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DECISIONS AND DECISION AIDS

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Abstract

This paper addresses the general character of decision making, decision problems, and the resultant possibilities for decision aids, as well as factors which limit their applicability and usefulness. A general program for the systematic development of decision aids is outlined.

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In real world settings, actions are undertaken in order to transform an existing situation into a new one of a desirable sort or in order to prevent the situation from changing into a new one of an undesirable sort. Where the success of such an effort is not accidental, the effort requires the following.

(a) Knowledge of the existing situation and its possible transformations.

(b) Knowledge of the options for action, including knowledge of limitations imposed by limited knowledge, limited capabilities, and so on.

(c) Choice principles (values, policies, strategies, etc.) for choosing among options and evaluating outcomes.

(d) A practical assessment of the expected consequences of each action option (this is a special case of (a) above).

(e) The capability for applying the choice principles to the situation, action options, and expected outcomes.

If it were routine to meet these requirements flawlessly, human decision making would be impeccable, and decision aids would be unnecessary. If it were possible to model these requirements flawlessly, decision making at the practical human level could be accomplished automatically.

Of course, neither of these conditions holds. Decision problems arise for persons because in general any of the five requirements may be problematic to a greater or lesser degree. Whenever this is the case, there is a potential use for a decision aid. In general, therefore, there is a potential for decision aids in each of the five requirement areas or any combination thereof.

To be successful, a decision aid must effectively model the problematic aspect(s) of the decision/action situation. Probably the most fundamental difficulty in this regard comes from the fact that real world decision making is highly context dependent. Indeed, one might better say it is completely context dependent. That is, an appropriate decision depends on the nature of this situation, and on the options actually available in this situation, and the anticipated consequences in this situation. Because of this, deductive schemas for going from hard facts to observable behavior to observable consequences are never available as rigorous methods for choosing. To be sure, we sometimes employ logical or mathematical (etc.) algorithms as decision aids, but only after the prior decision has been made that in this situation (or this kind), such a schema is relevant to decision making. Blindly following a formula which says "Whenever X, do Y", where "X" and "Y" are concrete descriptions of facts and behaviors, is a prescription for disaster, for such a formula will have genuine value only under extremely limited conditions and cannot provide a general basis for decision making.

Instead, rational decision making fits a more complex structure involving the five components noted above. Two elaborations are of critical importance. The first has to do with choice principles and the second with empirical identities as the key to understanding how decision making can be both completely principled and completely situation-dependent.

There are choice principles which are universal and tautologous and therefore function as a "logic" of decision making. However, these are

abstract and free of empirical, observational content. For example, we may note the following.

(1) In a social system, a given person views (evaluates) events in light of the values and concerns which go with his position in the system.

(2) A person values some states of affairs over others and acts accordingly.

(3) If a person recognizes an opportunity to achieve something he wants (values), he has a reason to try to achieve that.

(4) If a person has a reason to do something, he will do it, unless he has a stronger reason to do something else instead.

Such principles, being abstract, contrast with concretely stated, context free prescriptions such as "whenever you're outnumbered, retreat". The abstract choice principles do not prescribe which actual choices to make or which observable behaviors to engage in. They do operate as logical constraints on the possibilities of choices and therefore exhibit the inherent rationality of choice making. They also provide the general forms which positive choice principles and actual choice making exemplify.

For example, as an actual decision maker, I might have the following value.

(2') I (we) value safety and stability over other states of affairs (e.g., over opportunities to attack, over honor and prosperity, over economic self-sufficiency, and so on).

This is a positive choice principle, and from it, in accordance with principles 1-4 above, stem the following.

(3') If a situation provides a recognizable opportunity to engage in (choose) an action which is conducive to safety and stability, I will have a reason to engage in that action, and

(4') I will engage in that action unless I have a stronger reason to do something else instead.

To take a parallel example, briefly, if the value in (2') is accuracy (e.g., for an intelligence analyst) rather than, say, clarity, suggestiveness, or explanatory value, then I will respond affirmatively to opportunities to make accurate statements rather than the other kinds of statements, unless I have reason enough to do otherwise.

Note that even the positive (and non-universal) choice principle must still be applied. I must be able to recognize which states of affairs in my present circumstances (let us assume that these are directly described in observational terminology) constitute an opportunity (and therefore provide a reason) to realize safety, accuracy, or whatever it is I value. I must also recognize which actions and their outcomes qualify as being conducive to safety and stability (or accuracy, etc.). The "unless" clause in the choice principle above is a way of recognizing that the judgment and choice is situation-dependent. For there is in principle no way of knowing what my situation will be and therefore no way of knowing what reasons and opportunities it will provide me, and specifically, there is no way of knowing whether it will provide me with a stronger reason to do something else instead.

To recognize which states of affairs constitute an opportunity to achieve safety and stability (etc.) or which actions qualify as facilitating safety and stability (etc.), I must be able to deal with the

part-whole character of my situation. In particular, I must be able to recognize the relevant empirical identities.

Empirical identities are cases where one thing is the same thing as another thing, not as a universal or necessary fact (the way "a rectangle" is always and necessarily the same thing as "a trapezoid with right angles") but only as a historical, empirical fact. These are cases where in this situation, what is described as "P" is the same thing as what is described as "Q" and as "R" (etc.).

Consider an example where

"P" = "Three units have moved from point A to point X";

"Q" = "Three units are threatening position Y from point X"

"R" = "An offensive is beginning with an attack on position Y".

A human decision maker might readily recognize that in these circumstances, the movement of the three units from A to X was a threat directed at Y and was the beginning of a general offensive. If so, he would be taking account of part-whole and part-part-whole relationships (a) in seeing the movement of those three units as being relative to Y within a motivational framework and (b) in seeing that movement as part of a larger pattern of human activity, most of which had not yet occurred and was not available as observable "information".

On the other hand, the human observer might not recognize the significance of the movements of those units, if this was just one fact among many which he was dealing with. In this case, the modeling of the situation from the relevant frame of reference (the values and concerns

which go with being in the position of having to defend Y), which would make the significant redescription of "P" available, to him would be a decided asset. To be sure, accomplishing that would pose substantial and characteristic difficulties. So also would the modeling required to help him evaluate the consequences of choosing one response option rather than another in that situation.

The problem of recognizing empirical identities and achieving significant redescriptions holds for objects, events, and processes in general and not merely for human activities. For example, "Passing location X at 2305 hours on a bearing of 86° at 30 mph" could in these circumstances be redescribed as "Coming within effective range of equipment Z at 2343 hours."

To summarize:

1. Decisions and choices of action options are made within a behavioral frame of reference, which, for a given decision, can be represented as a value/action/value framework.
2. Actions are chosen from among the actor's action options on the basis of evaluative descriptions of the actor's situation; actions are undertaken to influence the value of the situation for the actor.
3. The choice of actions is governed by a set of universal abstract principles which exhibit the logic of choice making.
4. The choice of actions is further governed by a set of positive choice principles which may be represented as values and which are not universal, but rather may vary from one person, group, activity, time (etc.) to another.

5. Observation reports (and "hard data" and "information") are, by design, in general noncommittal ("objective") rather than evaluative.
6. If a decision maker has "objective" data to go by in making a decision, he cannot make a rational decision until he has mapped the data into the behavioral frame of reference and redescribed the situation in a way which brings out its value/action implications. This evaluative redescription is usually accomplished implicitly by persons and therefore may be difficult to reconstruct in specific cases.
7. The objective basis for such redescription is the empirical identities which hold in that situation. That is, what is described in the first ("objective") way <u>is the same thing as</u> what is described in the second ("evaluative") way.
8. The primary objective basis for these empirical identities is the part-whole structure of the situation.
9. Therefore, human decision making in practical matters is <u>essentially</u> situation-bound. Generalized or context-free decisions are to be regarded as merely approximations or rules of thumb and may be disastrous if followed blindly.

The fundamental problem in the field of decision aids is that there has been no formulation of foundation-level theory. Such a theory would include an abstract formulation of (a) the behavioral framework and the logic of choice making and (b) the logic of part-whole relations in real world situations. In the absence of such formulations, the choices and actions of the developers of decision aids have been governed primarily by the following abstract choice principle.

(5) If the situation calls for a person to do something he can't do, he will do something he can do.

In the main, this has taken the form of (a) using existing formalisms (logic, mathematics, probability calculi, etc.) to represent positive choice principles or (b) investigating "how the decision maker actually does it" without having available an adequate theory of human behavior and choice making.

In contrast, the requirements for decision making noted above can also serve as a systematic orientation in regard to the needs and possibilities for decision aids.

A. Acquiring knowledge of the situation and its possible transformations

At the most basic level, the need for knowledge of the situation is simply the need for relevant information, and the creation of information gathering systems and their associated data bases is a response to this need. The emphasis in such efforts is on "clean," "hard" information. Certain possibilities for decision aids arise in connection with the need for relevant information.

1. Data bases and information systems are so common and so complex that they are generally regarded as separate fields of knowledge and endeavor rather than as a class of decision aids. However, from the standpoint of a systematic analysis, it is well to keep in mind that the point of maintaining the information systems which are of present relevance is to facilitate decision making. Thus, problems of obtaining relevant data, problems of obtaining complete

and up-to-date data, and problems of accessing data distributed across heterogeneous data bases may all be regarded as subsidiary forms of decision problem, and methodologies and devices for addressing these problems are correctly classified as decision aids.

One reason for keeping this in mind is that there seems to be a natural, evolutionary trend such that the decision aids of one generation of information systems are incorporated as simply features of the information systems of the next generation. The development of decision aids is therefore a way to influence the evolution of information systems in the direction of greater functionality for decision making.

2. "Hard data," or "observational data," generally refer to records or reports which are fully justified (hence "hard") because they do not imply anything beyond what was observed or recorded. Because of this, there is inevitably a significance gap between the "data" and the relevant facts which provide the grounds for decision and action. (Recall the gap between "Three units moved from point A to point X" and "Three units are threatening position Y from point X".) It is precisely because the relevant, significant description does imply something more than the "hard data" that it is useful to someone at some other time and place than the observation. By and large, the human analyst or decision maker can generate significant redescriptions when given the relevant hard data. However, because human capabilities are limited, certain kinds of decision aids may be of value in this regard.

a. Data bases need not be restricted to hard data, or whatever the primary input is. An information system auxiliary could be developed which would generate redescriptions of the relevant type. Even a crude system, working on a production basis without any feedback or validity checking could serve as a way of prompting the decision maker or catching his attention. A more sophisticated system with validity checks could provide direct warnings or call the decision maker's attention to patterning of events which he might otherwise overlook or remind him of certain opportunities or threats which he might overlook, and so on.

b. Sometimes the task of generating relevant descriptions reduces to performing a set of transformations for which formalisms and algorithms are already known (e.g., any mathematical functions, probability calculi, truth functions, etc., or any combination thereof). In such cases decision aids which automatically perform these transformations can make a contribution by virtue of greater speed, or reliability, or greater information handling capacity, and so on. Such applications are familiar in, e.g., the areas of logistics, mission planning, and I&W. Transformations of this sort retain the same observational or "hard data" characteristics as the input in that they still need to be redescribed (evaluated) in value/action terms. In general, their utility lies in that human decision makers find it easier to generate the redescriptions from the transformed data than from the input data.

c. There are borderline cases where some formalisms relevant to a given decision problem exist but there is only limited evidence for their validity or utility as decision aids (e.g., the use of Bayesian probability calculations). In these cases the development of such decision aids should be carried out in the context of research designed to formulate alternatives and arrive at comparative utility or validity indicators and at a formulation of the limitations on the utility or validity of each.

B. Acquiring knowledge of the action options in the situation and making it available

As noted above, the kind of decision making that is of interest here is not the kind that only involves a single action by a single person. Rather, what makes a given decision or action important is that it sets into motion (or implements or modifies significantly) a whole set of activities by various persons. There is, therefore, a crucial part-whole aspect to the question of action options; in choosing a given option the decision maker is also choosing the set of continuations which go with that option rather than the continuations which go with the other options. And since the decision maker must choose specific, concrete actions to perform, there is the corresponding issue of redescribing them in significant (evaluative) terms (usually, the value associated with the continuation set and its associated states of affairs).

Thus, the decision maker is not in the position of a rat in a maze, who merely decides whether to go left or right; rather his position is like that of an architect, who must think ahead as to what he is initiating and whether the necessary ingredients and activities will be available when needed to complete it.

Because of this, the question of what action options are open to the decision maker is often far from trivial and far from obvious. Indeed, this problem may be regarded as a special case of the general problem of acquiring relevant facts concerning the situation and its possible transformations. The choice of one action rather than another is a decision maker's primary way of transforming present reality into one future reality rather than another. Excluding non-human agency for the time being, we can say that the possible transformations of a given situation are the same as the possible choices of action options and their outcomes by the various decision makers in the situation.

Clearly, this is an area where suitable decision aids might be extremely useful. Two major classes of action option analyses and corresponding types of decision aids can be distinguished.

1. Opportunity analysis

This class of action option analyses takes the following form.

Given:

I am in situation SA = C1, C2, C3, ...Ck

I have action capabilities A1, A2, ...Aj

Question:

Which future states of affairs, SAj, could I [possibly; expect to; etc.] bring about by engaging in which action sequence Aj, Ak, ...An that are open to me?

In this form of analysis, the situation and the action capabilities are the "givens" and the question concerns what such actions would lead to. Colloquially put, the question is "What opportunities (or dangers, etc.) does this situation offer me?" Doing certain of the things the decision maker has the ability to do will, in this situation, be the same thing as bringing about certain valued states of affairs (or making them more likely, etc.).

2. Implementation analysis

The second class of action option analyses is equivalent to a Task Analysis (Ossorio, 1971/1978) and has the following form.

Given:

I am in situation SA = C1, C2, ... Ck

I have action capabilities A1, A2, ... Aj

State of affairs G is a possible transformation of SA

Question:

Which sequences of actions Ai, Aj, ... Ak are [literally, probably, etc.] the same thing as achieving G? If only an approximation, G', is achievable, how good an approximation is it and how is it achievable?

In this form of analysis, a valued state of affairs is part of the "given" and the question concerns the existence of an implementation constructed from the specified repertoire of actions. Colloquially put, the question is "Can I get there from here, and if so, how?" Here again, part-whole and redescription issues arise. Doing certain of the things I know how to do will, in this situation, be the same thing as bringing about the valued state of affairs or an approximation thereto. In the limiting case, the valued state of affairs is described in the same terms as the applicable choice principle, e.g., "What can I do to maintain the safety of position P?"

C. Choice principles (values, policies, etc.) for choosing among options and evaluating outcomes

Even when the facts concerning the situation and the behavioral options in that situation are (for practical purposes, at least) completely known, the decision maker's choice of options is not a foregone conclusion. The choice also depends on the decision maker's choice principles and the constraints under which he operates. (It appears that both positive choice principles and constraints can be formally represented as valued states of affairs.) Therefore, in a given situation there are, in general, a variety of possibilities for rational decision making.

Most of these possibilities have not been adequately modeled or formalized as such. Instead, much of the previous work in the area of decision aids has begun with a known procedure schema (e.g., the Delphi

method) or a known formalization developed in other contexts (mathematics, first order logic, "fuzzy" logic, Bayesian probability calculus, etc.) and has attempted to demonstrate its utility in some particular application as a decision aid. Although such work has potential value, an overemphasis on this kind of approach could be expected to result in a fragmentary and ad hoc program having an uncertain level of success.

In fact, as noted above, the basic logic of choice making can be formulated in a set of abstract behavioral principles. These principles are of two general sorts which are not mutually exclusive. The first sort, which includes all such principles, expresses constraints on possible choice (decision) making. It is exemplified by the principle that "If the situation calls for a person to do something he can't do, he will do something he can do." The second sort consists of paradigmatic statement forms which can be exemplified by specific, positive choice principles (it is similar to the sentence schemas found in certain logical theories). An example of this kind was provided above by "If a person has a reason to do something, he will do it, unless he has a stronger reason to do something else instead."

Certain kinds of decision aid are possible at the level of the basic logic of choice making. In general, these would be consistency checks and coherence checks. For example, it would be possible to check mission plans against the possibility that something with less value was taking priority over something with more value or that activities were being planned for which some essential capabilities were missing or uncertain.

Beyond this, there is the possibility of decision aids which model positive choice principles used in a given setting. In this connection, the basic abstract choice principles would guarantee formal rationality and the positive choice principles would represent models for good practical judgment. Decision aids of this general sort would take account of complex motivational patterns (in the simplest case, the pro's and con's provided by the situation). More sophisticated decision aids in this genre would also take account of multiple choice principles simultaneously (these are designated as "decision models") and provide active modeling of different perspectives on the given situation.

D. A practical assessment of expected consequences of each action option

[This was dealt with under B, above.]

E. The capacility for applying the choice principles to the situation, action options, and expected outcomes

The modeling of particular part-whole relations and a particular choice principle provides a decision aid for a person who adopts that choice principle for decision making. However, a great deal of human decision making is not settled in advance even to this degree, i.e., the method of arriving at the decision was not settled in advance. In general, every different policy, strategy, or decision principle will have differential utility with respect to the different values and

constraints which a real world decision maker inevitably has. Thus, one of the procedures which is often involved in decision making is the hypothetical trying out of various ways of arriving at a decision in order to assess the differential consequences that each way of deciding would have for the various different values of the decision maker. This holds for both the individual use of choice principles and the use of a set of such principles jointly. This level of complexity corresponds to the concept of a "decision model" and it corresponds to the normative case of non-routine decision making in practical situation.

It has been demonstrated (Carlson, 1979; Ossorio, 1968) that different decision models will often do equally well at modeling and predicting human judgment even though they are quite different from one another as models and lead to different choices much of the time. Some simple cases of this phenomenon are provided by game theory and decision analysis. These approaches, which involve the comparison of simple utility functions (value x likelihood) of various outcomes, make it possible for the decision maker to try out various strategies or policies for making choices and to evaluate their outcomes in the given settings. Of course, these are far too simple, require unacceptable assumptions, and are not sufficiently context-sensitive to be sound models for actual decision making.

A Program Rationale

Given the orientation provided by the initial analysis of the requirements for decision making, a rationale for a systematic program of decision aid development follows in a fairly direct way.

A fundamental approach to modeling rational decision making is to develop the methodology for explicitly representing and implementing the logic of choice making and then generate the special cases of choice making in the particular settings where it is important to do so. The logic of choice making is embodied in a set of abstract principles such as the four noted above (e.g., "If a person has a reason to do something, he will do it unless he has a stronger reason to do something else"). The aim of this development would be to arrive at a set of principles which was complete (for practical purposes) and computer implementable. This set of principles would be the basis for modeling the various possibilities of rational (justifiable) decision making and these models would provide decision aids for persons operating in accordance with those models.

A systematic approach to particular decision problems would be to apply the general behavioral model to the given operational setting, make explicit the various relevant choice principles, and construct alternative decision models each representing a distinctive way to arrive at a decision using some set of choice principles (actual ones, not merely abstract constraints) jointly. Although the use of existing formalisms (mathematics, logic, etc.) should not be overlooked, the primary emphasis would have to be on (a) the explication of actual acceptable choice principles and decision models, (b) the automatic classification of states of affairs (situations, facts, possibilities) in regard to their values, and (c) the automatic redescription of specific actions in decision-relevant terms. The major alternative to a reliance

on purely algorithmic solutions is the use of real world representation (Ossorio, 1971; 1971/1978) and human judgment methodology (Ossorio, 1968; 1969/1978).

The various kinds of study and development noted above all make contributions to a systematic program of decision and development. Optimal development requires, in addition, an active modeling capability to provide a functional context in which the various contributions are brought together.

1. From one point of view, the problem addressed by the active modeling capability is simply the need for an operational framework within which any or all of the components of the general decision problem can be addressed for any given application. The operational framework would consist of a DBMS which implemented both the logic of part-whole relationships and the logic of choice making in representing specific situations, action options, and choice possibilities. Both an interactive capability for trying out decisions and decision methods and a distributed data base access capability for ensuring access to available relevant facts would be important features of the DBMS.

2. From a more speculative viewpoint, the need addressed by the active modeling capability is the need for a quick and effective way to construct a variety of specific decision aids. For if the abstract representation and implementation of situational representation, redescription based on empirical identities, and choice principles is substantially successful, then it could be made to

function essentially as a decision aid compiler. That is, given a high level language input of relevant facts, the output would be a specific decision aid suitable for a designated operational setting.

3. Given the evolutionary principle that today's successful decision aids become part of tomorrow's information systems, the active modeling capability can be significantly redescribed as a potential prototype and an investigative tool for designing and stress-testing information systems for the future.

From a programmatic point of view, an optimum strategy would be to aim for cross-fertilization between (a) in-depth, ad hoc solutions for specific decision problems in operational settings and (b) the formulation and computer implementation of the fundamental principles and real world ingredients involved in decision making.

A Decision Aids Development Program

Given the foregoing analysis of the general character of the decision making problem and the corresponding possibilities of decision aids, various ways of implementing a development program are possible. For example, it would be feasible to follow the strategy of pursuing the synergistic development of (a) specific decision aid applications, (b) the systematic explication of general and specific principles for decision making, and (c) an active modeling capability. There would be, correspondingly, three major components of such a program. These are outlined below.

I. Decision Aid Applications

In this component, the task is to develop a limited number of specific decision aids in areas of significant need, making use of what is already known about part-whole relationships, empirical identities, and choice principles and choice making. This program would begin with an assessment to establish where there is most current need for decision aids. The assessment would generate a set of candidates for decision aid development. From this set, an initial subset would be selected for immediate development using such criteria as degree of need, apparent feasibility, acceptability to users, etc.

The following would be a standard tasking format for individual decision aid projects.

A. Representation of the real world action/decision context, including past, present, and possible future situations or states of affairs.

B. Representation of action options and action sequences with differential outcomes.

C. Representation of a realistic set of choice principles and decision models for that context.

   1. Generate possible ways of making choices at various problematic points in the activities in question.

   2. Evaluate options by either desktop study, interviews, or experimental procedures.

   3. Select an acceptable set of choice principles.

D. Computer implementation

   1. Program the representations

   2. Access relevant data

   3. Ability to select any given choice principle or decision model

   4. Comparison of results using different choice principles

   5. Ability to operate with hypothetical data

   6. Documentation

e. Trial use

   1. Experimental use with test data

   2. Operational use

F. Evaluation

G. Final version

This task format could also be used in reviewing, evaluating, and upgrading existing decision aids and decision aid projects.

II. A Decision Aid Production System

As noted above, a fundamental problem in decision making and decision aid development is the systematic representation of part-whole relationships (for generating significant redescriptions) and the implementation of rational choice principles. An associated technical problem is the computer implementation of both. Because these are substantive problems in all but the most trivial application projects, it would be extremely cost effective to develop and systematize the abstract representation of real world situations, behavioral options, and choice principles for the specific purpose of providing a general, systematic framework for the efficient production of specific decision aids. A production system is called for because the number of needed decision aids now and in the future is not small, and much duplication of effort and inconsistency in achievement could be expected from a one-by-one approach. The production system approach offers at least two distinct advantages.

A. The development and implementation of a general methodology for decision aids might well be an essential ingredient in the successful modeling of specific action/decision contexts and specific choice principles. Because of this, it would be appropriate to begin this development immediately, either as an independent project or in conjunction with a specific decision and application. The advantage of the latter is that it would help to ensure the applicability of the abstract implementation to real world contexts. A possible disadvantage is that the general model might be too heavily influenced by the specific application.

B. The implementation of general solutions to part-whole representation and choice principle implementation would make it considerably easier to design and implement decision aids in specific applications. In principle, in fully automated form, the general implementation would function almost as a compiler in that, given the input of the particulars for a given decision/action setting and the particulars for a set of admissible choice principles, the particular decision aid would follow more or less straightforwardly and, for the most part, could be generated automatically.

The following would be an appropriate task structure for a general model, or production system.

1. Part-whole modeling and associated redescription
   a. Objects, processes, events, and states of affairs as wholes and as parts
   b. Principles and algorithms for describing any of the above as any of the others, and with recursion. This would include principles and algorithms for transforming "whole" descriptions to "part" descriptions, and vice versa.
   c. Description and classification of part-part relationships
   d. A library of representations of significant objects, processes, events, and states of affairs.
   e. Documentation
2. Choice principle modeling
   a. Explication of abstract choice principles
   b. Explication of specific choice principles and development of standard representational formats for them

c. Representation of abstract decision/action context, action options, and situation transforms.

d. The use of abstract choice principles as constraints on possible choices

e. The use of specific choice principles as exemplifying abstract choice principles

f. The use of abstract choice principles and specific choice principles to generate decision models

g. The use of human judgment to generate decision models and test them.

h. The redescription of choice principles and decision models as values of certain states of affairs.

i. The redescription of decision/action outcomes as instances of or approximations to valued states of affairs

j. Documentation

3. Computer implementation

a. Program situation and choice principle representations

b. Program an abstract decision making episode

c. Program ability to accept hypothetical specific cases

d. Preliminary documentation

4. Trial use

a. Consistency checks and desktop study using hypothetical situations and representative choice principles or decision models

b. Development of a specific decision aid using actual data and representative decision models

c. Development of a specific decision aid for an operational setting using actual data and establishing a realistic set of choice principles and decision models

5. Evaluation

6. Final documentation

III. An Active Modeling Capability

The purpose of this project is to design and implement a Data Base Management System which would incorporate the general framework of the production system described above and would permit the modeling of different evaluative frames of reference and different hypothetical situations. This capability is needed because effective research and development of decision aids require that decision aid methodology and technical resources be readily available in functional form.

The following would be an appropriate subtasking.

A. Design a DBMS using real world representation (objects, processes, events, and states of affairs as wholes and as parts) and choice principle representations as the data model.

B. Design the general capability for accessing multiple heterogeneous data bases as well as the data directly accessible on site.

C. Design the capability for modeling specific situation/action options/ decision model problems.

D. Design an interactive capability giving the user the ability to input specifics and vary the parametric values of the models for specific situation/action options/decision model examples.

E. Implement the foregoing designs on suitable hardware

F. Preliminary documentation

G. Trial use

   1. Use hypothetical situations and problems

   2. Model a currently useful decision aid and variations of it

   3. Generate a decision aid by using the system to analyze an existing decision problem

H. Evaluation

I. Final documentation

Summary

Enough is known about the representation of real world situations, the behavioral structure of decision making, and principles of choice making to provide a theoretical basis for the development of decision aids and a practical basis for a systematic program of decision aid development. A program combining specific decision aid development, conceptual/methodological development, and computer implementation is outlined.

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