) elicited were not the same or similar.

I analyzed each set of constructs based on the ratings given to the elements on each construct. The correlations computed for the pairs of constructs of each student, with some qualitative assessments, can give us some ideas about each student's perception of the problematic situation.

Four constructs of Jackie, C1, C4, C5 and C6, out of the total of eight, are highly positively correlated with each other. The correlations range between .75 to .92. Also, C2 has a high negative correlation with C1 (r = -.73). This indicates that if the poles of one of these constructs were reversed they would have a positive high correlation. The meanings of these two constructs, therefore, can be interpreted by simply assuming that the poles of one of them were in the reverse position.[15] Such an interpretation increases the number of highly correlated constructs in Jackie's grid to five.

From the perspective of the personal construct theory, more than half of Jackie's constructs are very similar, or maybe even different expressions of the same one. Jackie associates "external issues" (C1) with "national and international ties" (C2), "broader knowledge" (C4), "global" (C5) and "macro development" (C6). On the other pole, she has "changes within the area" (C1), "emphasis on research only" (C2), "knowledge within the area" (C4), "knowledge within the program" (C5) and "micro development" (C6). I interpret these five as being the expressions of a strong single dimension in Jackie's construct sub-system of vocational and technical education, that is "internal, micro vs. external, macro."

Five of the six constructs elicited from Bob (C1, C2, C3, C4, C5) are highly intercorrelated (both negative and positive). The magnitudes range between .72 and .93. After reversing the poles of those negatively correlated, it can be seen that Bob associates "moving away from ethnocentricity" (C1) with "more international concerns" (C2), "more concerns with participation" (C3), cultural, socio-political concerns" (C4) and "increased awareness" (C6). On the other pole, his associations are between "move toward ethnocentricity" (C1), "less international concerns" (C2),

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[15] The software developed by Shaw automatically reverses the poles of the constructs which are highly negatively correlated, and displays the results as such (Shaw, 1980). Our software does not have that capability.

Table 8. Constructs Elicited from Jackie, Bob and Beth in the Division of Vocational and Technical Education Case

Jackie's Constructs

C1	Changes within the area	-- External issues
C2	Involves national and international ties	-- Emphasis on research only
C3	Excellence	-- Specific to industry
C4	Knowledge within the area	-- Broader knowledge
C5	Knowledge within the program	-- Global
C6	Micro development	-- Macro development
C7	Expansion of working relationships	-- Specific to manpower
C8	Improvement of the program	-- Specific to instructional manpower

Bob's Constructs

C1	Move away from ethnocentricity	-- Move towards ethnocentricity
C2	More international concerns	-- Less international concerns
C3	More concern with efficiency	-- More concern with participation
C4	Cultural, socio-political concerns	-- Lack of these concerns
C5	Curriculum-related	-- Faculty-related
C6	Updating faculty skills	-- Increased awareness

Beth's Constructs

C1	Internationally recognized	-- Nationally recognized
C2	Change in industry	-- Change in lifestyle
C3	Improving business and industry	-- International competition
C4	Multi-facet approach to a given subject	-- Single world view
C5	Social, political, philosophical	-- Needs of business
C6	International technical needs	-- Domestic technical needs
C7	Image related	-- Student related
C8	Improving student education	-- Degree, status

"more concern with efficiency" (C3), "lack of cultural, socio-political concerns" (C4) and "updating faculty skills" (C6). It seems that Bob has a major dimension in his mind, like Jackie. That dimension can be called "concern with international and humanitarian issues - concern with efficiency and skills."

Unlike Jackie and Bob, Beth's grid has only one high correlation, which is a negative one between C7 and C8. This suggests that she associates image-related issues (C7) with degree, status (C8), and student-related issues (C7) with improving student education (C8). All the other constructs seem to be independent dimensions.

These brief analyses may have some implications: the higher intercorrelations between the constructs on Jackie's and Bob's grids indicate that these two had one strong, central dimension in mind when construing the problematic situation. They kept repeating the same construct in different forms.[16] In other words, their constructions lack multi-dimensionality.

This lack might have been due to the immature tightening of the element at the first stage of the process. Such can prevent loosening which is essential for construing in multiple dimensions, which helps creativity. The hypothesis suggesting that there is a connection between immature tightening and lack of multi- dimensionality seems to be supported by Jackie's and Bob's cases. I can say that I observed these students having difficulties when formulating their constructs during the interviews. My impression was that the way the elements were formulated was a major factor for their difficulties. However, Beth's case was a rebuttal of this hypothesis. She had the same elements to begin with, but was able to formulate so many independent constructs.

It might also be argued that since Beth formulated more independent constructs than Bob and Jackie, her construction system was more complex. However, as I discussed in the last chapter, cognitive complexity also involves integration of constructs, and measurement of integration is a controversial issue. Therefore, it would not be appropriate to reach a conclusion about the cognitive complexities of these persons.

Christina's and Charles' constructs are not directly comparable to the other three. They did not use the computerized process. Their exercise was model building, and they used pencil and paper to elicit their constructs. Therefore, quantitative comparisons, based on computed correlations was not possible. Table 9 shows their constructs. The [+] sign on each construct dimension indicates Christina's and Charles's choices between the two poles of each dimension. As I mentioned in the last chapter, choosing one pole of the construct is the first step of the model building process. These choices indicate the preferences to take action in the problematic situation, as Kelly's "choice corollary" suggests.

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[16] Dealing with the construct dimensions which are expressed repeatedly but using different words, is a major issue in personal construct theory. Shaw's computer software (Shaw, 1980) has the capability to detect such constructs and remind the user of them. Thus it lets the user reformulate his constructs and eliminate the recurrent ones. Our software does not have this capability.

Table 9. Christina's and Charles' Constructs in the Division of Vocational and Technical Education Case

Christina's Constructs

[+]
C1 Broadened perspectives in VTE -- Local in perspective
[+]
C2 Theoretical basis in VTE -- Practical
[+]
C3 Concerns with quality of content -- Material aspect
[+]
C4 Paradigm of research -- technical question
[+]
C5 Connections to national work life -- International aspects
[+]
C6 Education of researcher -- Equipment mastery
[+]
C7 Integration in education department -- Foundations of VTE
[+]
C8 Researcher training -- Hands on experience
[+]
C9 Mechanics of program -- Globalization
[+]
C10 Integration in the discipline -- Foundations of each program area of VTE

Charles's Constructs

[+]
C1 More of a research related -- More standardization of course content degree
[+]
C2 More pragmatic look at -- More philosophical faculty development faculty development
[+]
C3 Generalization of curriculum -- Ties to existent business, industry
[+]
C4 Broader based degree -- Requiring faculty to be more broadly trained
[+]
C5 Dependent on facility -- Degree content and degree
[+]
C6 Different realities in the world -- Plain pedagogical concerns

Christina's and Charles's choices among the poles of their constructs indicate that Christina is more theoretical, philosophical and global in her approach. Charles, on the other hand, is more practical and specific. We can expect these approaches to be reflected in their resultant models, which I will discuss below.

Interpretations of Grids

Jackie, Bob and Beth rated their own grids using the procedure described in the method chapter. Unlike the participants in the VCES case, they used the computer directly, when they entered their scores. Then, each of them interpreted the results of the cluster analysis of elements on the computer printouts. In this case, like in the VCES case, the interpretation did not work very well. The students could not come up with meaningful interpretations. Therefore, their problem structures emerged only from the elements.

The problem structures of Jackie, Bob and Beth are shown in Figures 3, 4 and 5. The names given to the cluster at the best clustering stage are shown in boxes. The computer printouts for Beth and her interpretations of the clusters are shown in Appendix V, as an example.

Jackie's problem structure is the most integrated one among the three. As Figure 3 shows, her ultimate goal and thus highest construct, for the Division of VTE was "excellence."[17] She thinks that there are four sub-goals that would lead to the achievement of excellence by DVTE: 1. increasing industrial, social/political awareness, 2. improving program quality, 3. improving program image, and 4. increasing program credibility. The phrases and propositions at the third level specify how each of these four goals would be reached.

Bob did not formulate an ultimate goal for DVTE, unlike Jackie. His problem structure rather indicates a sharp bi-polarity. Both "program development" and "concrete concerns" are two aspects of "traditional, conventional program improvement." He sees a sharp dichotomy between "traditional, conventional program improvement" and "lesser ethnocentricity." During my interview, I asked him to go further and combine these two poles under a single category. He could not come up with one. In other words, he could not find any commonality between these two poles.

The terms, names and phrases in the parentheses right under these two dichotomous poles are the associations that Bob made with these poles. It can be seen in Figure 4 that he makes a clear

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[17] Identifying "excellence" as a construct in this context may seem to be inconsistent with the definition of constructs as bipolar dimensions. Although constructs are bipolar, according to Kelly, they may be phrased as only one pole. That is the "emergent pole" of the construct. Kelly and some others used only one pole in some of their repertory grid experiments. "Excellence" can be considered as the emergent pole of Jackie's construct.

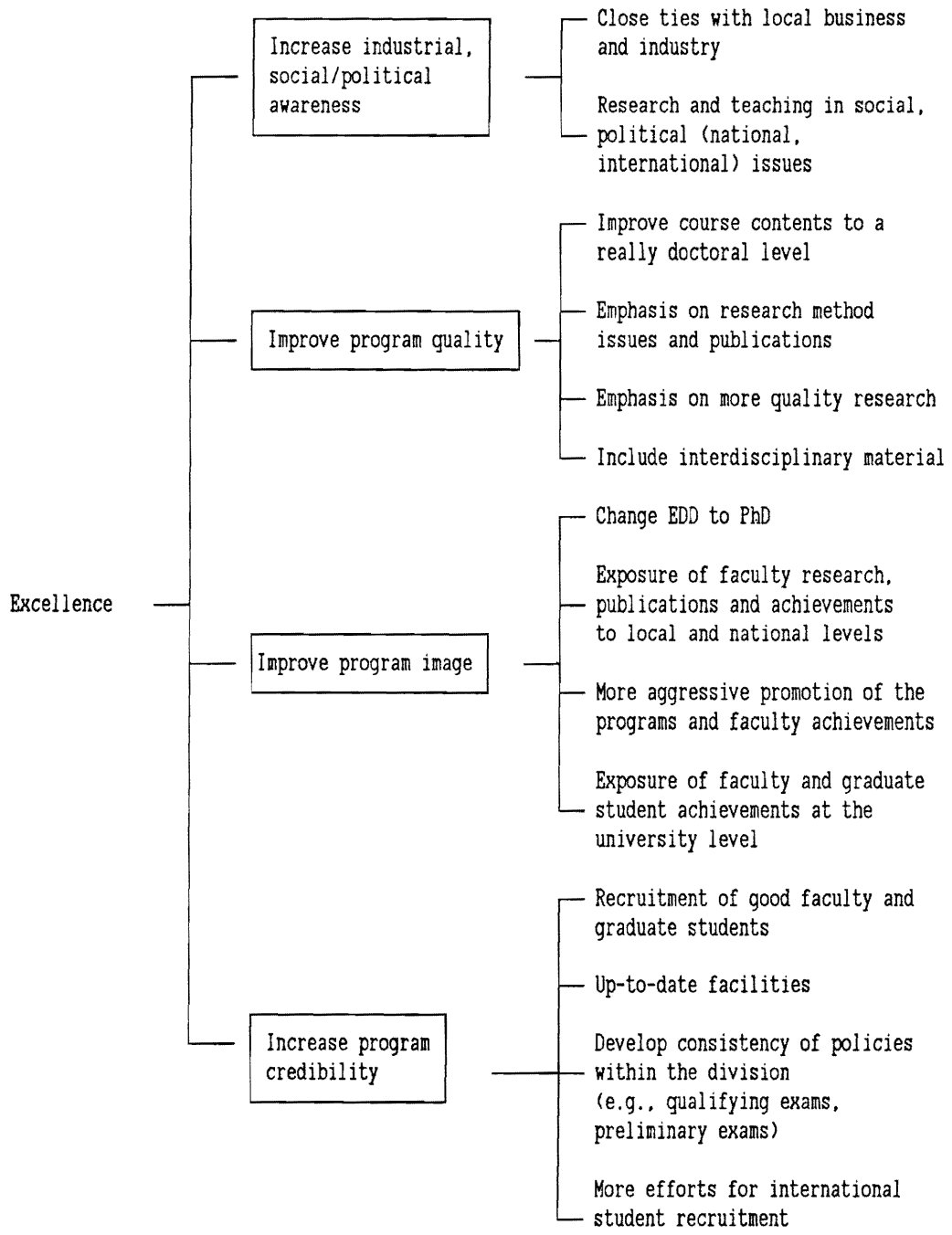

Figure 3. Jackie's Problem Structure in the Division of Vocational and Technical Education Case

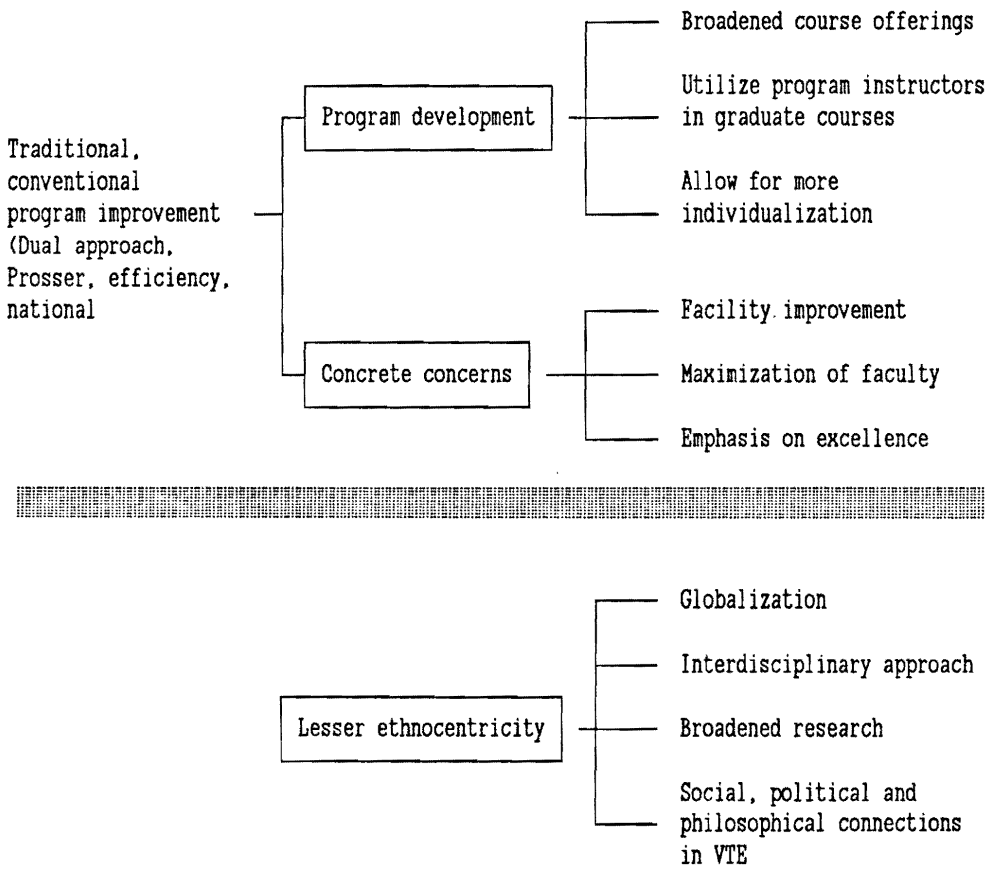

Figure 4. Bob's Problem Structure in the Division of Vocational and Technical Education Case

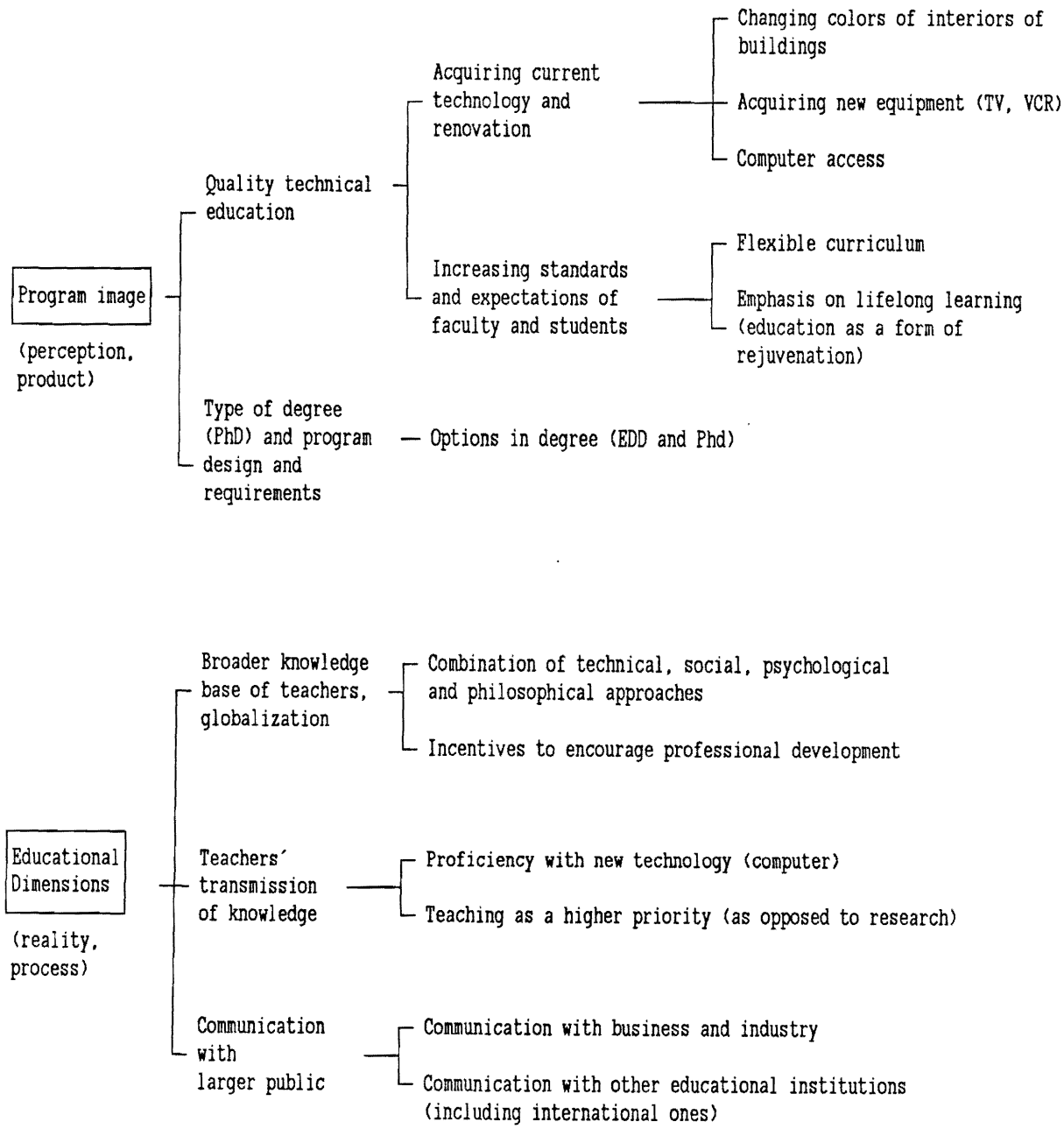

Figure 5. Beth's Problem Structure in the Division of Vocational and Technical Education Case

choice between the two main poles; he thinks that more emphasis should be put on "lesser ethnocentricity."

Beth, like Bob, could not come up with an ultimate goal for the DVTE. However, unlike Bob, she was not clear whether "program image" and "educational dimensions" are dichotomous or not. As can be seen in Figure 5, she generated 3 or 4 levels of specific propositions for these two highest goals.

Beth's structure is the least integrated one of the three. As I mentioned above, my analysis of Beth's grid indicated that her construct system was more multi-dimensional. I also mentioned the possibility of her construct system being more complex. However, the lack of integration I observed in Beth's construct system can be used as a counter argument. Crockett (1965) argues, as I cited in Chapter 3, that the level of hierarchical integration of constructs and clarity in superordinacy are necessary qualifications for "cognitive complexity." Since Beth's structure is not as integrated as Jackie's or Bob's, it becomes difficult to contend that her construct system is more complex than others.

Christina's and Charles' Models

Figures 6 and 7 are the models built by Christina and Charles.[18]

As I argued in Chapter 4, the models built are more complex in comparison to the problem structures. Models usually have more numbers of components, and the relationships between these are more complicated than merely being hierarchical. That is why I consider models closer to being concretes-in-mind.

Although models are not directly comparable to problem structures, there are some bases of comparison within the perspective of Personal Construct Theory. The ultimate goals, located at the rightmost end of the model, are the highest constructs. Other components with direct connections to these constitute a level which is one step lower.

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[18] I do not include the model segments built by Cristina and Charles in the appendix, because Mary's model segments in Appendix C will give an idea about how they would look.

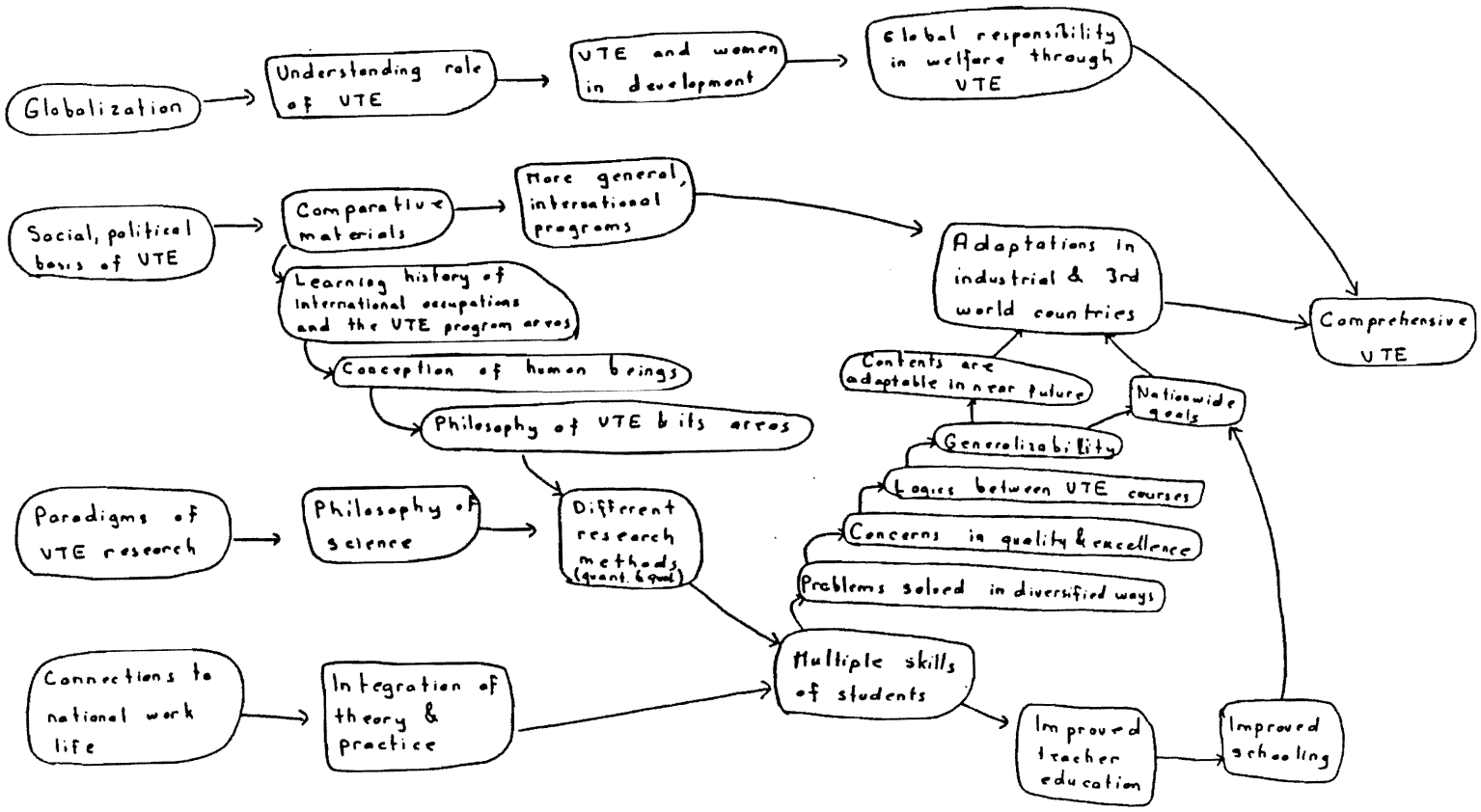

Figure 6. Christina's Model in the Division of Vocational and Technical Education Case

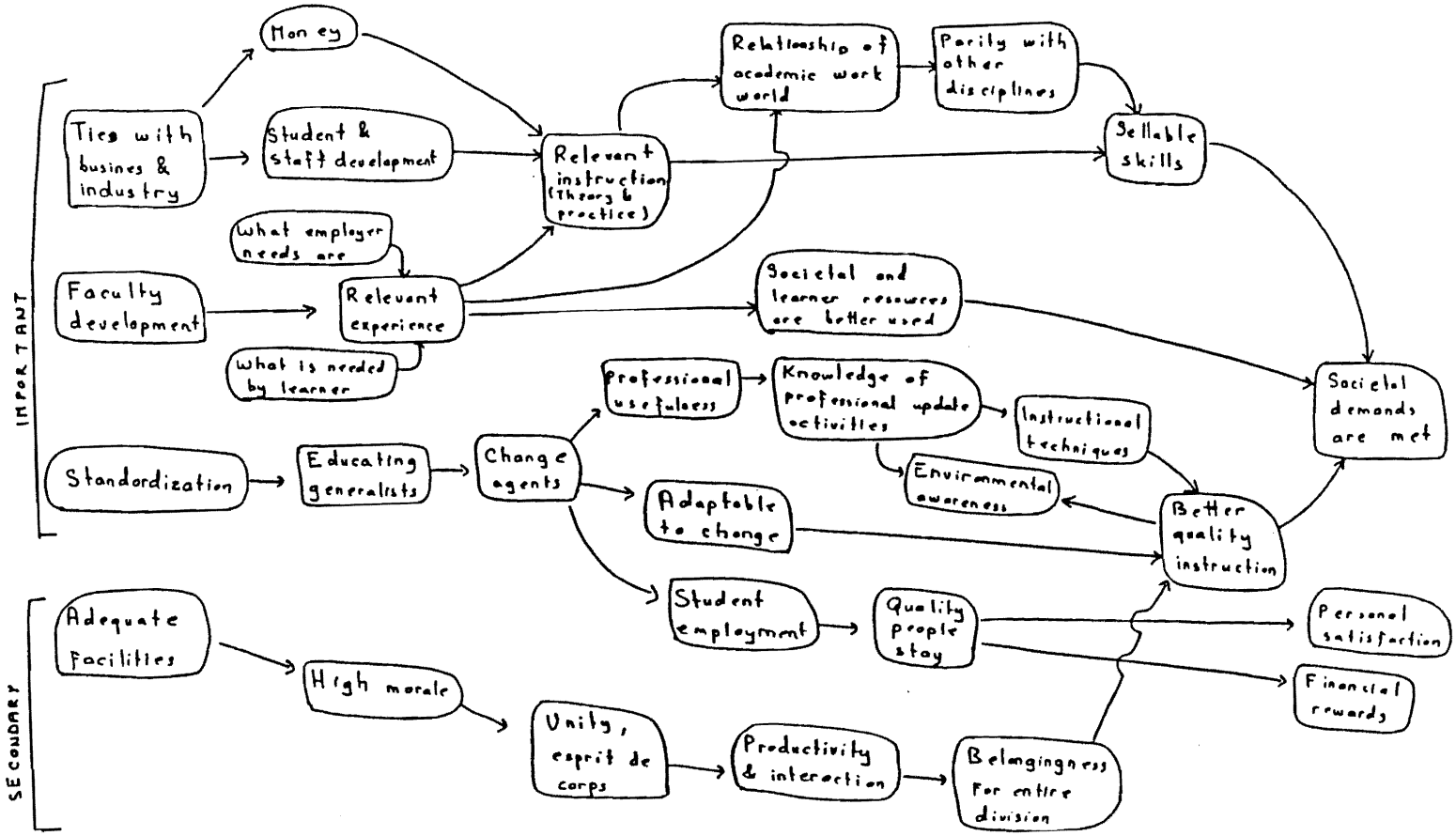

Figure 7. Charles' Model in the Division of Vocational and Technical Education Case

We thus can say that for Christina the highest construct (ultimate goal) is "comprehensive VTE," and this can be achieved through "global responsibility in welfare through VTE" and "adaptations in industrial and third-world countries." On the other hand, Charles sees the "societal demands to be met" as the ultimate goal. This goal can be achieved by having "sellable skills," using "societal and learner resources better" and "better quality instruction." Charles also identifies two other ultimate goals which are independent from "meeting societal demands." These are "personal satisfaction" and "financial rewards."

These two models confirm my earlier suggestion that Christina's approach is more theoretical, philosophical and global, whereas Charles' is more practical and specific.

Final Group Meeting and the Group Problem Structure

In the second group meeting the individual problem structures and models which were drawn on flip charts and put on the walls. They were discussed one by one, and a common problem structure was generated. This group process was facilitated by myself and Dr. Marion Asche. The structure generated by the group is shown in Figure 8.

The process started with formulating the three goals in the middle boxes: globalization, program quality/development and program image. The more specific propositions, shown on the right were generated through discussions. The ultimate goal on the left, also emerged as a result of the discussions in the group. The component "business and industry linkage" created a controversy. Students could not reach an agreement on the importance of it, i.e., whether it should be an independent goal, at the second level, or a goal at the third level contributing to "program image" and "program quality/development." Finally, it was put at the "2.5th level" as a compromise solution.

It was my impression that the group process was characterized by a major disagreement between the two approaches, which were represented by Jackie and Bob. As Jackie's structure indicates, she had a business-like attitude. Her ultimate goal, "excellence," reminded participants of the business terminology of recent years. Also, during the discussion she pushed the constructs "pro-

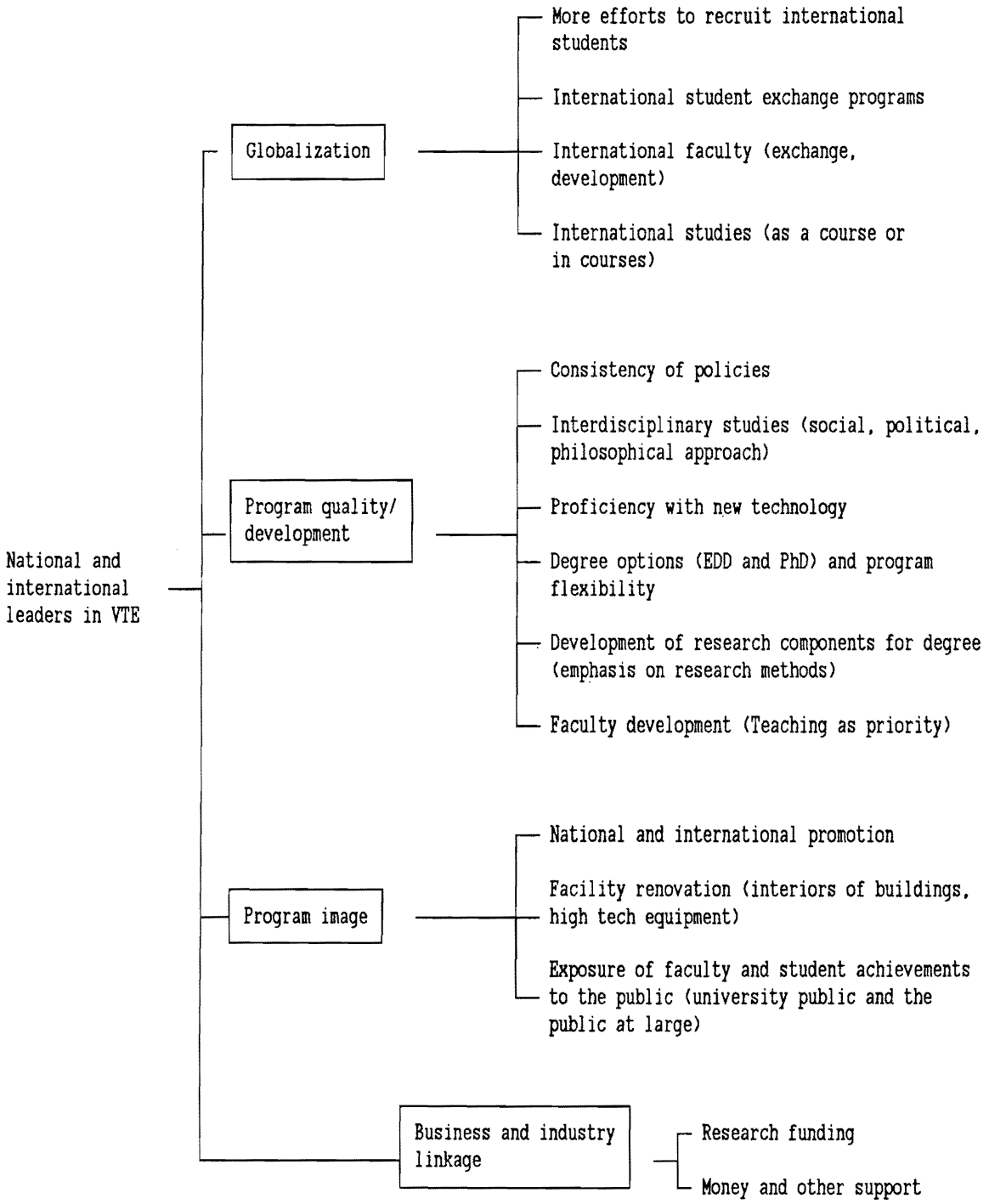

Figure 8. Group Problem Structure in the Division of Vocational and Technical Education Case

gram image" and "business and industry linkage." Her suggestions were supported by Beth and Charles. Their supports were not unexpected, because of the similar constructions displayed in Beth's individual problem structure and Charles's model.

Bob, on the other hand, resisted Jackie's suggestions, primarily by asking subsequent questions of clarification and by raising objections outright. He also pushed the idea of "globalization." This was expected given his explicit and strong preference for "lesser ethnocentricity" in his own problem structure. Christina's philosophical and global approach in her model also found its reflection in her support of Bob's position. Her support was sometimes tacit, sometimes more open.

As a result of this interaction, the "common" problem structure emerged as a document of compromise. The goal of "globalization" was accepted by all, however it was my observation that this goal was not supported as much by Jackie, Beth and Charles as it was by Bob and Christina. There was no disagreement on the "program quality/development" goal among the group. "Program image" was one of the two most controversial goals. Bob raised objections to the notion of commercial promotion of the VTE program. How important was the business-industry linkage was another controversial issue. I, as the facilitator, put off the controversy by suggesting that it be placed at the "2.5th level." The agreement on the ultimate goal was not reached easily. Dr. Asche's intervention and proposal finally helped settle the arguments on the ultimate goal, and "training national and international leaders in VTE" was agreed upon. The specific propositions at the third level were less controversial. Once the "big issues" were settled, what remained was simply listing specific suggestions. All group members contributed to these lists.

A close look at the group problem structure reveals that a considerable number of the components are similar to some of the elements in the list with which the process was initiated. In other words, those elements were repeated in similar ways in the final structure. Table 10 shows that seven elements out of the total ten were repeated in the final group structure.

Such repetition can be interpreted to mean that the formulation of elements as goal statements at the beginning of the process had negative effects on the creativity in the process. Instead of generating new ideas, the students repeated their initial formulations. This was probably because of the immature tightening at the element identification stage. However, there are other components

Table 10. Elements in the Initial List and Components in the Group Structure Which are Similar in the DVTE Case

	Elements	Components
E1	Closer working relationships with business and industry	Business-industry linkeage
E2	Adequate facilities	Facility renovation
E3	Change degree to Ph.D.	Degree options (EDD, Ph.D.) and program flexibility
E5	Increase in interdisciplinary approach	Interdisciplinary studies (social, political, philosophical approach)
E6	Faculty development	Faculty development (teaching as priority)
E8	Globalization	Globalization
E10	Socio-political-philosophical connections in VTE	Interdisciplinary studies (social, political, philosophical approach)

in the group structure which are not repetitions of the initial elements. The early tightening of elements, therefore, did not seem to prevent creative generation of ideas completely. Although the effects of initial tightening cannot be concluded from this example, it seems to be a relationship worthwhile to explore further.

A Comparison of the Two Cases

Although I described a procedure for problem structuring in Chapter 4, it was not supposed to be the final one. In the spirit of personal construct theory, the problem structuring procedure I proposed has been changed as I construed my experiences with the participants in the cases. My experiences in the Virginia Cooperative Extension Service case helped me to make some improvements in the procedure.

Using "maps" of the clustering patterns of elements in the VCES case was a good idea. Those visual aids made the participants more interested in the process. On the other hand, using maps prevented step-by-step interpretation. Therefore, the participants ended up with the lists of problem

areas and suggested actions, not with integrated problem structures. I used the computer printouts in the Division of Vocational and Technical Education case. As a result, the participants could generate the problem structures I discussed above.

Eliciting the constructs collectively, in the VCES case, was a "theoretical error." Therefore, I insisted on individual elicitation in the DVTE case. The constructs thus became more meaningful for each participant. However, I lost the capability of making quantitative comparisons.

The nature of the element identification process also was different in the DVTE case. Some elements were formulated as goal statements. Although this was unintended, it gave me an opportunity to experience the effects of early tightening on creativity in the process. It seems that early tightening does have an effect.

There were three common experiences in the two cases: first, the interpretations of the clustering patterns of constructs were much more difficult for the participants, and much less productive, than elements. I attribute this to the higher level abstractness of constructs. However, the computer software used did not have the capability of reversing the poles of constructs, which might have affected the interpretation process. The construct poles were not placed at one side or another, according to their meanings. It, therefore, was highly likely that the meaningful patterns that could have emerged in their relationships were lost.

The second common experience in the two cases was that the model building procedure was capable of creating better pictures of the problematic situation. The results were closer to being concretes-in-mind.

The third common experience was that "the procedure" of model building was indeed not a procedure, because it did not happen in an algorithmic sequence of steps. The model building turned out to be a far less structured, much more heuristic process than had been originally intended. This makes it very difficult to make model building a computerized procedure.

VI. Summary and Conclusions

The underlying premise of this dissertation has been that problem structuring is not only an important stage in policy analysis and decision making, but is an ongoing process throughout all the stages, as Dunn (1988) suggests. It is a social and cognitive process. However, my aim was not to explain how problem structuring takes place throughout. Nor was it to study the social processes in which it takes place. My focus rather was on the cognitive processes.

My approach was to discuss and elaborate the perspectives on problem structuring in the literature and develop a theoretical perspective based on these discussions. Then I proposed a method (i.e., a procedure) of structuring problems in individual minds and group interactions. I illustrated this method with two case studies. Although it was not my primary objective to "prove" the theoretical points I made in the second chapter with these case illustrations, I used those also to demonstrate some of the theoretical points.

I began my discussion with a critique of "the rational model" of decision making. I tried to show that the rational model not only confines "problem definition" to a "step" of the decision making process, but ignores it. This is because of its underlying empiricist assumptions. The rational model assumes that a problem is an "empirical gap to be identified." Yet, the rational model faces a difficulty when it starts dealing with one of the parameters of that empirical gap, namely "the goal." It assumes that goals belong to the realm of "values," which is incommensurable with the

realm of "facts." The projection of goals to the realm of facts creates both theoretical and practical difficulties. The rational model also considers goals as "immutable," and problems as "static gaps."

I argued against the claim that problems are static gaps existing in external reality and are empirically observable. I think problems belong to human cognition. They are more than simple gaps; they are complex cognitive structures. They change as parts of the everchanging human cognition.

A corollary of the proposition that problems belong to the cognitive system of the construing person is that a problematic situation, i.e., objective reality, is subject to different personal constructions, as Wildavsky (1979, p.83) suggests. Personal histories determine the differences and the commonalities in the ways problems are structured and solved, as Newell and Simon (1972, p.866) point out. These points were illustrated in the cases that I discussed.

The problem areas formulated, the actions suggested by all the group members and the model built by Mary in the VCES case indicate that each member of the PEP group had a different construction of the problematic situation. Although the goal, i.e., establishing a Human Resource Planning and Development System, was "quite clear" and was given to all members as "the same goal," we figured at the end of the process that it was not conceived as the same by all group members. Furthermore, "the problem" was not simply "the gap" between the need for a HRPDS and its absence in the present situation. There was a whole series of administrative, organizational, larger political and technical issues involved. Each group member formulated these issue differently. The repertory grid each member used facilitated the elicitation of the different constructions of the problematic situations.

The differences between individuals were not only in their formulations of different problem areas, but also in the processes of problem structuring. I observed this in both the VCES and the DVTE cases. In the former the contrast between Susan and Jim was illustrative. Susan generated the longest list of problem areas and suggested actions. She formulated those practical and specific propositions one after another. On the other hand, Jim formulated only one problem area and suggested only one action, which were both general. Contrary to the other group members, Jim was not comfortable with the elements, and formulated his problem area from constructs, which

were more abstract. In the DVTE case, my analyses of Bob's and Jackie's grids indicated that Their constructs boiled down to a single, strong dimension, whereas Beth's grid was multidimensional. In other words, each one had different dimensionality in his/her construction.

My argument that problems are not static gaps, and that problem structuring is a dynamic process in which goals are modified, was exemplified in the cases illustrated. I observed the changes taking place during personal interviews with the members of the VCES group. The long, iterative model building process by Mary was the best case. At the end of the process, her model turned out to comprise maintenance of a HRPDS as well as its establishment. Her ultimate goal emerged to be "increasing participation of individuals." The HRPDS was only a "means" or a "context" to reach this goal. As Dery suggests, "problem definition is a framework for learning about goals" (1984, p.8).

The cases illustrated supported my and others' argument that the distinction made between "problem definition" and "selection among options" by the rational model was an artificial one. As Simon (1973, P. 195), Wildavsky (1979, p. 26 and p. 83) and Dery (1983, p.xxi) point out, there are close cognitive links between the ways problems are structured and the actions are suggested or strategies for solutions are designed.

The problem formulations, structures and models in both cases were not only "definitions" of a situation, but were also "normative" in their formulations. In other words, the processes of structuring problems generated also rough models of action plans or strategies. Particularly the problem structures in the DVTE case and the models built in both cases can be considered as such. Both problem structures and models suggest that the ultimate goals can be achieved by taking the actions which are linked to them with arrows. The arrows indicate construed causalities. The whole picture (problem structure and model) becomes a plan of ways of achieving goals at various levels and the interconnections among them.

Although I used the case illustrations to support my theoretical arguments to an extend, the main thrust of my dissertation was developing an alternative to the rational model, both in theory and applications, and the cases were mainly for illustrating the method proposed as an alternative.

My theoretical framework was derived from Althusser's reformulation of Marx and the propositions and implications of the Chaos perspective. I also argued that George Kelly's personal

construct theory could be integrated into this framework, and his repertory grid technique can be used to operationalize it.

The Althusserian epistemology sees a cognitive process as a whole, with its abstract concepts, concretes-in- thought and self reflexivity. The Chaos perspective contributes to the framework at two points: first, it suggests that external reality is infinitely complex. A knowledge of this reality also should be complex, and the knowing process should involve creativity. Second, some research on the human mind indicate that it has a chaotic structure, which enables the mind to know this complex reality.

Kelly's constructive alternativism and personal construct theory complement and extend the theoretical framework that I used in my approach to problem structuring. His repertory grid technique gave me the practical tools to demonstrate how problems could be structured. Kelly's "constructs" and "elements" correspond to Althusser's abstract concepts. The repertory grid is a "structured conversation" process (Shaw, 19870, p.9) in which concretes-in-thought are built. A person converses with himself as well as with other people in the repertory grid process. Therefore, the repertory grid constitutes a medium of self reflexivity as well as social communication. Furthermore, it uses quantitative techniques in a specific way that contributes to self reflexivity. Its use of quantitative tools is in the context of a person's construct system. In other words, the person quantifies his/her own construction being aware of it. He/She does not attribute the quantities to an external reality. Thus, the repertory grid de-mystifies and de-objectifies quantitative analyses.

After developing the theoretical framework I proposed my method of problem structuring. This aimed at facilitating the generation of problem structures in the forms of "problem areas," "suggested actions," hierarchical problem structures and models. Although I described my method as a step-by-step procedure, it was not meant to be a strict procedure, but such made it easier to communicate with the participants and the readers of this dissertation. In fact, the "procedure" was a flexible one, and was adjusted to the practical conditions in the two cases I discussed. The need for flexibility was even more apparent in the model building process. As I mentioned in the last chapter, this was highly heuristic and iterative. I consider the method of problem structuring as a procedure in need of change. As I construed my experience with it, I felt the need to make

modifications. Such were necessary also for being consistent with the basic philosophy of Kelly, which suggests that personal constructions change incessantly. The method I discussed in this dissertation changed from one case to another. However, it still is not in its "final form," and it will never be in such a form, since it will keep changing with every new experience.

At the beginning of Chapter IV, I set three criteria to be met by my problem structuring method in the theoretical perspective I developed. The cases illustrated need to be discussed in order to assess whether these criteria were met by the method in these applications.

The first criterion is that the method should enable the person to reflect upon his/her construction, and elicit his/her own constructs and relate them to each other in the process of construing a problematic situation. The personalized nature of the method, in my opinion, ensured that participants could not detach themselves from the problem formulations they generated. It was also my observation in the individual interviews with the participants that they felt the excitement of encountering the products of their own cognitive processes. The method also enabled them to "play" with their own ideas and modify them in the process. This was especially apparent in the models building procedure which was much more heuristic and flexible. In the group discussions participants could evaluate their own models or problem formulations in comparison to others, which, I think, helped them understand their own constructions better, and modify them, if needed. In sum, it can be said that the method satisfied the first criterion in both self-reflexivity and ease of modifying personal constructions.

My second criterion is that the method should provide the person with the mechanisms of "loosening" and "tightening" of construction, and thus help him construe creatively. As I discussed in the illustration chapter, the participants were enabled to go through the phases of creativity cycle, as defined by Kelly.

Whether the products of the processes, i.e., the problem formulations, were creative or not can be a subject of discussion. This can be assessed in one of two ways. First, the person can be asked whether he/she thinks that the process has reminded him/her of some new aspects of the problem, and helped him/her formulate it in new, creative ways. Second, each participant can be asked to formulate the problem using also another method. A comparison of the results of the repertory grid

and the other method can give an idea about the degree of creativity fostered by each. I used the first approach. I asked each participant about their own assessments. They responded that the method helped them see the problems in new and creative ways. These responses confirmed my observations. However, there were some shortcomings, like the immature tightening of constructions in formulations of elements in the DVTE case, which I discussed in the illustration chapter.

My third criterion was that the constructs, problem structures and models should be communicable among the participants. One clear advantage of the method illustrated in two cases was that it used both visual and verbal forms of communication (maps, charts and problem formulations). This helped improve communication among the participants. It was my observation that clear and smooth intercommunications were achieved in both cases.

If problem structuring is an ongoing process throughout the policy analysis and decision making, as Dunn suggests and I agree, then how can we systematize this process and integrate it into daily practices? I think, the method I proposed can be a first step in that direction. With the help of the advances in the computer technology, particularly in Artificial Intelligence and Expert Systems, this method can be expanded to create a computerized, interactive problem structuring and restructuring system. A group of problem solvers can structure and restructure problems, formulate and reformulate their goals, suggest and modify actions, in interactive systems facilitated by computers, and communicate their constructions of problematic situations to each other. Such an interaction between human mind and computer can combine the advantages of the non-linearity of human mind with the high speed of the computer to generate worthwhile creative solutions.

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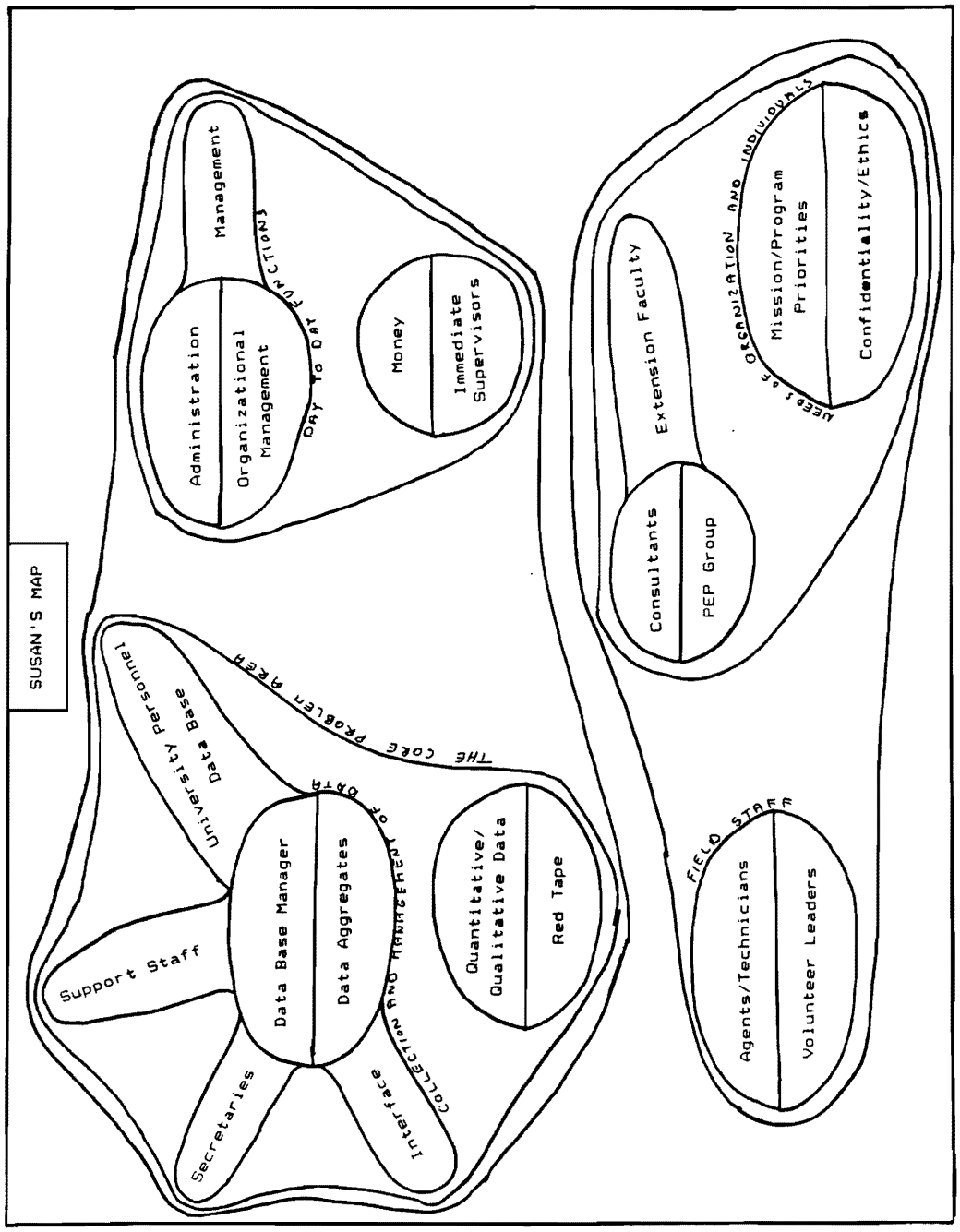
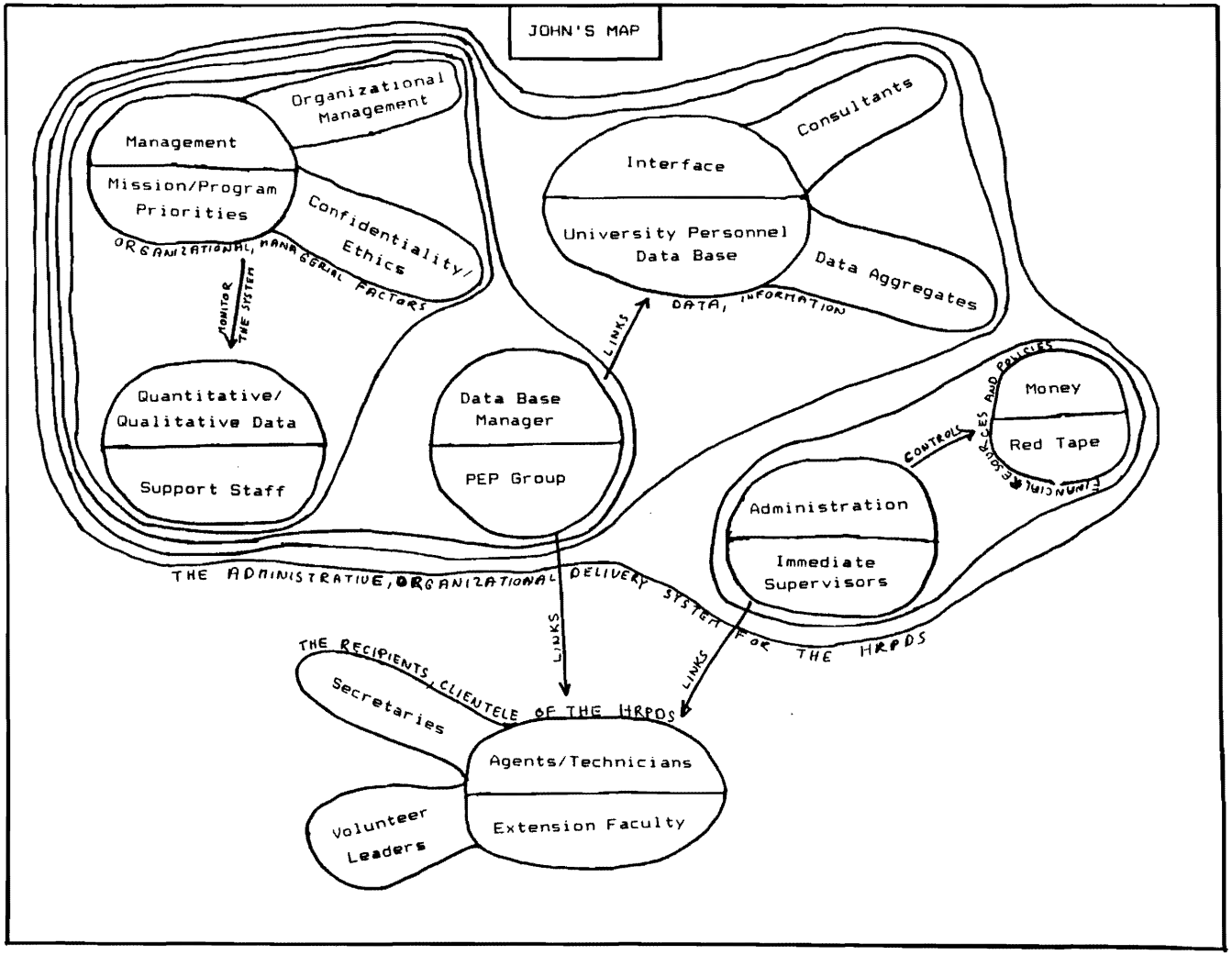
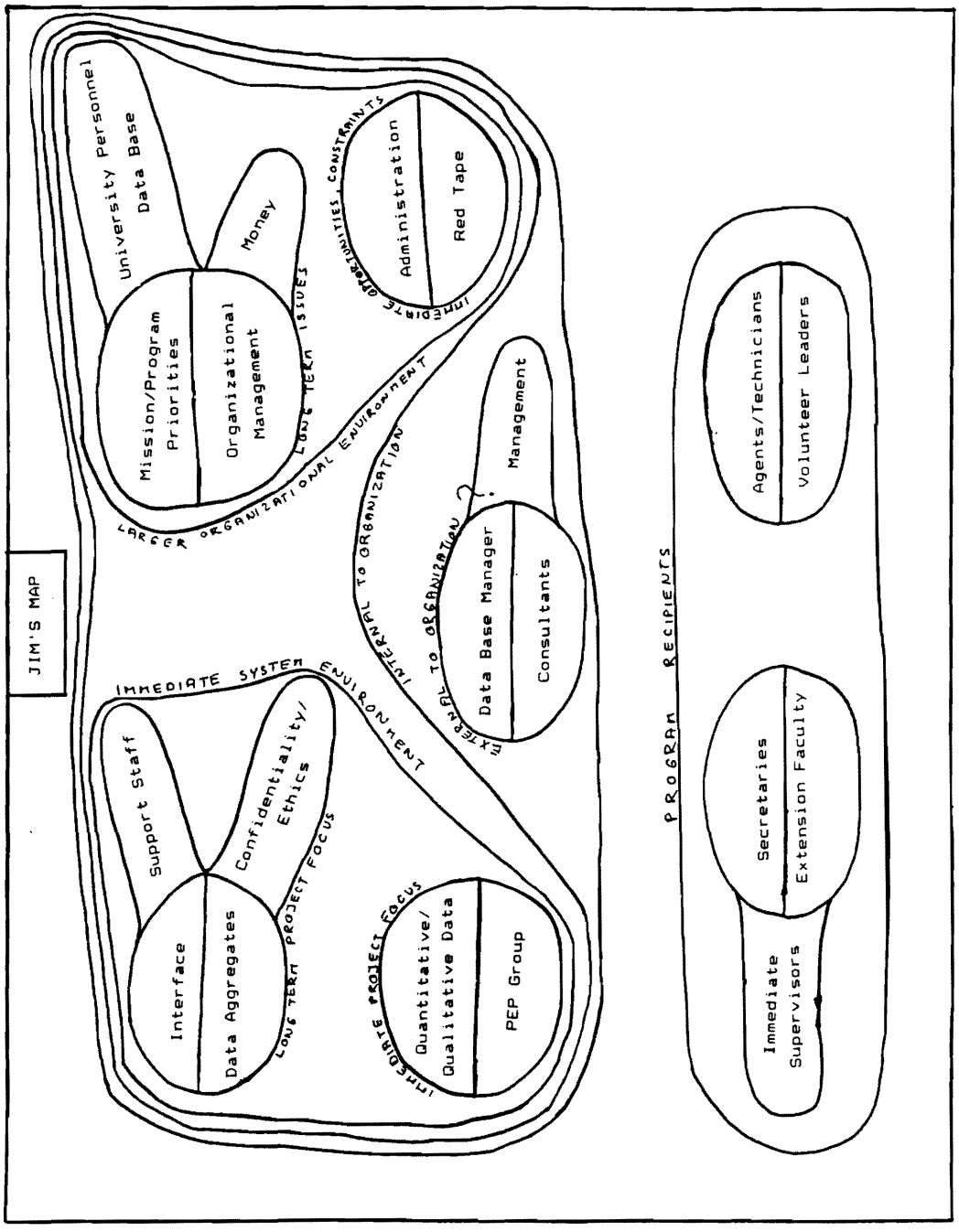
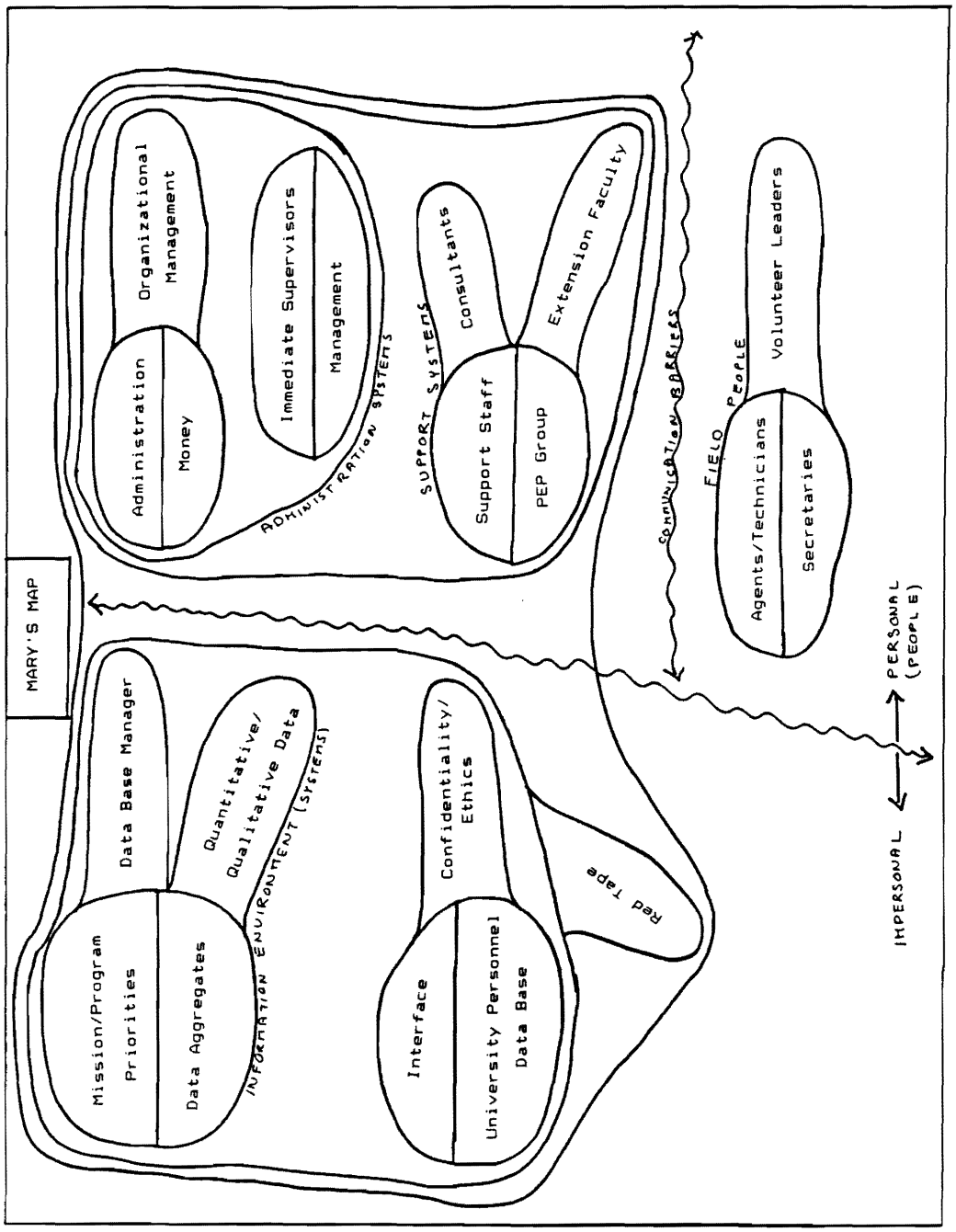
Appendix A. "Maps" of Group Members in the Virginia Cooperative Extension Service Case


SUSAN'S MAP
Management
Administration
Organizational Management
DAY TO DAY FUNCTIONS
Money
Immediate Supervisors
Extension Faculty
Consultants
PEP Group
ORGANIZATION AND INDIVIDUALS NEEDS
Mission/Program Priorities
Confidentiality/Ethics
THE CORE PROBLEM AREA
University Personnel
Data Base
Support Staff
Data Base Manager
Data Aggregates
MANAGEMENT OF DATA
Quantitative/ Qualitative Data
Red Tape
COLLECTION AND
Secretaries
Interface
FIELD STAFF
Agents/Technicians
Volunteer Leaders


JOHN'S MAP
Organizational Management
Management
Mission/Program Priorities
Confidentiality/ Ethics
ORGANIZATIONAL, MANAGERIAL FACTORS
MONITOR THE SYSTEM
Quantitative/ Qualitative Data
Support Staff
Consultants
Interface
University Personnel Data Base
Data Aggregates
DATA, INFORMATION
LINKS
Data Base Manager
PEP Group
Money
Red Tape
RESOURCES AND POLICIES
FUNCTIONAL
CONTROLS
Administration
Immediate Supervisors
THE ADMINISTRATIVE, ORGANIZATIONAL DELIVERY SYSTEM FOR THE HRPDS
LINKS
LINKS
THE RECIPIENTS, CLIENTELE OF THE HRPDS
Secretaries
Agents/Technicians
Volunteer Leaders
Extension Faculty


JIM'S MAP
LARGER ORGANIZATIONAL ENVIRONMENT
University Personnel Data Base
Money
Mission/Program Priorities
Organizational Management
LONG TERM ISSUES
Opportunities, Constraints
Administration
Red Tape
IMMEDIATE SYSTEM ENVIRONMENT
Support Staff
Confidentiality/ Ethics
Interface
Data Aggregates
LONG TERM PROJECT FOCUS
SHORT PROJECT FOCUS
Quantitative/ Qualitative Data
PEP Group
INTERNAL TO ORGANIZATION
Management
Data Base Manager
Consultants
PROGRAM RECIPIENTS
Agents/Technicians
Volunteer Leaders
Secretaries
Extension Faculty
Immediate Supervisors


MARY'S MAP
Mission/Program Priorities
Data Aggregates
Data Base Manager
Quantitative/ Qualitative Data
INFORMATION ENVIRONMENT (SYSTEMS)
Interface
University Personnel Data Base
Confidentiality/ Ethics
Red Tape
Administration
Money
Organizational Management
Immediate Supervisors
Management
ADMINISTRATION SYSTEMS
Support Staff
PEP Group
Consultants
Extension Faculty
SUPPORT SYSTEMS
COMMUNICATION BARRIERS
Agents/Technicians
Secretaries
Volunteer Leaders
FIELD PEOPLE
IMPERSONAL
PERSONAL (PEOPLE)

Appendix B. Problem Areas Formulated and Actions Suggested in the Virginia Cooperative Extension Service Case

SUSAN

From Elements:

1. Problem Area:

The core problem area is the collection and management of data. Data Base Management System is important for both information needs and legitimization.

2. Problem Area:

Objectives of the project (establishing a HRPDS) is not clear. It may lead to a restructuring of the organization.

3. Problem Area:

Administration and Organizational Management are wrapped up in a bag. There is a lack of clarity in differences. There is a lack of delegation of responsibility.

4. Problem Area:

The power and advocacy of top administration is needed to get the job done.

Suggested Action:

Briefings with the administration will help (to gain its advocacy).

5. Problem Area:

There is a lack of trust between the administration and the field staff.

Suggested Action:

PEP may play a role to build trust between these two groups.

6. Problem Area:

The field people is the major target of the project. They need to be assured. Confidentiality is very important.

Suggested Action:

The field people are being interviewed. [This has been the right thing to do].

7. Problem Area:

Support for individuals in the organization is needed.

Suggested Action:

Stress management, career planning programs.

From Constructs:

8. Problem Area:

The attention is now inside the organization [VCES]. It will shift to the outside when the project is finished. The extension services of the other states will be affected by the results.

JOHN

From Elements:

1. Problem Area:

There should be links between the PEP unit and the program recipients.

2. Problem Area:

Will a restructuring of the institution, and dissolution of the PEP unit be necessary ?

3. Problem Area:

Good relationships between the immediate supervisors and the other personnel is important. Red tape, money [availability of financial resources] may hinder good relationships.

Suggested Action:

Coaching, counselling, mentoring and personal appraisal by the immediate supervisors are necessary actions.

4. Problem Area:

The secretaries, agents/technicians, volunteer leaders and extension faculty, have some common needs. Also, each group has specific needs. HRPDS must consider both common and specific needs.

5. Problem Area:

Personal developmental needs of the personnel also need to be considered.

6. Problem Area:

What is the best way of accessing external data base ?

7. Problem Area:

Continuous data collection will be necessary for managerial decisions.

8. Problem Area:

A Specific data base is needed for VCES.

From Constructs:

9. Problem Area:

The major emphasis is on the inside of organization.

Suggested Action:

There are resources inside (mainly the human beings) that should be used.

JIM

No problem area identified from the elements.

From Constructs:

1. Problem Area:

There are philosophical issues and operational issues. Philosophical issues are essential. Operational ones are secondary.

Suggested Action:

There has to be a philosophical approach. It should involve how to get people buy into the process. Involvement of people will be important for the effectiveness of the system.

MARY

From Elements:

1. Problem Area:

There are communication barriers between the administrative and support staff, who are on campus, and the field people.

Suggested Action:

The administrative staff should go to the field.

2. Suggested Action:

The information and bureaucratic systems should be personalized. The communication and computing systems should be made personal, simplified and user-friendly.

From Constructs:

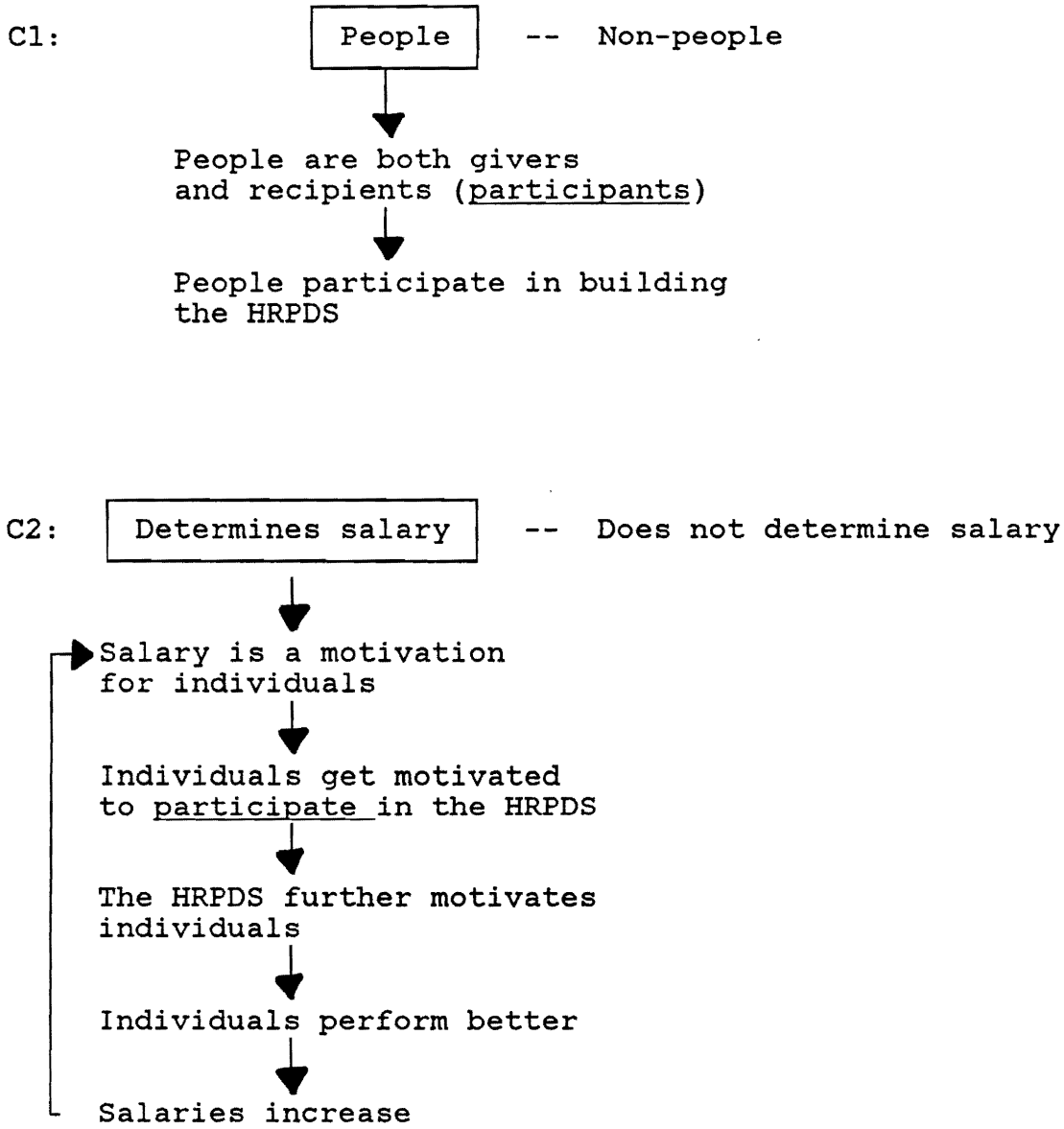
3. Problem Area:

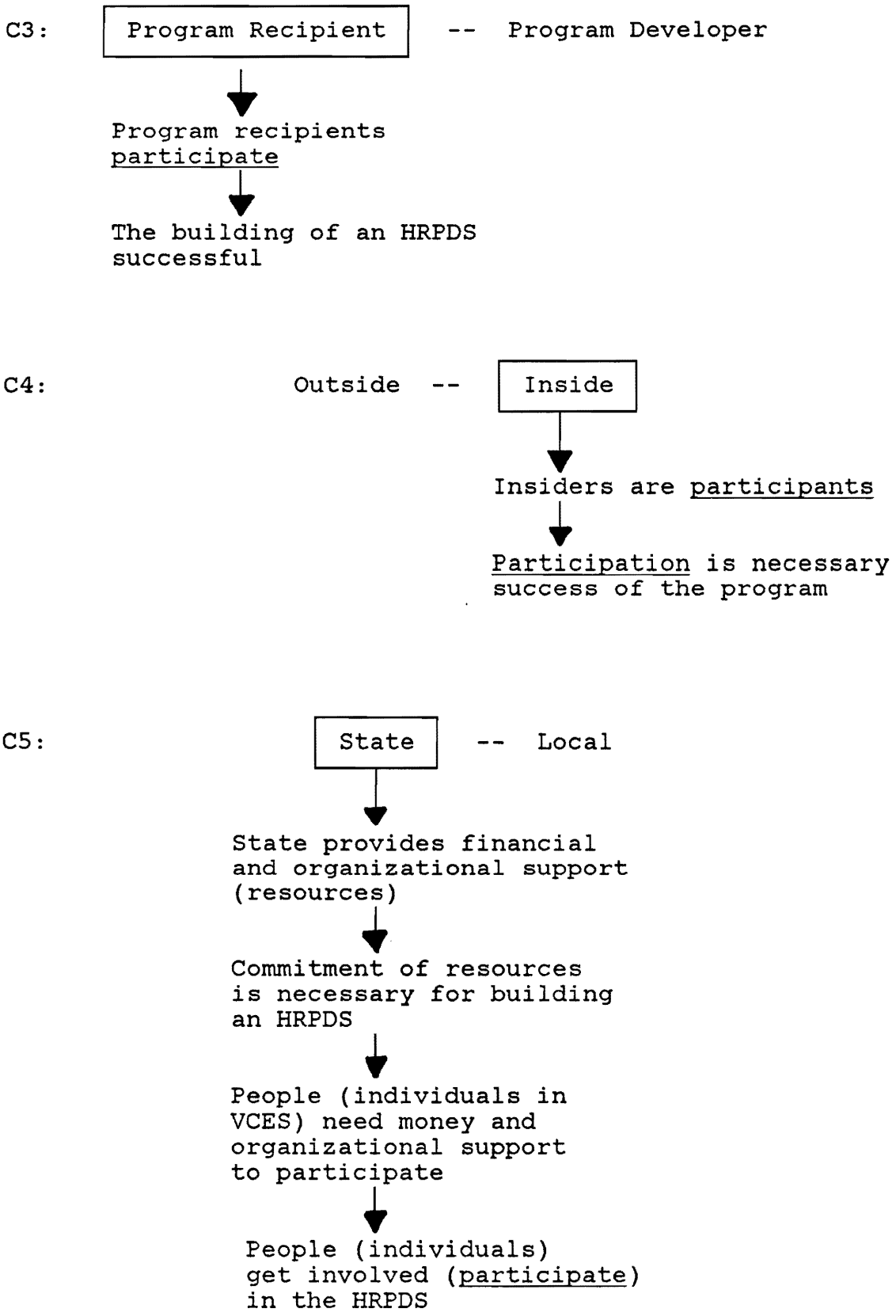
External factors like state agencies is important, because they hold some resources.

4. Problem Area:

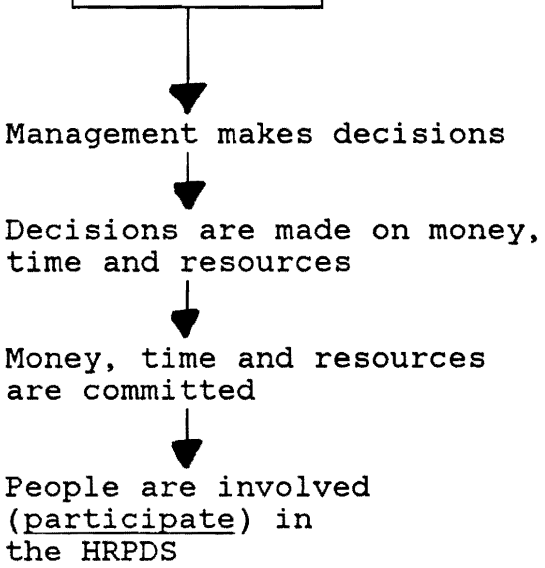
Organizational culture effects the success of project.

Appendix C. Model Segments Generated by Mary in the Virginia Cooperative Extension Service Case


C1:
People
-- Non-people
People are both givers and recipients (participants)
People participate in building the HRPDS
C2:
Determines salary
-- Does not determine salary
Salary is a motivation for individuals
Individuals get motivated to participate in the HRPDS
The HRPDS further motivates individuals
Individuals perform better
Salaries increase


C3:
Program Recipient
-- Program Developer
Program recipients participate
The building of an HRPDS successful
C4:
Outside --
Inside
Insiders are participants
Participation is necessary success of the program
C5:
State
-- Local
State provides financial and organizational support (resources)
Commitment of resources is necessary for building an HRPDS
People (individuals in VCES) need money and organizational support to participate
People (individuals) get involved (participate) in the HRPDS

C6: Management -- Labor



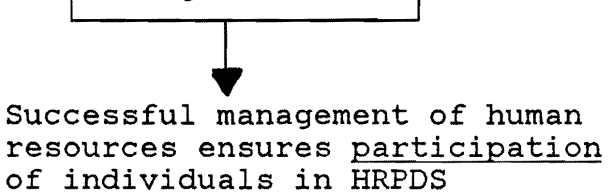
C7: Management -- Application

Mary skipped this construct, because it did not seem meaningful to her.

C8: Builders -- Users

Mary skipped this construct too, because, she said, "builders" and "users" should not have been at the two opposite poles of a construct. In other words, this was not a construct at all for Mary.

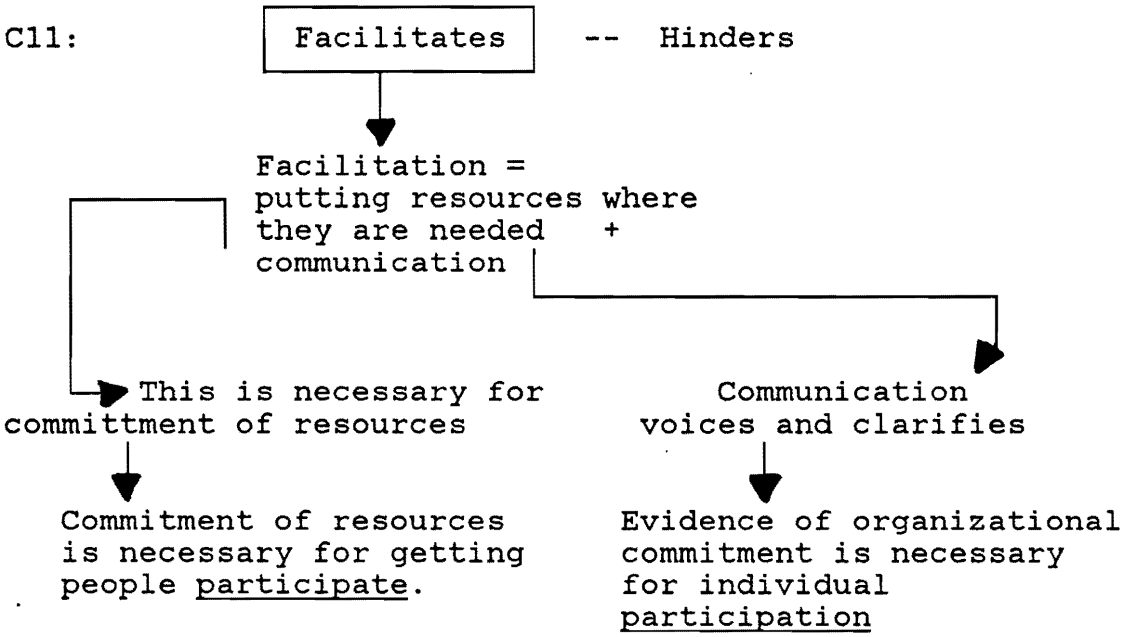
C9: Administrative Management -- Human Resources Management



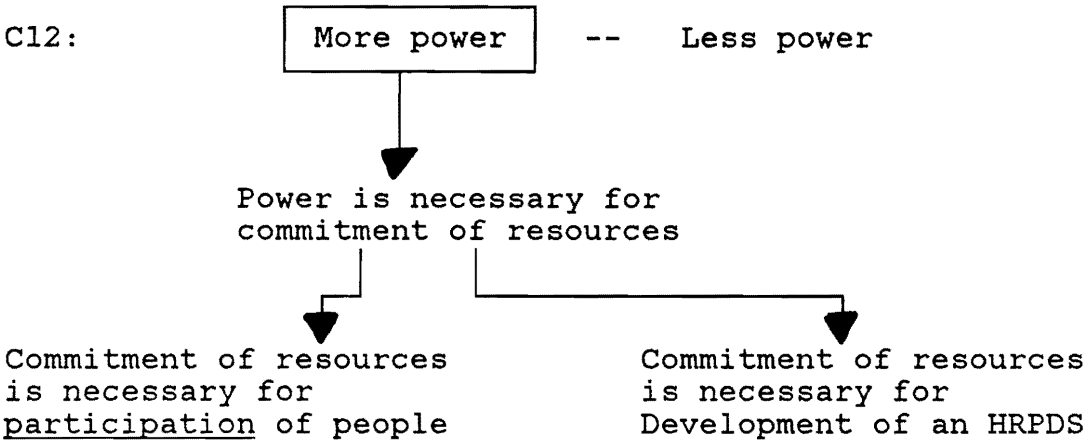
C10: University-related -- Project-related

This construct did not seem meaningful to Mary.

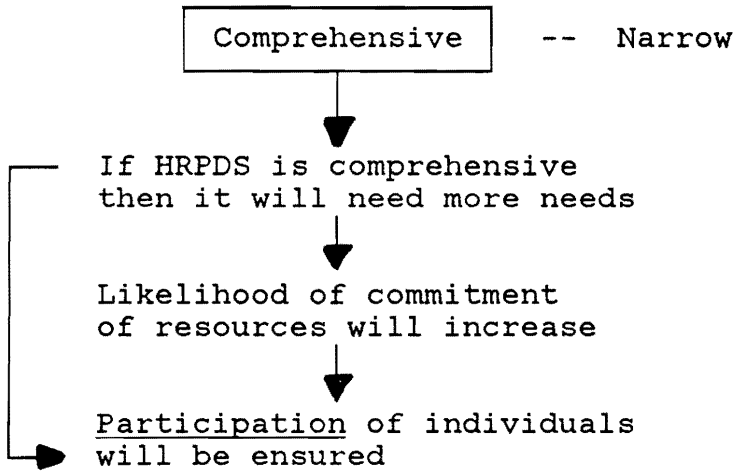
C11:



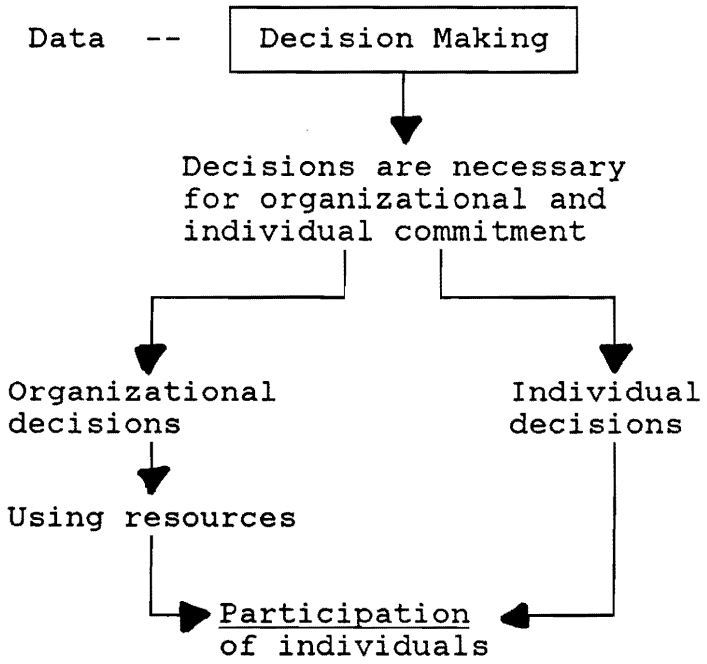
C12:



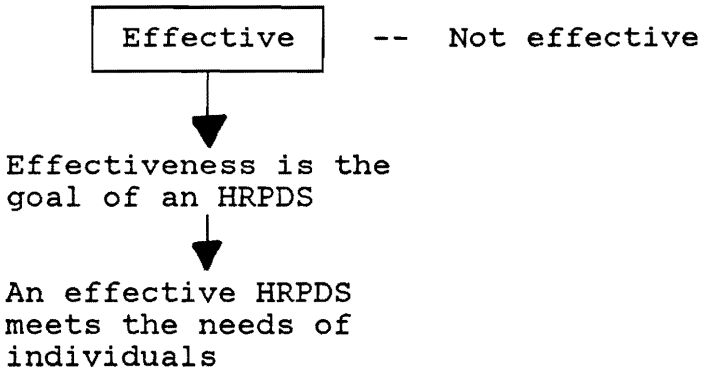
C13:


Comprehensive
--
Narrow
If HRPDS is comprehensive
then it will need more needs
Likelihood of commitment
of resources will increase
Participation of individuals
will be ensured

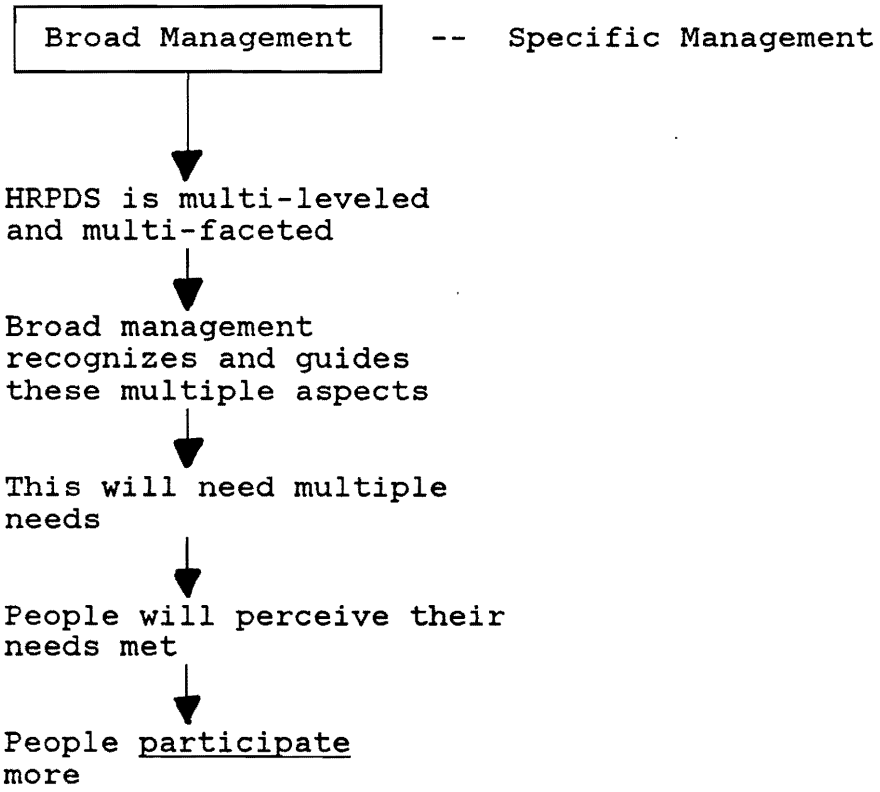
C14:


Data
--
Decision Making
Decisions are necessary
for organizational and
individual commitment
Organizational
decisions
Individual
decisions
Using resources
Participation
of individuals

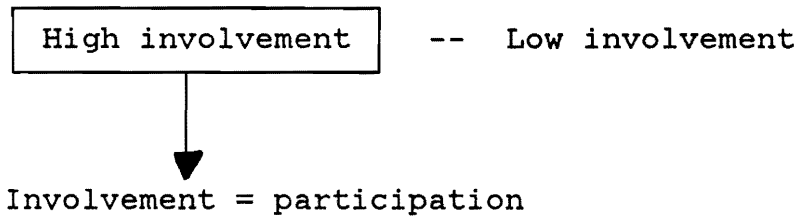
C15:


Effective
-- Not effective
Effectiveness is the goal of an HRPDS
An effective HRPDS meets the needs of individuals

C16:


Broad Management
-- Specific Management
HRPDS is multi-leveled and multi-faceted
Broad management recognizes and guides these multiple aspects
This will need multiple needs
People will perceive their needs met
People participate more

C17:


High involvement
-- Low involvement
Involvement = participation

Appendix D. The Initial List of Elements Generated in the Division of Vocational and Technical Education Case

Enrollment

Adequate Facility

Change to Ph.D.

Research Oriented Programs

Less Positivism, More Phenomenology

Improved Instructional Technology

Image

Increase Support Services

Philosophical Aspects of Vocational Education

Increase Interdisciplinary Approach

LAN (Local Area Network)

Improve Course Quality

Extension and Demonstration Mission

Short-term Parking Near Building

International Comparisons

Lifelong Learning

Faculty Fellowships Abroad

Faculty Development

Recruitment of High Quality Faculty

Program Instructors Teach More Graduate Classes

Third World Policies in Vocational Education

Ageing of Society

Renovation of Offices and Work Areas

Emphasis on Excellence

Growth of Graduate Program

Continuity in Qualifying Exam

Socio-political Connections in Vocational Education

Overhaul of Labs

University's Attitude Toward COE

Efforts to Secure Additional Financial Support

More Flexibility in Concentration vs. Cognate

Hard and Soft Technology

Changes in Selection Process for Grad. Committee

Increase in Travel Funds Allotment

Competition with Other Colleges

Establishment of Student Grievance Program

Graduate Courses in Training and Development

Integration of the Different Program Areas

Closer Relationship with Business and Industry

Input from Other Universities

Appendix E. Beth's Printouts and Her Interpretations In the Division of Vocational and Technical Education Case

LIST OF ELEMENTS OF THE PROBLEMATIC SITUATION

CASE NAME: Beth DATE: 03-03-1989 TIME: 09:23:05

ID CODE	DESCRIPTION
E1	Closer working relations with business and industry
E2	Adequate facilities
E3	Change degree to PhD
E4	Broadened, research oriented program
E5	Increase in interdisciplinary approach
E6	Faculty development
E7	Program instructors teach more graduate classes
E8	Globalization
E9	Emphasis on excellence
E10	Social, political and philosophical connections in VTE

LIST OF PROBLEM DIMENSIONS

CASE NAME: Beth DATE: 03-03-1989 TIME: 09:23:05

ID CODE	DESCRIPTION
PD1	Internationally recognized -- Nationally recognized
PD2	Change in industry -- Change in lifestyles
PD3	Improving business and industry -- International competition
PD4	Multi-facet approach to a given subject -- Single world view
PD5	Social, political, philosophical -- Needs of business
PD6	International technical needs -- Domestic technical needs
PD7	Image related -- Student related
PD8	Improving student education -- Degree status

LIST OF ELEMENTS, PROBLEM DIMENSIONS AND SCORES

CASE NAME: Beth DATE: 03-03-1989 TIME: 09:23:05

FOR THE PROBLEM DIMENSION: PD1 Internationally recognized -- Nationally recognized

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	3.0
E2	Adequate facilities	3.0
E3	Change degree to PhD	3.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	3.0
E6	Faculty development	3.0
E7	Program instructors teach more graduate classes	3.0
E8	Globalization	3.0
E9	Emphasis on excellence	4.0
E10	Social, political and philosophical connections in VTE	4.0

FOR THE PROBLEM DIMENSION: PD2 Change in industry -- Change in lifestyles

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	2.0
E2	Adequate facilities	2.0
E3	Change degree to PhD	3.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	4.0
E6	Faculty development	3.0
E7	Program instructors teach more graduate classes	2.0
E8	Globalization	3.0
E9	Emphasis on excellence	3.0
E10	Social, political and philosophical connections in VTE	4.0

FOR THE PROBLEM DIMENSION: PD3 Improving business and industry -- International competition

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	2.0
E2	Adequate facilities	2.0
E3	Change degree to PhD	3.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	3.0
E6	Faculty development	2.0
E7	Program instructors teach more graduate classes	2.0
E8	Globalization	2.0
E9	Emphasis on excellence	1.0
E10	Social, political and philosophical connections in VTE	4.0

FOR THE PROBLEM DIMENSION: PD4 Multi-facet approach to a given subject -- Single world view

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	3.0
E2	Adequate facilities	3.0
E3	Change degree to PhD	2.0
E4	Broadened, research oriented program	2.0
E5	Increase in interdisciplinary approach	1.0
E6	Faculty development	2.0
E7	Program instructors teach more graduate classes	2.0
E8	Globalization	4.0
E9	Emphasis on excellence	3.0
E10	Social, political and philosophical connections in VTE	4.0

FOR THE PROBLEM DIMENSION: PD5 Social, political, philosophical issues -- Needs of business

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	5.0
E2	Adequate facilities	4.0
E3	Change degree to PhD	2.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	2.0
E6	Faculty development	3.0
E7	Program instructors teach more graduate classes	2.0
E8	Globalization	5.0
E9	Emphasis on excellence	3.0
E10	Social, political and philosophical connections in VTE	1.0

FOR THE PROBLEM DIMENSION: PD6 International technical needs -- Domestic technical needs

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	3.0
E2	Adequate facilities	4.0
E3	Change degree to PhD	3.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	3.0
E6	Faculty development	3.0
E7	Program instructors teach more graduate classes	3.0
E8	Globalization	1.0
E9	Emphasis on excellence	4.0
E10	Social, political and philosophical connections in VTE	3.0

FOR THE PROBLEM DIMENSION: PD7 Image related -- Student related

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	1.0
E2	Adequate facilities	4.0
E3	Change degree to PhD	1.0
E4	Broadened, research oriented program	3.0
E5	Increase in interdisciplinary approach	5.0
E6	Faculty development	4.0
E7	Program instructors teach more graduate classes	5.0
E8	Globalization	4.0
E9	Emphasis on excellence	1.0
E10	Social, political and philosophical connections in VTE	5.0

FOR THE PROBLEM DIMENSION: PD8 Improving student education -- Degree status

ID CODE	ELEMENT	SCORE
E1	Closer working relations with business and industry	2.0
E2	Adequate facilities	2.0
E3	Change degree to PhD	5.0
E4	Broadened, research oriented program	1.0
E5	Increase in interdisciplinary approach	1.0
E6	Faculty development	1.0
E7	Program instructors teach more graduate classes	1.0
E8	Globalization	1.0
E9	Emphasis on excellence	3.0
E10	Social, political and philosophical connections in VTE	1.0

CLUSTER ANALYSIS OF ELEMENTS

```
STAGE  1   G-VALUE = .987
COMBINE-------------------------------------------------------

   0     0     0     4     0     6     0     8     0     0
-------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
Cluster 2:
  E2     Adequate facilities
Cluster 3:
  E3     Change degree to PhD
Cluster 4:
  E4     Broadened, research oriented program
  E6     Faculty development

Cluster 5:
  E5     Increase in interdisciplinary approach
Cluster 6:
  E7     Program instructors teach more graduate
         classes
Cluster 7:
  E8     Globalization
Cluster 8:
  E9     Emphasis on excellence
Cluster 9:
  E10    Social, political and philosophical
         connections in VTE
-------------------------------------------------------------
```

Name: Faculty competency

```
STAGE  2   G-VALUE = .955
COMBINE-------------------------------------------------------

   0     0     0     4     0     6     7     0     0     0
-------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
Cluster 2:
  E2     Adequate facilities
Cluster 3:
  E3     Change degree to PhD
Cluster 4:
  E4     Broadened, research oriented program
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
Cluster 5:
  E5     Increase in interdisciplinary approach
Cluster 6:
  E8     Globalization
Cluster 7:
  E9     Emphasis on excellence
Cluster 8:
  E10    Social, political and philosophical
         connections in VTE
-------------------------------------------------------------
```

Name: Faculty teaching

```
STAGE  3   G-VALUE = .919
COMBINE-------------------------------------------------------------

   1     2     0     0     0     0     0     0     0     0
-------------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
  E2     Adequate facilities
Cluster 2:
  E3     Change degree to PhD
Cluster 3:
  E4     Broadened, research oriented program
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
Cluster 4:
  E5     Increase in interdisciplinary approach
Cluster 5:
  E8     Globalization
Cluster 6:
  E9     Emphasis on excellence
Cluster 7:
  E10    Social, political and philosophical
         connections in VTE
-------------------------------------------------------------------
```

Name: Current technology

```
STAGE  4   G-VALUE = .861
COMBINE-------------------------------------------------------
   0     0     0     4     5     6     7     0     0     0
-------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
  E2     Adequate facilities
Cluster 2:
  E3     Change degree to PhD
Cluster 3:
  E4     Broadened, research oriented program
  E5     Increase in interdisciplinary approach
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
Cluster 4:
  E8     Globalization
Cluster 5:
  E9     Emphasis on excellence
Cluster 6:
  E10    Social, political and philosophical
         connections in VTE
-------------------------------------------------------------
```

Name:Broader knowledge base

```
STAGE  5   G-VALUE = .751
COMBINE-------------------------------------------------------
   1     2     0     0     0     0     0     0     9     0
-------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
  E2     Adequate facilities
  E9     Emphasis on excellence
Cluster 2:
  E3     Change degree to PhD
Cluster 3:
  E4     Broadened, research oriented program
  E5     Increase in interdisciplinary approach
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
Cluster 4:
  E8     Globalization
Cluster 5:
  E10    Social, political and philosophical
         connections in VTE
-------------------------------------------------------------
```

Name: Quality technical education

```
STAGE  6   G-VALUE = .622
COMBINE-----------------------------------------------------------
   1     2     3     0     0     0     0     0     9     0
-----------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
  E2     Adequate facilities
  E3     Change degree to PhD
  E9     Emphasis on excellence
Cluster 2:
  E4     Broadened, research oriented program
  E5     Increase in interdisciplinary approach
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
Cluster 3:
  E8     Globalization
Cluster 4:
  E10    Social, political and philosophical
         connections in VTE
-----------------------------------------------------------------
```

Name: Program image

```
STAGE  7   G-VALUE = .452
COMBINE-----------------------------------------------------------
   0     0     0     4     5     6     7     8     0     0
-----------------------------------------------------------------

Cluster 1:
  E1     Closer working relations with business
         and industry
  E2     Adequate facilities
  E3     Change degree to PhD
  E9     Emphasis on excellence
Cluster 2:
  E4     Broadened, research oriented program
  E5     Increase in interdisciplinary approach
  E6     Faculty development
  E7     Program instructors teach more graduate
         classes
  E8     Globalization
Cluster 3:
  E10    Social, political and philosophical
         connections in VTE
-----------------------------------------------------------------
```

Name: Educational Dimensions

STAGE 8 G-VALUE = .252

COMBINE

0	0	0	4	5	6	7	8	0	0

Cluster 1:

E1	Closer working relations with business and industry
E2	Adequate facilities
E3	Change degree to PhD
E9	Emphasis on excellence

Name: Program image

Cluster 2:

E4	Broadened, research oriented program
E5	Increase in interdisciplinary approach
E6	Faculty development
E7	Program instructors teach more graduate classes
E8	Globalization
E10	Social, political and philosophical connections in VTE

Name: Educational Dimensions

STAGE 9 G-VALUE = 9.01E-15

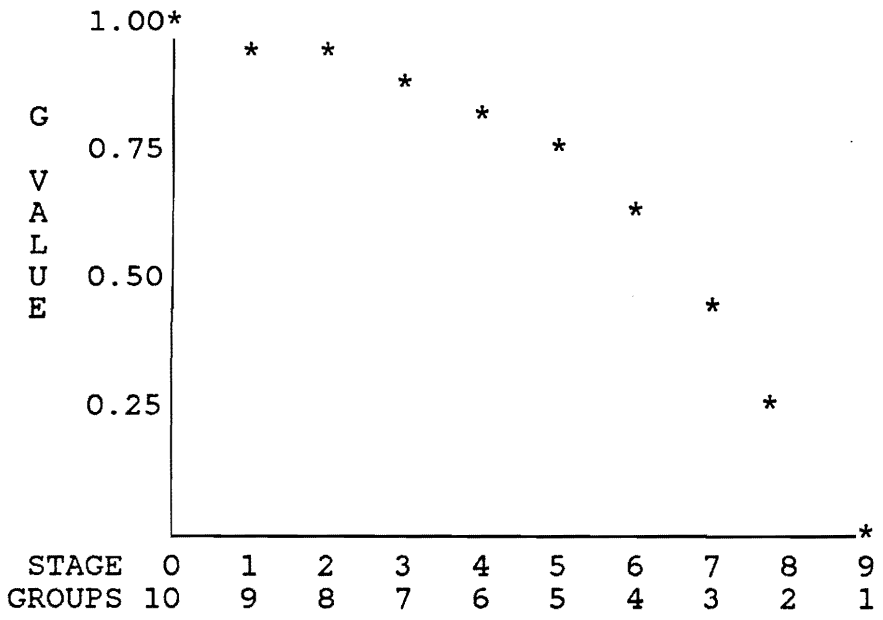
COMBINE

0	0	0	4	5	6	7	8	0	0

Cluster 1:

E1	Closer working relations with business and industry
E2	Adequate facilities
E3	Change degree to PhD
E9	Emphasis on excellence
E4	Broadened, research oriented program
E5	Increase in interdisciplinary approach
E6	Faculty development
E7	Program instructors teach more graduate classes
E8	Globalization
E10	Social, political and philosophical connections in VTE

G-VALUES AT EACH STAGE OF CLUSTERING ELEMENTS



G-VALUE versus STAGE NUMBER

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