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Policy Dialogue and Problem Formulation in
Strategic Planning

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Abstract

Decision analysis has been criticized by some practitioners for its inability to deal with strategic planning problems. It typically starts with the assumption that a problem has been recognized and stated and that the task of the step-wise decision analysis process is to indicate the optimal strategy in terms of a specified choice criterion. Writers such as Ackoff, Mason and Mitroff, and Raiffa have argued that this approach may lead to solving the wrong problem and that this is potentially dangerous, particularly in the context of ill-structured, planning problems.

The paper develops an understanding of the process of organizational problem formulation through the examination of current literature and research. This is a necessary prerequisite for discussing the value of decision aids for strategic planning. Approaches to problem formulation such as matching of problem to problem type, creativity stimulants, and dialectical inquiry and devil's advocate are examined as well as an expanded view of decision analysis as a policy dialogue process. Finally, the relationships between the various approaches are examined and a synthetic model for their use in problem formulation is suggested.

INTRODUCTION

Strategic planning can be considered a type of ill-structured decision-making. It has been argued that decision analysis, which has proven effective in dealing with relatively well-structured problems, is of little value in the ill-structured problem solving which characterizes strategic planning.

The decision analysis paradigm is both an approach to decision-making and a set of techniques. The approach involves consideration of issues such as the decision-maker's search for alternative strategies, the recognition and subsequent assessment of the uncertainty inherent in the problem and the process by which policy judgments about an appropriate course of action are made. It, therefore, allows a decision-maker to carry out a thorough and logical evaluation of alternative strategies in order to determine systematically the 'best' available strategy in terms of some stated preference criterion for choice amongst them. Thus, decision analysis provides a basic model of rational choice under uncertainty for an individual decision-maker.

Decision analysis typically starts with the assumption that the problem has been identified and stated and that the task of the analyst is to provide a solution. Managers, however, are interested in the processes of problem recognition and diagnosis. Problem recognition can be facilitated by the identification of signals such as lost profit or by a pattern in a series of prior events which provides an indication of how the problem arose. Problem diagnosis is achieved by specification of the organizational context of the problem, by the identification of key uncertain variables and by the generation of feasible alternatives

for problem solution. These processes of problem recognition and diagnosis are missing links in the effective application of the decision analysis approach to strategic planning.

In this paper, a broad view of decision analysis is adopted. Decision analysis is viewed as an approach to problem solving somwhat similar to the diagnostic, clinical component in medical training. It is, therefore, a 'thinking algorithm' or 'decision structuring' framework for the decision-maker. Second, it is contended that decision analysis should be regarded as an analytic decision aid rather than as a technology for developing an optimal solution. A decision analysis can best be thought of as a multi-stage decision procedure involving the following steps (see Raiffa [48], Brown, Kahr and Peterson [6], Moore and Thomas [43]) problem decomposition; decision structuring; probability and utility assessment; solution income of expected utility; sensitivity examination; decision review and implementation. Schematically, the process is depicted in Figure 1:

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Insert Figure 1 about here
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Whilst some authors quoting papers such as (Brown [4], Greiner [20], Conrath [10]), point to the limited range of application of such approaches, we would not share this view. The more recent work of, for example, Keeney and Raiffa [29], of Brown, Kahr and Peterson [6], Kaufman and Thomas [28], and Moore, Thomas, Bunn and Hampton [44] lists an impressive range of applications—even though some authors (e.g., Lock [34]) have questioned the soundness of these applications in terms of issues such as the organizational resistance to the approach and the fact that the analytic conclusions were rarely substantially implemented.

They have argued that implementation is hindered both by poor problem
formulation and also by the inability of decision analysts to recognize
that the approach is essentially an organizational 'intervention' mechanism
requiring careful design in the context of a political decision-making
process.

Rex Brown [5], an acknowledged expert and a prominent decision analysis
consultant, recently made the following statement:

> Decision analysis may well turn out to be one of the
> most influential aids towards the world's conduct of
> its affairs. Certainly the pace of application has
> perceptibly quickened during this past decade at
> upper levels of government and industry in the
> United States.

He continues as follows:

> The first major field of application was business.
> Probably a third of the five hundred largest busi-
> nesses now make some use of decision analysis, many
> of them at board level. To take just one organiza-
> tion, at least three senior executives of Ford Motor
> Company, have based major decisions on systematic
> analysis: one used it in the decision to drop con-
> vertibles; another to evaluate a move into the tire
> business; the third to adjust prices on tractors.

A number of authors (see Kunreuther and Schoemaker [30], Jenkins
[27], Moore and Thomas [43]) have pointed out that despite the strong
assets inherent in the approach, it has not lived up to its potential.
The reasons given range from the inadequate attention given to organiza-
tional processes (such as for example the potential relationship between
the organization's ability to cope with uncertainty and the organiza-
tional structure) to a concern, often expressed, that insufficient
allowance is made for the descriptive content of the process of problem
formulation.

On the other hand, congnitive psychologists and systems scientists are generating debate about problem formulation and are seeking to integrate descriptive and prescriptive decision-making analyses. Tversky and Kahnemann [57] are prominent amongst the cognitive psychologists interested in decision analysis. They have demonstrated the crucial importance of designing meaningful decision frames and problem formulation in the context of applied decision analysis. They state that the relative attractiveness of options in a decision situation varies when the same decision problem is framed in different ways. The authors have obtained systematic preference reversals by changes in the framing (or formulation) of decision problems. These formulation changes have consisted of variations in the framing of acts, uncertain events, or outcomes. This dependence of preferences on decision problem formulation has significant consequences for the theory of rational choice. Thus, in Tversky and Kahnemann's words, adoption of a decision frame is an ethically significant act.

Ackoff [1], a proponent of the systems approach, catalogues the weaknesses of rationalistic approaches known under the general heading of operations research (and these would also presumably apply to the approach known as decision analysis). He suggests that in the organizational context the operations research (OR) paradigm should be replaced by one directed at designing a desirable future and inventing ways of achieving successful implementing of that future. Further, OR should replace its problem-solving orientation by one that focuses on interactive, planning for, and design of, systems.

In this interactive planning process, the formulation phase, described as "formulating the mess", is considered to be very important.

In this phase, Ackoff notes the importance of managerial involvement in the identification of problems and prospects facing the organization. Through this involvement, managers become better sensitized to the relationships between problems and problem variables and can begin to conceptualize them as a system. His view is that such conceptualization requires skills of integration and synthesis rather than decomposition and analysis. Further, the mess often is best formulated through scenarios of likely futures of the organizations which are based on the (not necessarily valid) assumption that no significant changes will be made in current organizational policies and practices.

Ackoff also believes that most problem identifiers lack a WELTANSCHUNG or world view. They are uncomfortable in the world of ideas and like to formulate problems in terms of closed mechanical systems. They do not understand the structure or functioning of organizations, business or government, nor of the environment which contains them.

This paper concentrates on the processes of problem formulation and structuring in relation to decision analysis. It addresses particularly those problems often categorized as ill-structured, unprogrammed, and of strategic concern to the organization. Subsequent sections will focus on three main topics. First, the processes of organizational problem formulation will be examined, as well as appropriate paradigms for conceptualizing this process. Second, aids for problem finding and formulation will be discussed. Evidence which bears upon the role and value of such aids will be presented. Finally, a synthetic model will be developed which attempts to integrate these aids within the strategic planning framework.

At this initial stage, it is appropriate to provide working definitions of two terms which will be used frequently, namely problem and problem formulation.

A problem exists if there is a gap between an existing or anticipated state of affairs (performance level) and some desired state (a set of goals or objectives), and if someone wishes to accept the responsibility of attempting to close that gap. Problems can arise as a result of performance deficiencies, threats to future performance, or opportunities which may alter goals or objectives.

Problem formulation is the process of formulating the present set of conditions, symptoms, causes, and triggering events into a problem or set of problems sufficiently well specified so that the risk of using analytic procedures to solve the wrong problem has been minimized.

ORGANIZATIONAL PROBLEM FORMULATION

Problem formulation has traditionally been viewed as an ill-structured and unprogrammable process which differs from organization to organization, from decision-maker to decision-maker, from problem to problem. If it is not possible to develop generalizations about problem formulation, it is not possible to develop generally applicable suggestions or techniques for improving the process. However, research has demonstrated that it is possible to develop generalizations about problem formulation and general techniques for improving it.

There is a rich literature in the areas of cognitive psychology, organizational behavior, and international relations which is applicable to managerial problem formulation. This literature describes the process

of problem formulation and outlines the potential malfunctions in the
process caused by the fact that decision-makers operate with limited
information and limited information processing capacities [51], [52].

The discussion which follows will draw upon this literature. First,
a general model of the problem finding/problem formulation process will
be developed. Next, organizational problems will be divided into two
categories and the unique aspects of problem formulation in each category
will be discussed. A variety of biases in problem formulation and decision-
making will then be listed and several individual and situational factors
which aggrevate these biases will be covered.

The Process of Problem Formulation

An early paper by Pounds [46] discusses the first part of the
problem formulation process: problem finding. Pounds clearly distin-
guishes problem finding from problem solving and offers a model of the
problem finding process drawn from Simon [51] and Miller, Galanter, &
Pribram [38]. Figure 2 represents his model:

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Insert Figure 2 about here
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Pounds describes the first four stages of his model as follows:
Managers have conceptual models of the operation of the firm and its
environment which they use to make predictions of outcomes important to
the firm such as sales volume, cost of sales, etc. The models are devel-
oped from the managers' experience, from formal planning models, other
people associated with the firm (customers, suppliers, etc.), or from
sources outside the organization such as trade journals or industry-wide

groups [46, pp. 474-478]. In the first stage, they choose a model as the basis for problem finding and make outcome predictions from it.

Once they have selected a model and made outcome predictions from it, they compare these to reality in the second stage. In the third and fourth stages, differences are identified (these constitute problems) and one or more of the differences is selected for problem solving. Problem solving consists of the selection and implementation of "operators"; elements of managerial activity which transform a set of input variables into a set of output variables according to some predetermined plan [46, p. 470].

As mentioned earlier, Pounds focuses on problem finding rather than problem formulation or diagnosis. Once a difference has been identified between predicted and actual outcomes, managers may use their own conceptual models to identify causes of these differences. Pounds' model does not explain how decision-makers react to different types of gaps (for example, those indicating a crisis vs. those indicating an opportunity). Nor does it explain how they search for information related to the causes of the gap or how they define those causes.

Mintzberg, Raisinghani, and Theoret [39] point out that differences between expectations and outcomes may be perceived as either opportunities, problems, or crises [39, p. 251]. They also expand Pounds' discussion by adding an explicit diagnosis routine to the problem-formulation process. Through studying managers' descriptions of 25 specific organizational decisions, they found that an explicit diagnostic or formulation step could be identified for most of the decision-making processes which were activated by problems. However, far fewer of the

decision-making processes activated by opportunities and crises showed
an explicit diagnosis stage. Mintzberg, et. al., suggest that opportuni-
ties may not require much problem definition since only improvement of
existing conditions is required rather than correction. On the other
hand, time pressures and cognitive pressures which discourage formal
diagnosis may be produced by crises. This point is supported in the
studies of Billings, Milburn and Schaalmar [3] and Smart and Vertinsky
[53].

The Mintzberg, et al. model includes the following phases and
subroutines, the first phase of which involves problem formulation:

A)   The Identification Phase

    1)   The Decision Recognition Routine: Opportunities, prob-
        lems, and crises are recognized and evoke decisional ac-
        tivity.

    2)   The Diagnosis Routine: Information relevant to opportu-
        nities, problems, and crises is collected and problems
        are more clearly identified.

B)   The Development Phase

    3)   The Search Routine: Organizational decision makers go
        through a number of activities to generate alternative
        solutions to problems.

    4)   The Design Routine: Ready-made solutions which have been
        identified are modified to fit the particular problem or
        new solutions are designed.

C)   The Selection Phase

    5)   The Screen Routine: This routine is activated when the
        search routine generates more alternatives than can be
        intensively evaluated. Alternatives are quickly scanned
        and the most obviously infeasible are eliminated.

    6)   The Evaluation-Choice Routine: An alternative is chosen
        either through a process of analysis and judgment or a
        process of bargaining among decision makers.

7)   The Authorization Routine: When the individual making the decision does not have the authority to commit the organization to a course of action, the decision must move up the organizational hierarchy until it reaches a level at which the necessary authority resides. [39, pp. 252-263]

The authors also point out that the processes of problem formulation and decision-making are generally not linear but cyclical. By cycling within one phase or between phases, the decision-maker gradually comes to comprehend a complex problem. Further, the most complex and novel decisions seem to involve the greatest incidence of cycles. Mintzberg, et al. state,

> He (the decision-maker) may cycle within identification to recognize the issue; during design, he may cycle through a maze of nested design to develop a solution; during evaluation, he may cycle to understand the consequences of alternatives; he may cycle between development and investigation to understand the problem he is solving; he may cycle between selection and development to reconcile goals with alternatives, means with ends [37, p. 265].

Types of Strategic Problems and Differences in Problem Formulation

It may be that different types of strategic problems are formulated differently. Maier has pointed out one important distinction between problem types in his discussion of "Type I" and "Type II" problems [35 , pp. 325-326]. With Type I problems, standards of high quality are applied to solutions and it is not difficult to obtain acceptance of the solution by those responsible for implementing it. Type II problems are those in which internal political and bargaining processes are important and acceptance of the solution is the most important evaluation of its quality. Numerous theorists have discussed the characteristics of Type II problems [31], [32], [47], [61].

There seem to be at least two fundamental differences between the problem-formulation process for Type I problems and Type II problems. Lindblom's work [31], [32] on incremental decision-making processes suggests that for strategic problems in which organizational acceptance is the crucial factor, there may be little or no attempt to collect preliminary information about the environment or to formulate the problem. Rather, the problem is defined as a demand by various interest groups for a change in some aspect of organizational policy. In response to this problem, the key decision-makers make a small incremental change in organizational policy in the direction demanded by the interest-groups. The decision-makers then wait for reactions to the new policy from those who are affected by it and modify it incrementally in the direction of the new demands. Lindblom calls this the method of successive limited comparisons [31, p. 84].

Maier [35, p. 348] has suggested that group decision-making may be more important in dealing with Type II than Type I problems because it promotes acceptance of decisions. The role of the leader is also important in assuring acceptance in Type II decision processes.

Vroom and Yetton [61] have suggested a related notion in their discussion of a continuum of five possible levels of participation by subordinates in organizational decision-making. In their model, the degree of participation varies from the lowest level (the leader makes the decision and announces it to the group) to the highest level (the leader involves subordinates in the decision from beginning to end and accepts the group's consensus decision). Vroom & Yetton specify a number of contingencies which should help leaders determine how much participation

to allow in the decision process. The importance of group acceptance
of the final solution is one of these contingencies.

Though the problem formulation process may be somewhat different
for different types of strategic problems, the same general model of
the decision-making process can be developed and used as a basis for
suggestions on improving the formulation process in <u>all</u> types of problems
in strategic planning. This model would include the following stages:

1)   Gap identification/problem recognition
2)   Problem diagnosis/formulation
3)   Alternatives generation
4)   Alternatives selection

At any point, decisional activity may cycle back to any previous stage.

For different types of problems, different stages should be empha-
sized. For Type II problems for example, very little activity is re-
quired at the problem diagnosis/formulation and the alternative genera-
tion stage. In fact, there may be <u>no</u> clearly identifiable diagnosis
stage. Also, group members should be involved at the alternative selec-
tion stage if more than one alternative was generated.

<u>Biases and Malfunctions in Problem Formulation</u>

Research in the areas of cognitive psychology, organizational behavior,
and international relations has uncovered a number of biases which afflict
decision-makers during problem formulation and the generation of alternatives
for solving problems once defined [23], [55]. A few of the many biases
identified in this literature will be discussed in order to illustrate
their effects on problem formulation and other decisional activities.

As has been suggested earlier, stage 1 of the problem formulation
process results from the recognition of a difference or gap between

expectation and organizational performance. At this stage, decision-makers sometimes avoid problems by not recognizing gaps. Forecasts of expected organizational performance should be revised as new information comes in, particularly if this information indicates that assumptions underlying the forecasts were wrong. However, Tversky & Kahnemann [57] discuss a decision heuristic called adjustment and anchoring which (among other things) causes decision-makers to inadequately revise predictions as new information comes in. They cite earlier research showing that decision-makers are conservative information processors; that they develop an initial judgment based on preliminary information and then anchor on that judgment as they deal with new information. Their revisions are smaller than are justified by the new information. Because decision-makers use this heuristic, they may miss gaps and may therefore benefit from techniques designed to stimulate the search for potential problems.

Decision-makers may escape the negative effects of this heuristic, admit that the gap does exist, and move to stage 2: problem diagnosis/ formulation. If this happens, there is at least one heuristic which helps to determine the manner in which the problem will be defined. Steinbruner [54] calls this heuristic reasoning by analogy. Reasoning by analogy involves the application of analogies and images from one problem situation to another. In organizational decision-making, it typically involves the application of analogies from simpler situations or from memories of recently solved poblems to complex strategic deci-sions. This helps to reduce the aversive uncertainty perceived in the environment.

However in strategic decisions, which involve a great deal of uncertainty and complexity, the use of simple analogies is likely to mislead the decision-maker into an overly simplistic view of the strategic decision situation [54, p. 115]. Research in cognitive psychology [19] indicates that decision-makers' psychological set may induce a kind of fixation on particular analogies or problem definitions. A decision analyst who has dealt with a large number of organizational problems may be able to suggest better analogies through matching a particular problem to a "problem type" he has identified through his experience.

Once decision-makers have defined a problem, do they generally develop numerous alternative solutions for dealing with it in stage 3? Cyert and March [12] among others suggest that they do not. They suggest that search for solutions to problems is simple-minded (it proceeds from simple concepts of causality and is conducted in the neighborhood of the problem symptom and the current alternative) and biased (that is, it is distorted because of training of organizational members, their hopes and expectations, and communication problems within the organization) [12, pp. 120-122].

Steinbruner [54] elaborates on Cyert and March's notions of problemistic search in his description of a process he calls single outcome calculations. Rather than attempting to specify all relevant values and goals and all alternative courses of action as normative decision theory would suggest, decision-makers may focus on a single one of their goals or values and a single alternative course of action for achieving it. They then simply refuse to consider other alternatives and in justifying their choice, attempt to interpret facts in such a way that the favored alternativ

appears to serve several values simultaneously and appears to have no costs associated with it. They attempt to deny that there are tradeoffs and that there are some values which may not be served by their favored alternatives. This is an extremely powerful simplification mechanism and is more likely to be used in highly complex and uncertain decision environments such as those characteristic of strategic planning. Since this mechanism allows decision-makers to deny the unpleasant value trade-offs which are always present in a choice between alternatives, it significantly reduces the stress associated with ill-structured decision-making.

In any complex decision environment, several alternative courses of action may be identified as new information comes to the decision-makers. These alternatives are troublesome to a decision-maker using single outcome calculations. There is at least one mechanism available to decision-makers for dealing with unwanted alternatives: <u>inferences of impossibility</u>. In contrast to the suggestions from normative decision theory, decision-makers may devote a good deal of effort to pointing out the negative aspects of non-preferred alternatives and attempting to convince themselves that they are not possible to implement [54, p. 119]. Since this mechanism forces premature rejection of alternatives, it may have disastrous consequences for decision-makers who use it. They will achieve a premature closure at the cost of rejecting possibly the most feasible alternative.

These malfunctions and biases in problem-formulation cause problems to be misdefined or to remain unrecognized and restrict the number of alternatives generated to deal with these problems. The decision analyst who concentrates only on the alternative selection phase of the process

and does not help decision-makers to correctly formulate the problem and generate good alternatives for solving it may find himself helping them to solve the wrong problem or to choose the best from among several low-quality alternatives for solving it.

Individual and Situational Factors

The biases and mechanisms previously discussed distort problem formulation even under the most ideal conditions. However, individual and situational factors may greatly magnify the impact of these mechanisms on the quality of problem formulation. Stress and tension may cause decision-makers to become stereotyped in their attempts at problem definition or to devote little or no time to problem definition. Personality factors such as dogmatism and cognitive complexity may effect procedures chosen for problem definition.

Goldstein and Blackman [18, pp. 98-100] discuss a number of studies which suggest that highly dogmatic decision-makers tend to make judgments about data necessary for problem-definition quickly and not to defer judgment until sufficient data are available to make an informed judgment. Further, they cite evidence that high dogmatics adopt simple strategies for processing information and use small amounts of information in making judgments because of their great need to reduce uncertainty.

They also discuss the effects of cognitive complexity on the formation of judgments [18, pp. 118-125]. Evidence suggests that cognitively complex people make more inferences from information and are better able to integrate discrepant information in making judgments.

Stress induced by time pressure and other factors may also influence the decision-maker's tendency to quickly choose simple analogies to help in defining the problem. Stress may also cause decision-makers to avoid dealing with the problem altogether.

Under high levels of stress, the need to escape from the decision situation may become acute and decision-makers may resort to one of two types of behaviors whose primary purpose is escape rather than resolution of the problem. These behaviors have been described by Janis and Mann [26, p. 52] as defensive avoidance and hypervigilance. Defensive avoidance on the part of decision-makers involves attempts to avoid the problem by ignoring information about it, developing an overly fatalistic attitude about their ability to affect outcomes, or relying on others to make the decision (buck passing). Hypervigilance is commonly called "panic behavior" and involves making snap decisions generally on the basis of the first bits of information to become available. This behavior is often observed when decision-makers feel they do not have time to collect information and evaluate alternatives.

Cohen, March, and Olsen [9, p. 33] discuss two related problem avoidance processes which they call flight and oversight. Flight involves reactively applying a solution to a problem which has traditionally been applied and failed to solve it. Oversight occurs when a choice between a number of courses of action is made without consideration of any of the organizational problems which might be resolved by the choice. The authors claim that flight and oversight are the most common approaches to decision-making in organizations [9, p. 34].

Decision analysts may be unable to prevent defensive avoidance or flight. However, by helping managers to more effectively use their time in problem solving when time is in short supply, they may be able to minimize hypervigilance. By encouraging decision-makers to specify outcomes and the subjective probability of each outcome, they may be able to discourage decision by oversight.

Summary

In this section, a general model of problem formulation has been developed. Its applicability to different types of problems has been discussed and a number of possible malfunctions in the problem formulation process have been considered. This discussion has shown that problem formulation can be modeled, that managers can make a variety of errors in the process, and that decision analysts can and should assist managers in problem formulation in order to avoid being put in the position of helping managers choose between a number of low quality alternatives for solving the wrong problem.

DECISION AIDS IN PROBLEM FORMULATION

In this section, four types of decision aids will be discussed. The first three are, in sequential order: matching of problem to problem type approaches, creativity stimulants--aids for generating new ideas, and devil's advocate/dialectical inquiry approaches. Each of these is designed for dealing with difficulties at a particular stage in the problem solving or strategic planning process. However, each technique may also indirectly affect all stages. The fourth aid discussed involves the use of decision analysis as a stimulus for policy dialogue. Finally,

an integrative model is presented which shows the appropriate use of these approaches at various stages in the process.

Matching of 'problem' to 'problem type' approach

Reference to earlier writing on decision analysis suggests that researchers have either elected to avoid the problem of how to elicit the structure of a decision situation or have argued that such decomposition and structuring skills can only be 'learned by doing.' To illustrate the first view Ulvila [58] has, for example, indicated that there are few, if any, computer aids available for structuring although a number had been developed for aiding solution procedures. Raiffa [48] also implied that he would prefer to by-pass the structuring problem in decision analysis even though he considered it an important issue. The second view of learning by experience in decision analysis has much support (Moore and Thomas [43], Brown, Kahr and Peterson [6], Holloway [24]) as a practical guideline. This view suggests that managers, through recognition of patterns or familiar problems, become more aware of certain problems and problem-types, (i.e., they have gone through some form of pre-diagnosis and can "reason by analogy" to them). This form of awareness can be described as internal learning about problems. Often, however, this internal learning is not translated into organizational learning either because of lack of communication or because of poor maintenance of records in organizational settings.

As a consequence it has been suggested that a taxonomy of problem types, (e.g., new product, manufacturing investments, etc.), should be developed so that the problem solver could be aided early in a decision

analysis by being able to make a comparison of his particular problem with this taxonomy. This approach would also be reinforced by external learning. That is, by managers reading accounts of case studies of applications performed in other organizations or by consultants. There is, by now, an increasing volume of such case studies and applications reprinted in the literature (see, for example, Brown, Kahr and Peterson [6]; Holloway [24]; Bell, Keeney, and Raiffa [2]; Kaufman and Thomas [28]; Moore, Thomas, Bunn, and Hampton [44]), and the range of reported applications continues to widen.

Interestingly, over the last ten years the areas of application have moved from well-structured and well-programmed problems to increasingly ill-structured and strategic ones. Recently, public sector applications have been more in evidence.

There are dangers, however, in the managerial use of the 'matching of problem to problem type' approach as a problem formulation aid. First, externally reported applications of decision analysis often appear to be too easy and simplistic and to be examples of 'techniques in search of solutions.' In addition, the descriptions rarely provide sufficient detail and do not adequately catalogue some of the difficulties--problem identification, assumption testing, problem formulation, structuring and assessment--involved in applications. That is, they do not throw sufficient light on the structuring and problem formulation phases of decision analysis.

Second, recent events might tend to make a particular problem type obsolete. A good example of this lies in insurance decision-making. The impact of inflation upon the operations of insurance firms

in the second half of the 1970s has significantly changed the balance between their underwriting and investment activities. Many individual insurance accounts (for example, for the insurance of marine, fire, and automobile risks) now show underwriting losses which are more than balanced by the rapid increases in investment gains generated by the continuing high levels of interest rates. As a result the view and premise held in the stable environment of the 1960's, namely, that 'underwriting profit is king' has eroded and has been replaced by a more adaptive strategic balancing posture which looks at the joint impacts of underwriting, investments, and claims upon the overall profitability of the insurance company.

Third, in some reported applications decision analysts may have biased the manager's perception of the problem and in so doing provided an inappropriate problem formulation and ultimately, an incorrect solution. For example, a decision analyst whose primary training background is in management science models might define every problem as a mathematical programming, resource allocation type of problem. As a result he might ignore potential problem differences and the availability of other solution procedures. Fourth, this type of approach is probably better suited to well-structured than ill-structured problems since it relies on such things as the recognition of familiar problem patterns and the presence or absence of key problem variables.

Nevertheless, the continued development of a taxonomy of problem types is an useful first step in helping the process of 'reasoning by analogy' even though it may 'anchor' the decision-maker's thinking around a previously developed problem structure and solution. However,

such a taxonomy should be based on case studies of ill-structured, complex problems. These case studies should catalogue the resolution of issues both in relation to problem formulation and policy dialogue about "messy" problems.

Creativity Stimulants

Typically when more structured approaches and analytic aids do not help with problem formulation, managers must search for new options. In those instances, consultants may assist through the use methods for developing creative alternatives. In some cases, these methods encourage new problem definitions as means to developing new alternatives. Certain conditions are important prerequisites for creative thinking. First, the organizational conditions have to be designed to allow the bridge between thought, creativity and idea generation to be built effectively. At minimum this means that there must be tangible organizational commitment to the creative search process. For example, there must be reduced stress and pressure on managers so that they have sufficient time to think about problems and gather and absorb any appropriate information about them. Second, creative thinking aids must be designed to include certain key features. For example, aids should attempt to free managers from conceptual or perceptual blocks to thinking and the influence of any inhibiting factors whilst simultaneously encouraging the utilization of past problem solving experience. In addition, aids should also make effective use of devices for introducing alternative ideas and problem critiques into the creative process. This controlled introduction of viewpoints should allow managers to consider, in a

broadly based manner, the influence of other ideas and assumptions about the decision problem. Thus, the mind's natural ability to explore the unknown and its natural curiosity about conflicting signals and incomplete problem linkages can be tapped. This curiousity ultimately leads managers to attempt to "complete the incomplete" and recombine the signals and linkages in a subjectively meaningful form, i.e., to attempt to achieve "order out of chaos".

The literature on creative aids is somewhat diffuse and piecemeal and some techniques have not been subjected to thorough scientific testing. However, an overview of some of the main classes of methods is presented below in order to provide some tentative operational guidelines for their use.

In this brief review it is not possible to discuss the full range of approaches for generating ideas and new alternatives. Instead, the concepts underlying some widely used approaches are examined in succeeding paragraphs. The structured approaches considered include brainstorming, synectics, morphological analyses and Delphi approaches. Unstructured approaches are limited to techniques for generating scenarios and alternative futures. Unstructured approaches attempt to stimulate the generation of new ideas whereas structured approaches try to systematically organize ideas and synthesize patterns from a broader set of ideas and viewpoints.

Brainstorming

This is a group procedure [see Osborn [45]] usually involving a nominated chairperson. The group is usually of small size and goes through

a number of phases such as fact-finding, idea-finding and solution-finding
in the brainstorming process.

The group is co-ordinated by a leader, who, having socialized the
group and defined the problem and group agenda, sets the framework for
the idea-finding phase. Typically, the group is counselled to operate
in a mode in which judgment about suggested ideas is deferred and crit-
icism is held back. It is stressed that group members should think
freely, generate as many ideas as they wish and, if appropriate, build
on ideas suggested by other members of the group. Once all possible
ideas have been generated the leader should attempt to synthesize the
ideas and try to focus further brainstorming on criteria by which alter-
native ideas should be judged. The best ideas are then listed and group
members are asked to develop strategies for implementation and adoption
of these ideas.

Existing research suggests that individuals brainstorming separately
produce a larger number of high quality ideas than do interacting groups.
The main advantage of the group may lie with the ease of organizing brain-
storming and the group's cohesion in subsequently gaining acceptance of
new ideas and proposals.

Synectics

This is a group creative thinking process [see Gordon [19]] directed
by a leader responsible for encouraging certain reasoning mechanisms in
the group members. The leader directs a thinking by analogy process in
which a series of creative ideas are generated by evoking appropriate
analogies. This approach involves the use of a trained and skilled

leader who possesses the ability to understand group dynamics, psycholog-
ical strain, role playing and to facilitate and catalyze group communication
and committment. The leader should also direct the group towards approval
of the ideas generated in the synectic process.

Morphological analysis

This approach, originally developed by Zwicky [63] in the context
of the Apollo project, is a structured search technique particularly
useful for situations of novelty such as new process or product development
in an environment of rapid technological change. An attempt is made to
promote openmindedness by encouraging decision-makers to identify the
characteristics or attributes defining the novel situation and to define
a list of all possible combinations of attributes which can be generated
from them. The process continues by reviewing each feasible combination
and trying to devise a problem solution which may fit that combination.
The intention is that one or more alternative solutions from the range
of potential solutions generated will be, at least, worth detailed con-
sideration for potential implementation. In essence, the process tries
to bring ideas into conjunction with alternative specifications of the
situation (e.g., a weapons system) under study. By such directed mapping,
it is anticipated that creative and novel solutions will be found.

The Delphi approach

Linstone and Turoff [33] provide a very broad definition of the
Delphi method as follows: 'Delphi may be characterized as a method for
structuring a group communication process so that the process is

effective in allowing a group of individuals as a whole, to deal with a complex problem.'

The Delphi procedure follows a series of phases in which a group of people anonymously participate in a problem solving process and in which the group's response (say, in terms of generation of alternatives for a problem situation) from the previous phase is given as feedback for the next phase. This feedback is controlled and synthesized so that at each phase some assessment of the group judgment (or consensus) is provided and an opportunity is presented for each individual to revise, change or revise his or her views.

Van de Ven and Delbecq [59] compared the effectiveness for decision-makers of Delphi, nominal group (i.e., nominal brainstorming groups) and interactive group meetings. Their conclusion was that both the nominal and Delphi approaches were more effective than interacting groups in producing high quality ideas and that the nominal approach was marginally more effective than Delphi.

Delphi has been used widely in applications such as the forecasting of future technological change and for idea generation for strategic planning in relation to organizational policy formulation. Linstone and Turoff's book [33] reviews a wide range of applications of the approach which seek to elicit either facts, ideas or decisions in organizational problem-solving.

Scenarios/Alternative Futures

A scenario can be described as a description of how some set of events defining a problem situation might come about over some defined

period of time in the future. It is most often developed by decision-makers in order to throw light upon the strategies which a business or public sector organization might take in confronting and adapting to an uncertain future. Usually a number of scenarios of alternative futures are developed to reflect a range of uncertain future conditions. Very often three scenarios are generated to reflect so-called pessimistic, most likely, and optimistic sets of future conditions.

Such generation of scenarios requires that individual decision-makers attempt contemplation about future events by adopting a "fantasy mode of thinking" in order that they can anticipate future events and surprises which cannot be predicted through the use of common extrapolative forecasting techniques. Decision aids such as logic trees, fault trees, and other structuring devices can help this contemplation process but the burden rests upon decision-makers' insights and creativity in judging the course of future events.

Earlier sections of this paper have pointed to biases in judgment about uncertain events and Hogarth [22] also reports on judges' difficulties in assessing future events in relation to a long-term future. Pierre Wack, a noted expert on scenario forecasting in Shell International, in discussing Shell's use of scenarios [62] points out that they currently ask decision-makers to assess only pessimistric and optimistic scenarios. This is because past use of a most likely scenario in addition to the pessimistic and optimistic cases had the effect of narrowing the range of scenarios confronted by decision-makers. An explanation for this finding is the anchoring and adjustment bias of

Tversky and Kahneman [57]. That is, decision-makers 'anchor' around the most likely scenario (often an extrapolation of the status quo) and make an inadequate adjustment around the 'anchor' in order to develop the pessimistic and optimistic scenario.

Though scenario development has sometimes been criticized as being unrealistic, it is an useful aid for drawing attention to the impact of alternative futures and in generating ideas for confronting such potential futures.

The Devil's Advocate and Dialectical Inquiry

Writers in organizational behavior have recommended two techniques for the introduction of interpersonal conflict into the strategic planning process [15], [16], [36], [37], [40], [41], [42]. Mitroff and Emshoff [40] and Mason and Mitroff [37] have suggested that there are three activities which can improve the quality of strategic planning in uncertain environments. The first is the generation of conflict between decision makers or within a decision maker. The second is the identification of assumptions regarding the internal and external environment and the nature of the problem. The third is the challenging of these assumptions.

Two techniques which may help to promote these activities (conflict, assumption identification, and assumption challenging) have been offered as aids to the strategy formulation process. These techniques, called the dialectical inquiry (DI), devil's advocate (DA), are seen as improvements on the traditional expert (E) approach in which decision makers formulate strategy with the help of advice from experts (such as decision analysts). In this approach members of a planning department or

consultants provide expert advice regarding the definition or structuring of the problem and the plans the organization should follow. The planners make a study of the organization's environment (opportunities and threats), its resources (strengths and weaknesses), its value structure, and its social responsibilities. The result of this study is a definition of the planning problem and a set of planning recommendations which are usually presented to management in the form of a strategic briefing session. Mason suggested that the planning recommendations contain hidden assumptions which are frequently not communicated to management. These, in turn, effect the structure of the problem. This is one of the most critical drawbacks of the E approach [36, pp. B406-B407].

The DI was first proposed as an aid to strategy formulation by Mason [36]. Mason, building on C. West Churchman's [7] ideas, suggested that a dialectical approach to decision-making would involve examining a decision situation completely and logically from two different and opposing points of view.

The dialectical process as incorporated into the DI involves three basic steps. First, a _thesis_ is developed and a "case" for the thesis is constructed.

Next, the _antithesis_ is developed and defended. A true antithesis is the "deadliest enemy" of the thesis and should stimulate "an anti-conviction of forcefulness at least as great as the conviction (in the plan)" [8, p. 172]. The antithesis must be a _different_ plan or position (not necessarily the opposite of the thesis) which has the maximum amount of credibility and can present the strongest challenge to the thesis in order to generate this anti-conviction. According to Churchman

[8, p. 172], the clearest example of this "deadliest enemy" concept is found in politics. The deadliest enemy of democracy, says Churchman, is not nondemocracy, but a very explicit and detailed political design called the Communist Party.

Finally, the synthesis emerges from the efforts of an observer of the conflict between the thesis and antithesis. This observer is opposed to the conflict and wishes to bring it to an end but understands the world-view or assumptions underlying both the thesis and the antithesis. This observer constructs yet another world-view which is more "objective" than that underlying either the thesis or antithesis. The act of generating the synthesis as well as its perceived ability to resolve the conflict between the thesis and antithesis tends to generate a strong conviction regarding its truth in the mind of the individual(s) who developed it.

The DI is a specific method for applying Churchman's ideas to strategic planning and ill-structured decision-making. This method begins by identifying the prevailing or recommended strategic plan in an organization and the data which were used to derive it. Next, an attempt is made to identify the assumptions underlying the plan. In order to test these assumptions, a counterplan is identified which is feasible, politically viable, and generally credible but which rests on assumptions different from those supporting the plan.

A structured debate is then conducted. This debate, in contrast to a traditional management briefing, consists of forceful presentations of two opposing plans which rest on different interpretations of the same data. The debate demonstrates that the same data can be

interpreted by the advocates of both the plan and the counterplan as providing support for their positions. This in turn should cause those witnessing the debate (those executives responsible for actually formulating the strategy) to focus on and evaluate the assumptions underlying the plan and counterplan [36, p. B408]. Once assumptions have been changed, these form the basis of a new (and better) definition of the problem and a more effective strategy for solving it. Mitroff, Emshoff, & Kilmann [42, p. 583] have suggested that the DI is a methodology for problem _formulation_ especially suited to ill-structured issues.

There is an alternative approach to strategy formulation which Mason [36] called the DA approach. He asserted that this approach should be more effective than the E approach but less effective than the DI approach. In this approach, a planner appears before management and advocates a plan. Another planner then takes the role of an adverse and often carping critic of the plan. An attempt is made to determine all that is wrong with the plan and to expound the reasons why the plan should not be adopted. The plan and critique are then presented to management and form the bases for revision of the plan. Figure 3 shows the process.

Insert Figure 3 about here

Mason suggested that while this approach does expose some under-lying assumptions, it does so in the context of what is wrong with them rather than what they should be. It does not serve to develop a new managerial world view. For this reason, Mason felt that the DI approach

should be more helpful in the strategy formulation task than the DA
approach [36, pp. B407-B408].

Other writers have also discussed the improvement of organizational
decision-making through the use of the DA. Herbert & Estes [21] discussed
the DA as a way of formalizing dissent in the strategy formulation process.
They suggested that an individual, either within or outside the organization,
should be appointed to the position of Devil's Advocate for any major
organizational decision in which it is desirable to introduce conflict.
The Devil's Advocate should begin with the formal statement of a proposed
course of action and the analysis underlying the proposal. He should then
examine the proposal for inconsistencies, inaccuracies, and irrelevancies
and prepare a critique of the proposal based on this examination. A kind
of confrontation session between an advocate of the original proposal
and the Devil's Advocate is then held with key organizational decision-
makers as observers. Based on this confrontation session the organi-
zational decision makers can then accept the proposal, modify it, or
develop a completely new proposal based on a more complete understanding
of the proposal's shortcomings.

Also, Janis [25] pointed out that the informal use of Devil's Advo-
cates was one of the positive features of the decision-making process in
President Kennedy's policy-making staff during the Cuban Missile Crisis.
The President's brother, Robert, and Theodore Sorensen were instructed to
assume the Devil's Advocate role and to promote conflict in order to pre-
vent errors arising from too superficial analysis of the issues [25,
pp. 147-148]. This, along with other changes in the group dynamics of

the President's policy-making group, was credited with the effectiveness
in the group's decision-making processes during the Cuban Missile Crisis.
Janis also made the following recommendation for the improvement of the
process of public policy-making:

> At every meeting devoted to evaluating policy
> alternatives, at least one member should be
> assigned the role of devil's advocate.
>
> [26, p. 216]

The DI and DA can help deepen decision-makers' understanding of a
problem. Mason [36, p. B411] suggests that the use of the DI will help
decision-makers form a "new, more encompassing conceptualization of the
problem." In other words, it will lead to better problem formulation.
Evidence from field studies provides some support for Mason's assertions
[16], [36], [41]. Since the problem formulation process is cyclical,
the DA and DI may improve this natural cycling process and assure that
it includes the identification of assumptions. These techniques begin
with a proposed solution to an organizational problem and, through
questioning the assumptions underlying the solution, force the decision-
makers to return to the problem diagnosis stage.

Of course, forcing decision-makers to re-examine assumptions after
they have already generated a solution may be disruptive and emotion-
ally unpleasant. This, plus the extra time involved in a decision-
making process using the DA or DI, might cause decision-makers to
resist these techniques. Because the DA is a somewhat simpler and
more straightforward process, it might be more palatable to decision-
makers than the DI. Also, there is evidence from laboratory studies
that the DA improves prediction performance, alternatives generation,

and overall quality of strategy statements more than the DI [11], [49], [50]. On the other hand, a combination of the DA and DI might be the most effective approach.

Decision Analysis As An Aid For Policy Dialogue

In this conception of the role of decision analysis there is no meaningful distinction between decision analysis and problem formulation. Rather, analysis and formulation are parts of a policy dialogue process which aims to provide a decision aid and a 'thinking structure' for ill-structured problems. This dialogue process is seen to be a cyclic search process in which analysis is used in an iterative, adaptive, and flexible manner so that decision-makers are encouraged to cycle back through previous stages of the analysis. Thus, it provides a framework for problem formulation through the continual presentation of problem solutions based on alternative sets of problem assumptions. This may ultimately lead to the development of a set of guidelines which can be used as a basis for framing policy. The essential features of the dialogue approach to decision analysis are described and illustrated in subsequent paragraphs.

a) Developing a Systems Model

Policy design and dialogue should begin with problem finding and decision structuring. The basis of the initial phase of problem finding should be an attempt to structure the issues and analyze the decision-making environment, thereby giving the decision-maker an opportunity to explore possible structural frameworks amd assumptions underlying alter-nate problem formulations. This exploration may be performed with some form of decision tree or logic tree as the structuring framework, and with

the results of an initial screening procedure or 'first-pass' decision analysis available to the decision-making group for purposes of discussion and debate.

b) Policy Design: Structuring and Modelling

It is argued here that any systems model for policy dialogue should have a narrow, specific focus and be designed to answer particular defined questions. That is, it is better to start with a simple model rather than over-complicate the process. In such a model the important uncertain variables would be identified and the problem defined adequately in terms of its anticipated time horizon and scope and through the generation of a range of potential alternative actions. The outputs of such a model would normally be the set of alternatives valued in terms of a number of indicator variables. Such variables could be thought of as "attributes" by which the alternatives should be judged e.g., cash flow, potential cost and R&D expenditure. These indicator variables, or attributes, would typically be presented as a stream or range of values for each period of the specified time horizon.

c) The Goal of Policy Structuring and Modelling

The initial structuring and modelling described in a) and b) gives the decision-making/policy group immediate feedback on their initial formulation of the problem under study. This, in turn, develops greater system understanding and develops the dialogue about a more appropriate policy design.

The development of a system model which will be acceptable to all members of the decision-making group is an extremely important part of

the process of bringing formal decision analytic methods into closer
proximity with the realities of the "policy-setting" situation. It is
crucial that there be consensus as to applicability of the model because
it provides a framework within which the responsibilities and requirements
for formal analysis can be divided and delegated amongst the individuals
who form the decision-making group. The individuals then jointly become
responsible for the tasks of information gathering, evaluation, and
assessment of uncertainties and value measures. Finally, through group
negotiations and bargaining a preferred strategy option may be chosen.

d) Obtaining Alternative Policy Prescriptions

The aim of initial policy design is to provide additional starting
points or policy prescriptions. The first-pass initial analysis works
from a basic narrow, specific model which focuses on the crucial aspects
of the problem. Through the use of analysis (often of the decision
analysis/simulation type) time streams of different policy indicators
can be presented in order to provide starting points for the generation
of more realistic alternatives for dialogue, modification and change.
That is, alternative policy prescriptions may be suggested from group
dialogue which should be examined and subjected to feasibility testing.

e) Evaluating Alternative Prescriptions

The message here is that the goal of the policy evaluation process
is to obtain a reasonable set of policy alternatives. Therefore, the
evaluation process should move in an adaptive, iterative manner towards
a comparison of alternatives in terms of the indicator variables and
check on the sensitivity of these alternatives to error, misestimation

and future surprises. A set of policy alternatives is then available for consideration by members of the decision-making group.

f) Implementation of Prescriptions

The message here is that adaptive/flexible mechanisms lead to successful implementation. The more extensive the previous policy dialogue, the greater the likelihood that the decision-making group will have confronted the range of organizational and other factors which will influence implementation. However, a check must be made on the feasibility of implementation in relation to resources, competition, and other con- straints and, if appropriate, some alternative strategies should be discarded and others added to the strategy space.

It is argued, therefore, that the greatest emphasis in policy dia- logue and design must be on the flexibility and adaptability built into the analytic process. For example, it is preferable to describe the outcomes of alternative policies in terms of a time-stream of indicator variables, rather than in terms of a single criterion such as expected utility whether or not that utility function is expressed in multi- attributed form. In this manner policies can be examined even more closely to see whether they fit when excluded factors and problem assump- tions are reexamined. The key message is that synthesis, the offering and examination of new options in the strategy space, is even more necessary in the resolution of ill-structured problems than in well-structured problems. This is consistent with Ackoff's systems-oriented views.

It should be noted that there is a need to distinguish between the direct value and the indirect value of a decision analysis in understanding

its use in policy dialogue. Direct value refers to the process of finding

the optimal act. Direct value is not stressed in this paper since the

focus is centered around the consideration of complex, ill-structured

problems. On the other hand, the indirect value of decision analysis

and its positive role as a decision aid is stressed here. Indirect

value is concerned with such issues as assumption and reality testing

of alternative formulations and increasing debate and awareness about

the influence of problem structure on policy prescription.

CONCLUSION

In this paper it is argued that problem formulation has not received

sufficient attention in the context of applied decision analysis and that fc

this reason many have suggested it is of little value in strategic planning.

Using working definitions of the terms problem and problem formulation

a review of the literature on organizational problem formulation re-

sulted in a synthetic general model of the problem formulation process

which would include the following stages in cyclic form:

1) Gap identification/problem recognition
2) Problem diagnosis/formulation
3) Alterantives generation
4) Alternatives selection

Possible malfunctions and biases in this process may, without

guidance and counselling, lead to decision-makers presenting decision

analysts with a diet of low quality alternatives for solving the wrong

problem. Therefore, some aids for the problem formulation process were

reviewed and their strength and weakness pointed out. 'Matching problem

to problem type' approaches were seen to be of particular value for

handling well-structured porblems and for conditioning decision-makers to problem elements. On the other hand, creativity stimulants are seen to be necessary when the problem formulation process becomes stagnant and new insights and more creative alternatives are required. Although some of the approaches require skilled group leaders they have demonstrated some success in removing perceptual and conceptual blocks for problem formulation. The devil's advocate and dialectical inquiry are forms of structured debate to generate a focus around problem assumptions and crucial issues. The evidence suggests that they are effective, if sometimes time-consuming, in expanding and clarifying problem definition and generating feasible alternatives, ideas and high quality strategies in the context of ill-structured problem situations. Analysis for policy dialogue was seen to be an useful aid for formulation in most situations. An exploratory 'first-pass' analysis can be developed and subjected to review and comment by the decision-making group. In the course of this process debate about the problem should become focussed around the questioning of assumptions and the generation of new alternative viewpoints and strategies.

Figure 4 below shows a conceptualization of the integration of decision aids into the problem formulation process.

- - - - - - - - - - - - -
Insert Figure 4 about here
- - - - - - - - - - - - -

This figure illustrates the stages of the problem formulation/problem solving/decision making process in strategic planning outlined earlier. The process involves a number of potential cycles from later to earlier

stages. Each of the decision aids previously discussed is normally intro-
duced at a particular stage. However, the techniques have impacts on all
phases. The matching of problem to problem type approach which helps
determine the problem formulation, also constrains the types of alterna-
tives generated and may influence choice criteria. The creativity stimu-
lants discussed may be introduced during the alternatives generation
phase when alternative generation has stagnated. However, in revitaliz-
ing alternatives generation, these aids may lead to different formula-
tions of the problem. Dialectical inquiry and devil's advocate methods
are structured approaches for moving from the selection to the problem
formulation phase through questioning the assumptions in an expert's
recommendations. Policy dialogue, in which decisions analysis is used
ostensibly to assist in selection of alternatives, should result in
problem redefinition.

Though this flow diagram and conceptualization can be regarded as
preliminary, it reflects the experience of the authors. For a recent
example of the application of this concept see Thomas [56]. In practice,
most applied decision analyses are cyclic in nature and different
problem formulations are constantly tried. The importance of focussing
on the right problem as quickly and effectively as possible is clear if
applied decision analysis is to maintain its momentum as an approach
and solution dialogue for handling ill-structured strategic planning
problems. It should be pointed out that the figure does not imply that
each and every decision aid must be applied in a particular problem
situation. The different aids provide the decision-makers with a range
of 'frames' of the problem environment which, if sensibly developed and

applied, should lessen the risk of committing the 'error of the third kind'

[48] in decision analysis, that is, solving the wrong problem.

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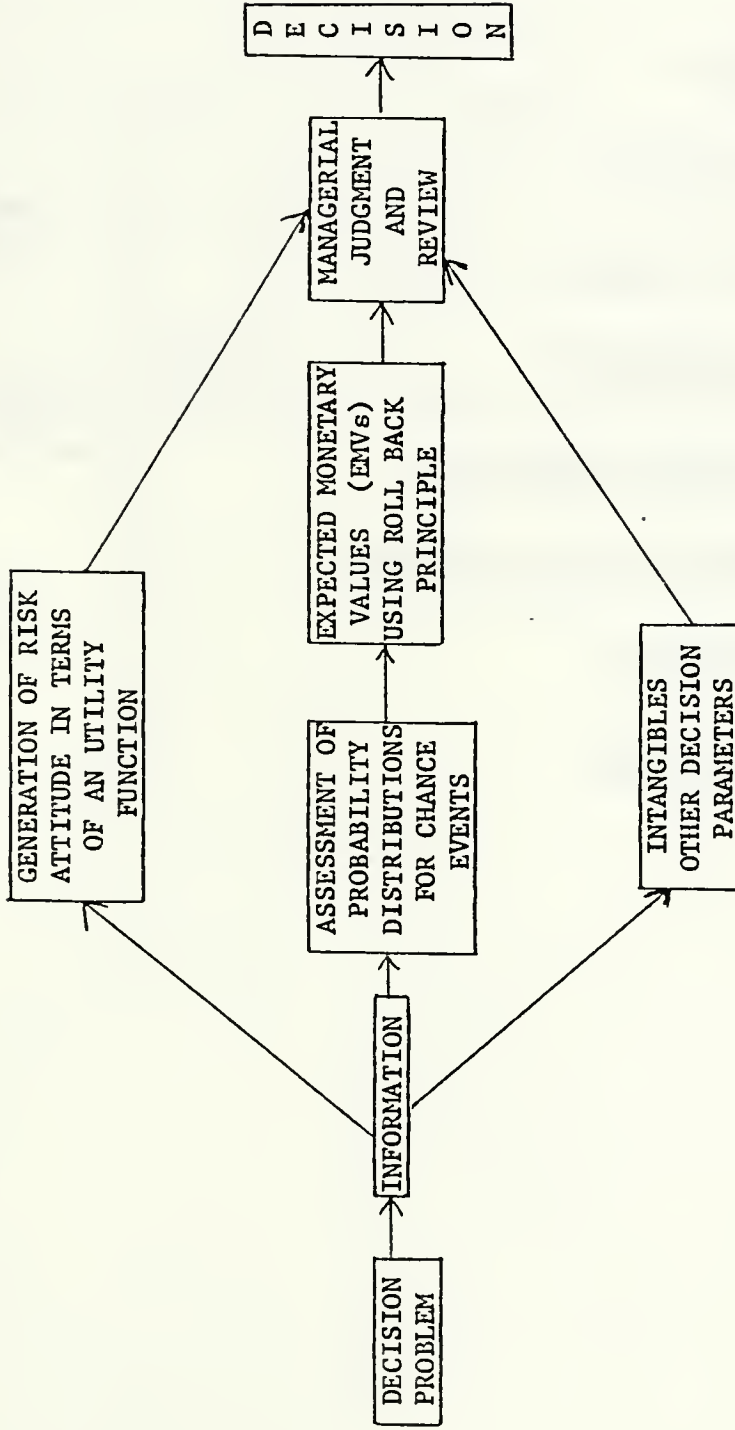[28] Kaufman, G. M. and Thomas, H. Modern Decision Analysis. London: Penguin Books, 1977.

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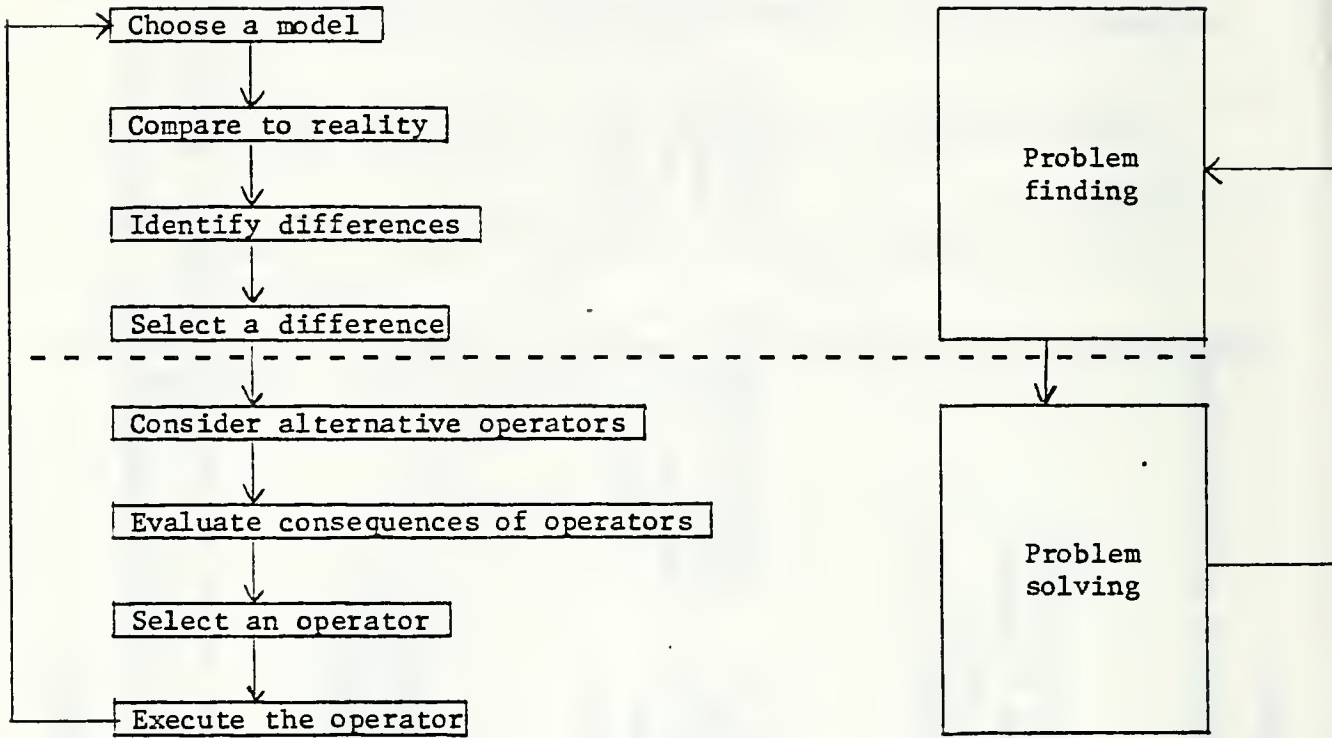
FIGURE 1

SCHEMATIC DIAGRAM OF DECISION ANALYSIS PROCESS

```
DECISION
PROBLEM
   |
   v
INFORMATION ----> GENERATION OF RISK
   |              ATTITUDE IN TERMS
   |              OF AN UTILITY
   |              FUNCTION
   |
   |----> ASSESSMENT OF
   |      PROBABILITY
   |      DISTRIBUTIONS ----> EXPECTED MONETARY
   |      FOR CHANCE            VALUES (EMVs)
   |      EVENTS                USING ROLL BACK
   |                            PRINCIPLE
   |                                 |
   |                                 v
   |----> INTANGIBLES        MANAGERIAL
          OTHER DECISION ---> JUDGMENT    ----> DECISION
          PARAMETERS          AND
                              REVIEW
```

[Note: In adaptations of decision analysis it may be useful to categorize variables

into three sets i.e., CONTROLLABLE (DECISION POINTS); UNCONTROLLABLE (CHANCE EVENTS)

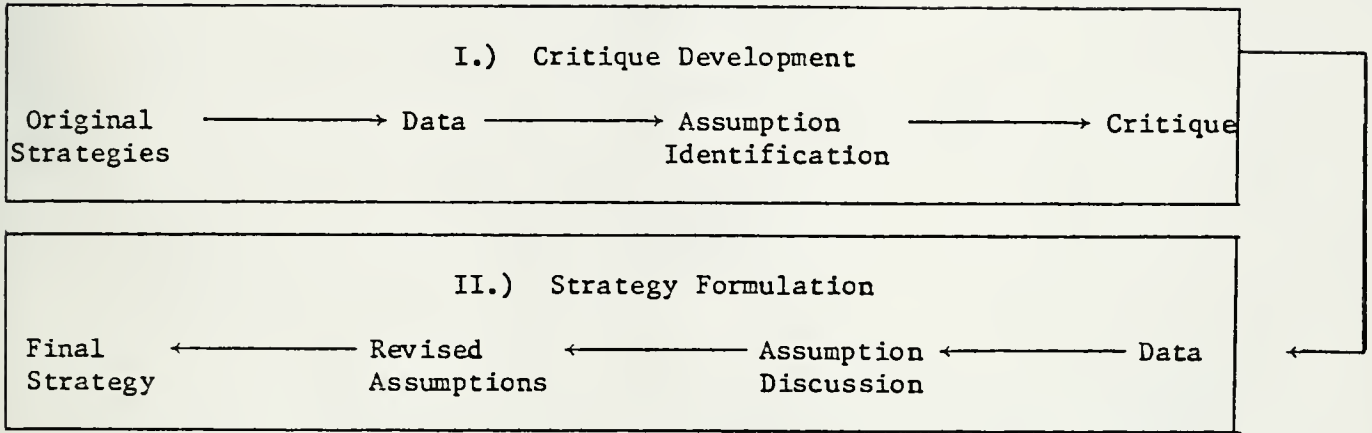and NEGOTIABLE (prelude to decision points)].

FIGURE 2

POUNDS' MODEL OF THE PROBLEM FINDING/PROBLEM SOLVING PROCESS
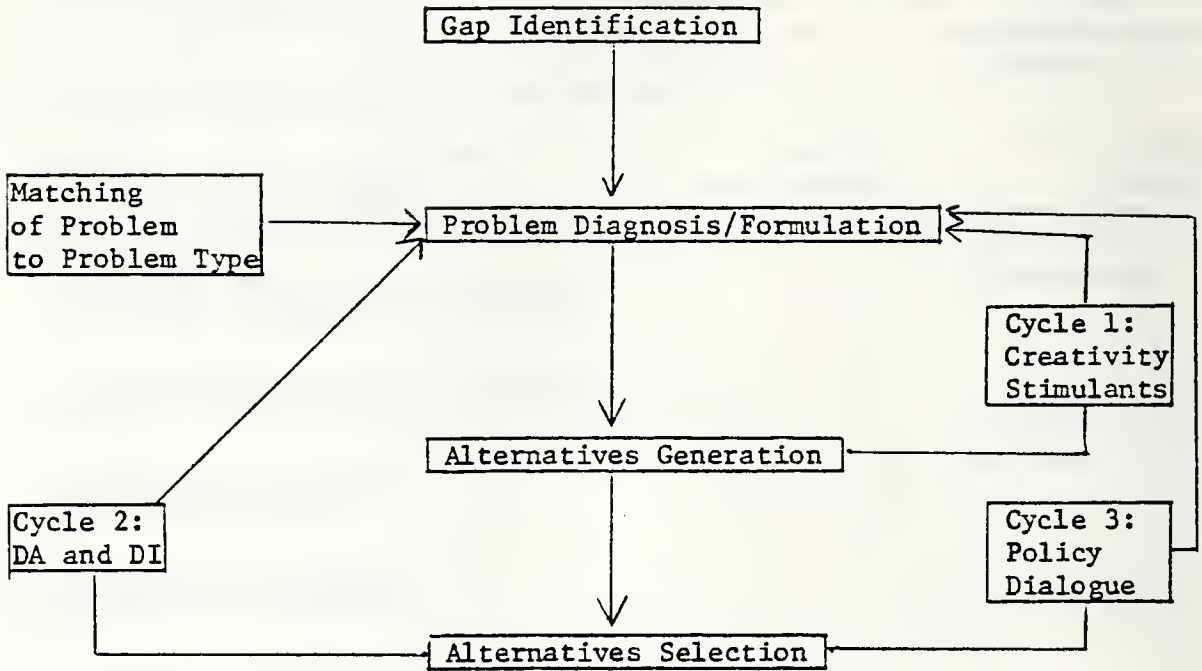

[46, p. 472]

FIGURE 3

A (DA)-BASED PLANNING MODEL

I.) Critique Development

Original ————————→ Data ————————→ Assumption ————————→ Critique
Strategies   Identification

II.) Strategy Formulation

Final ←——————— Revised ←——————— Assumption ←——————— Data
Strategy   Assumptions   Discussion

[49, p. 132]

FIGURE 4

APPROPRIATE USES OF DECISION
AIDS IN THE PROBLEM
FORMULATION/DECISION-MAKING
PROCESS