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DECISION PROBLEM STRUCTURING

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Table 1
Decision matrix containing two options, three states and four attributes; $k = 1$–4

	States		
Options	$j=1$	$j=2$	$j=3$
$i=1$	X_{11k}	X_{12k}	X_{13k}
$i=2$	X_{21k}	X_{22k}	X_{23k}

Decision-Problem Structuring

The structure of a decision problem should be specified prior to formal evaluation of the alternative action options. The process of structuring a decision problem is dynamic and cyclical; as additional problem elements and their interactions continue to be discovered, the preliminary structure is repeatedly modified. A fully structured decision problem contains a list of possible action options, attributes for evaluating the suitability of the options, and possible states of nature which will have an impact on the outcome of the options. This is illustrated in the example decision matrix given in Table 1, which contains two options, three states and four attributes.

In general, each alternative option i results in j possible outcomes, represented by $X_{ij}=(X_{ij1}, X_{ij2}, X_{ij3}, \ldots, X_{ijk})$, where X_{ijk} is the level of attribute k which occurs in the outcome of option i being chosen and state j occurring. The set of all possible states of nature provides a mutually exclusive and exhaustive partition of the environment, so that each state consists of one specific level of each of the possible probabilistic variables in the problem (such as the bank prime rate and the strength of the US dollar). The probability of state j is p_j. Note that the action taken does not affect the probability of a state. Thus, the decision maker cannot control which state occurs (or the probability of its occurrence) by altering the action chosen. An event is a set of states. An example event is that the variable "Dow–Jones index level" is above 2000. In a formal decision analysis, one prevalent criterion for recommending a top choice is to take the alternative with the highest expected utility, where the expected utility of alternative action i is computed by taking the sum over all states of the utility $u(X_{ij})$ times the probability of the state p_j. When there are multiple attributes, $u(X_{ij})$ can be represented with a multiattribute utility function (Keeney and Raiffa 1976).

The way in which a person processes decision-relevant information will have a large effect on the contents of the problem structure, the problem-solving process used and the ultimate solution of the problem. A number of methods for aiding a person to access relevant items in memory to creatively structure a decision problem are presented here. It is important to note that there is very little research that has been done on these procedures, so they should not be seen as validated methods, but as suggestions, still to be subjected to laboratory and field testing. First, methods for generating options are given in Sect. 1; methods for generating states of nature are presented in Sect. 2 and means for identifying attributes are briefly presented in Sect. 3. Human long-term memory can be modelled as an associative network with nodes in the network being cognitive units (such as decision-problem options, states of nature or attributes.) Figure 1 contains a partial cognitive representation of the problem of deciding among possible options for personal investments. When diagramming a portion of a person's knowledge, option nodes for the current problem can be modelled as squares; states of nature nodes are circular; and attribute nodes are triangular. The methods described here are designed to stimulate creativity by accessing the different kinds of cognitive units within memory.

1. Methods for Generating Options

The methods for generating options are divided into five categories: attribute-based, state-based, composite, option-based and creativity procedures. Keller and Ho (1988) give a more complete description of the methods together with relevant research results and an extensive list of references. A number of criteria may be used to evaluate the sufficiency of a set of options for a specific problem. When possible, the criterion which a specific method is likely to satisfy is identified along with the method.

1.1 Attribute-Based Procedures

A principal strength of a person's information-processing system is the complex associative memory in which small cues or attributes can lead to retrieval of complex associations which stimulate the option-generating process. Hence, attention to different subsets of attributes can lead to different options. Seven versions of attribute-based procedures for generating options are identifed. Attribute-based procedures

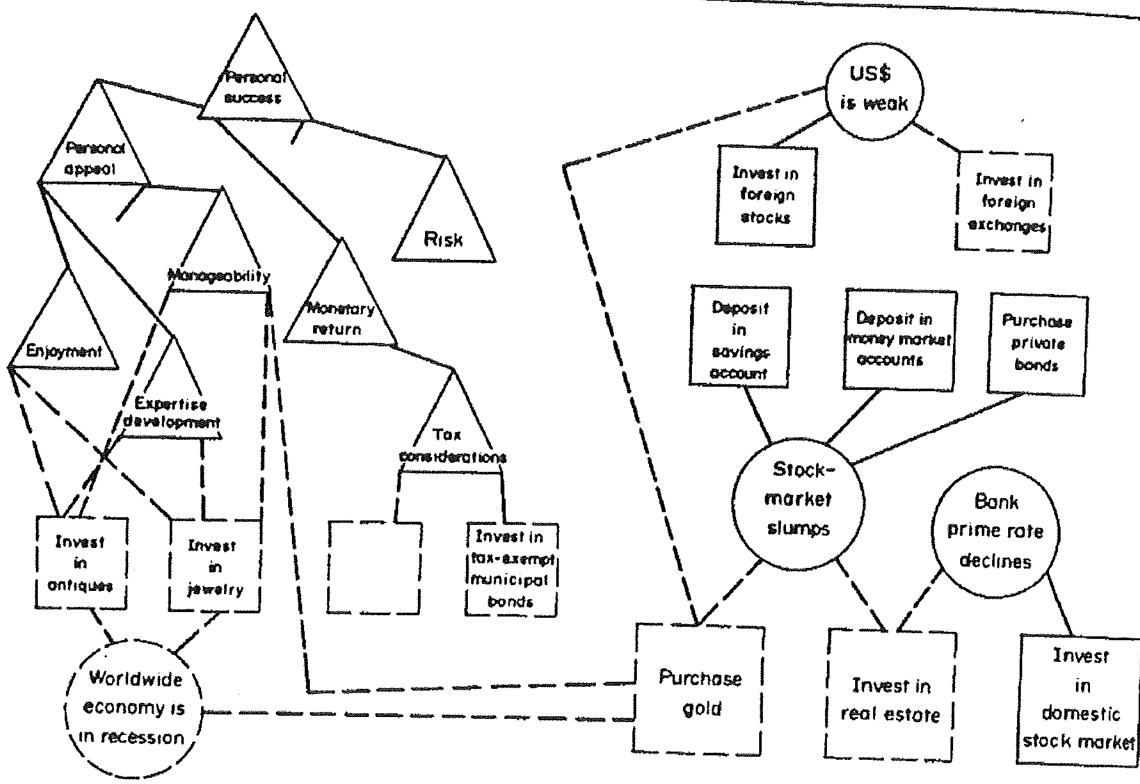

Figure 1
Partial cognitive representation containing some decision-problem elements: dotted lines indicate arcs and nodes that do not exist (or are weakly represented) in the associative network

provide stimulation from the environment by introducing nodes or stimulating existing nodes containing attributes or goals. Since a goal node serves as a relatively constant source of activation in a cognitive network, introducing an attribute should initiate a great deal of activation or search in the local region around that node.

One warning about attribute-based procedures should be given. In stimulating creativity, separation of idea generation from evaluation is recommended to avoid premature censoring of ideas before they are formally stated. In a cognitive network, premature evaluation might occur if a high threshold for activation level must be met before an idea would be added to the option set. Use of goals or attributes to prompt ideas may lead to immediate evaluation of options with respect to those attributes, and thus limit the number of options generated.

(*a*) *Present attributes one at a time. Elicit options which will help meet each individual attribute.* This method is likely to meet the criterion of maximizing the number of options in the choice set which are either perfect or good on at least one attribute. For instance, in the options for "personal investment" example given in Fig. 1, an attribute "risk" can first be presented to the decision maker, then the attributes "risk" and "tax considerations" together, and so on, until all attributes are presented. Experimental subjects generated more options for solving personal dilemmas when the task was first to generate options to satisfy only one attribute, then to consider a different attribute, and so on, until all the attributes had been considered. These results provide empirical support for the GODDESS computer system developed by Pearl *et al.* (1982), which assesses goals and subgoals (attributes) before asking for possible options to lead to improvements in each subgoal.

(*b*) *Design options to do well on the heavily weighted attributes.* This approach is likely to meet the criterion of maximizing the number of options which are close to optimal. For example, when the Los Angeles Unified School District was legally ordered to develop and implement a desegregation plan, Ward Edwards helped the school board generate a complete value tree with 144 bottom-level attributes. Interested groups were encouraged to submit possible desegregation plans to the school board for evaluation via the value tree (von Winterfeldt and Edwards 1986). In addition, the school board developed a new plan after the value tree had been constructed and the attribute weights for an additive multiattribute value function were computed by averaging the attribute weights of five board members. Thus, it is possible that the new plan was creatively designed to satisfy the more heavily weighted attributes.

(*c*) *Be more detailed in partitioning the attributes prior to eliciting options.* Specifying the value tree of attributes in more detail is likely to identify more attribute nodes in the cognitive network which could potentially be connected to additional option nodes. This may lead to a number of reasonable options, which are feasible based on the person's values. More vacation package options were elicited from experimental subjects when a value tree was specified down to three levels with six attributes (such as mental relaxation) than when it was identified with only one or two level(s). However, if a value tree is specified in too much detail, viable options may be screened out. For example, when planning a vacation, the attribute "variety" might be partitioned into "number of towns visited" and "number of activities done." This may preclude the potentially attractive option of backpacking for a week in the mountains.

(*d*) *Deemphasize the personal nature of the attributes to increase the number of options generated upon consideration of goals. Emphasize the personal nature of the attributes to increase the quality of the options generated.* Rating the personal importance of vacation goals (attributes) prior to generating options led to experimental subjects generating fewer options than those who did not rate the goals first. However, the options generated by this "personally involved group" were rated higher on goal-achievement scales than the options generated by other subjects. Thus, fewer and "better" options were generated by emphasizing the personal nature of attributes. On the contrary, deemphasizing the personal nature of attributes is likely to lead to maximizing the number of novel options. This suggests that by varying the role perspective of the decision maker, a better option set may be achieved.

(*e*) *Completely enumerate all possible options by combining all possible levels of each attribute.* In designing creative options, a useful procedure is forcing morphological connections in which the attributes of the "standard" option are listed, then alternative levels of each attribute are generated. Finally, candidate options are created by forcing all possible connections across attributes. The commercially available DECISION AIDE II software first requires the user to list all the features of current options (such as low cost), then the user is prompted to supply a new option which matches a forced combination of three features. This approach is likely to meet the criterion of maximizing the fraction of total possible major option variants which are included in the option set.

(*f*) *Invent or temporarily replace an attribute.* Inventing a new attribute that has not been considered previously may suggest novel alternatives and may lead to maximizing the flexibility (i.e., responsiveness to unmodelled future changes) of the option set. For example, multiuse and convertibility are two attributes of a combined diaper tote bag and portable infant bed which were not factors in the standard tote bag, but introducing them as attributes readily suggests the attractiveness of having a padded bag convert into a portable bed.

Second, temporarily replacing an attribute with an isomorphic description may stimulate new ideas. The framing of the description of outcomes has been shown to alter choices, possibly by causing the accessing of different nodes in the cognitive network. For example, presenting outcomes in terms of number of lives saved or number dying can lead to opposite choices.

(*g*) *Expand the scope of the problem by examining higher-level attributes.* At the beginning of the modelling process, it is important to vary the scope of the problem by asking why the current attributes are important in order to discover higher-level attributes. For example, considering the problem of North Sea oil pollution from different institutional levels can introduce different sorts of options (von Winterfeldt and Edwards 1986 p. 522). Experimental subjects who expanded the scope of a problem via a "problem–purpose expansion" heuristic generated more ideas than the subjects who were warned that problem formulation and reformulation is important, but were not given a specific method. In the problem–purpose expansion method, the purpose is first stated in the form of action verb + object phrase + qualifying phrase (TO MAKE + A PROFIT OF $20 000 + WITHIN ONE YEAR), then it is expanded by repeatedly responding to the means–end question, "What am I trying to accomplish?" (TO ATTAIN BUSINESS SUCCESS WITHIN ONE YEAR). Altering the scope of the problem will also help meet the criterion of maximizing the flexibility of the option set by increasing responsiveness to future changes in problem structure which arise owing to expansion of the scope.

1.2 State-Based Procedures

Some procedures depend on prior determination of the states of nature or combination of probabilistic events which may impact on the outcomes of the decision options. Two procedures are presented here.

(*a*) *Present possible states of nature one at a time. Elicit options which will be effective in each individual state.* First, the possible future scenarios are generated (by combining different probabilistic events to determine alternative states of the world), and then options which would be effective in each scenario are elicited. For example, facing the scenario that both "the US dollar is weakening" and "the stock market slumps," the decision maker might generate the option of investing in foreign exchanges (e.g., the Japanese Yen). This approach can be especially useful in selecting strategic long-range plans. In addition, options for gathering more information about the probability of the state (e.g., through market research) should be considered. Note that the order in which states are presented may affect the option set. For example, if the first state is that "the worldwide economy is in a recession," then this "bad" state may induce a pessimistic mood and alter the pathways of spreading activation through the cognitive network.

(*b*) *Design options to do well in the more probable states of nature.* Identifying the few states of nature which are most probable, then designing options which will do well on that set of states of nature is another approach. For example, a stadium vendor might sell hats as rain hats or sun visors depending on the state of the weather. This procedure is likely to lead to the creation of options with expected utilities which are close to the expected utility of the best option, meeting the criterion of minimizing the number of options in the set which are close to optimal.

1.3 Composite (Attribute-Based and State-Based) Procedures

A procedure which relies on specification of both the attributes and the states of nature may be especially useful for generating an enlarged set of options once a preliminary model of the problem has been built.

Elicit a preliminary set of options that addresses the heavily weighted attributes. Then conduct a sensitivity analysis using a preliminary decision tree before eliciting more options. Arbel and Tong (1982) created an option-generation procedure that uses a preliminary decision tree with the initial options to conduct a sensitivity analysis. The sensitivity analysis highlights sensitive states, so that new options can be generated which reduce or circumvent this sensitivity. Sensitive states are defined as those which have greater differences in the payoffs for the different outcomes. For example, suppose the preliminary option which maximizes the expected utility results in utility u_1 if state 1 occurs (with probability p) and a lower utility of u_2 if it doesn't. Thus the expected utility of the option is $pu_1 + (1-p)u_2$. This best option will result in utility u_3 if state 2 (with probability q) occurs and a lower u_4 if it doesn't. Suppose $u_1 - u_2$ is greater than $u_3 - u_4$. Then state 1 is called more sensitive than state 2 because an "error" in assessing the probability p of state 1 (e.g., the actual p is found to be 0.1 more) will lead to a greater change in expected utility $[0.1 (u_1 - u_2)]$ than if the same error were made with state 2. Arbel and Tong illustrated their procedure by generating alternative corporate strategic plans. The procedure is likely to lead to minimization of the number of options which are close to optimal.

1.4 Option-Based Procedures

(*a*) *Present examples of options and elicit more options.* Although presenting examples of options seems appropriate, experimental research results give mixed evidence about its effectiveness. Pitz *et al.* (1980) presented examples of possible vacation options to experimental subjects. This did not increase the number of options generated, but did lead to more options that related to the examples. Thus, providing examples seems to have caused subjects to anchor on those examples in the cognitive network, and to generate new options which were representative of the examples using the representativeness heuristic. Gettys *et al.* (1987) presented examples to encourage thinking prior to eliciting added options. Although the effectiveness of supplying examples was not directly tested, subjects only generated about 20–30% of the possible good options, so giving examples may have limited the quantity of generated options. This approach is likely to meet the criterion of maximizing the number of options related to examples.

(*b*) *Specify the characteristic or generic structure of options. Then select options which will meet the required structure.* For example, in a project to generate options for a psychology department's computer systems, the objectives were first decomposed into a tree. Then three requirements spaces (hardware, software and user) were mapped out. Finally, options for subsequent evaluation were designed which would span the requirements spaces. First options suitable in three small worlds (business, laboratory and statistics/simulation system) were identified, then they were combined as complete options.

Alternatively, the generic structure of example options can be used to identify goals or attributes which may be of interest. When experimental subjects were told to supply the goals which might be attained by example choices *and* the choices that could meet example goals, they generated more new options (and new goals). This method presumably aids a person in accessing problem prototypes or scripts in memory consisting of options linked with outcomes described in terms of attributes or goals. This should lead to maximizing the fraction of the total possible major option variations included in the option set.

(*c*) *Visualize the ideal option and design options which are close to it.* An ideal option which reaches the best level on each attribute can be imagined as an example option. This ideal option may be imagined with visual imagery and be represented as a spatial image in the cognitive network. Anchoring option generation on this option may activate search in the cognitive network locally about the node representing the ideal option and lead to maximizing the number of alternatives that are close to ideal. However, if a person is unable to imagine the ideal option, then it may also be hard to imagine options close to it.

(*d*) *Present examples of options framed in a different way*. The method of framing an attribute to stimulate new options has already been discussed. The framing of the reference point and sunk outcomes has also been shown to alter choices, perhaps because different frames lead to different node-activation patterns. The reference point, target level or neutral level on an attribute can greatly alter the perceptions of an option if changing the reference level leads to changing the perception of an outcome from being a gain or "good" to being a loss or "bad." For example, in a civil-defense problem of choosing between equal chances of losing 40 lives and 60 lives versus a sure loss of 50 lives, a different frame is achieved by setting the reference point at the 50 sure lives to be lost in the second option. Then the new frame for the first option leads to equal chances of saving 10 additional lives or losing 10 additional lives.

Sunk outcomes are costs or benefits of a problem situation which have already been experienced and which may or may not be perceived as relevant to the current decision problem. Presenting example options with and without sunk outcomes may lead to different new options. More generally, the time horizon (both backwards and forwards in time) which is spanned by the model must be specified.

1.5 General Creativity Methods

In addition to the specific techniques which are listed in the preceding subsections, some other general creativity techniques may be useful in generating novel options.

Examining the problem from the point of view of different experts, different interested parties and different levels of an organization may lead to more creative options. Similarly, an interdisciplinary team of analysts may generate a more complete set of options than a group of people from one shared background.

Methods for releasing self-imposed constraints can enhance creativity. For example, when confronted by the problem of an ostensibly broken doorbell, a person may think of the "creative" option of trying to open the door in case it isn't locked, but fail to relax the implicit constraint imposed by a written note (saying "please knock loudly, since the doorbell is broken") that ringing the doorbell wouldn't work.

The purpose of techniques such as brainstorming and synectics is to stimulate idea generation. Brainstorming involves the rapid generation of ideas, by building upon previously generated ideas or diverging onto new topics without concurrent evaluation of the ideas. A group of individuals separately brainstorming may lead to more breadth of options than if the same people do it in a group, which may lead to depth by following a specific idea with a related one. Synectics is a set of techniques which rely on metaphorical thinking and thinking with analogies to create new ideas. Training subjects to follow a diverging–converging two-step process called "ideation–evaluation" (in problem finding, solving and implementation) led to higher use of ideation in problem finding and solving and better performance in problem finding in a field experiment. Divergent thinkers have been shown to have a greater ability to generate alternative options. Inducing a good mood in experimental subjects (by having them watch a funny movie) helped to stimulate the creative generation of options for solving the problem of affixing a candle to a wall in a room with miscellaneous objects.

2. Methods for Generating States of Nature

This section contains four categories of methods for generating states of nature: probability-based, state-based, option-based and general creativity techniques. The methods prompt a person to search memory in a controlled fashion to stimulate creative generation of possible states by initiating activation of nodes in different parts of the cognitive network. There are many types of probabilistic variables which may be used to identify the state of the environment, including: technological advances, actions taken by competitors, "acts of God" and economic conditions. See Keller (1988) for a more complete description of the methods, experimental evidence and an extensive list of references.

Although the goal in state generation is to partition the environment with an exhaustive set of mutually exclusive states, this ideal will usually not be completely attainable. A general criterion (proposed in Keller 1988) for evaluating the sufficiency of the set of states is to continue searching for new states if the probability that these additional unmodelled states will occur exceeds a prespecified threshold p. The threshold will vary depending on the costs of suboptimality and of further search.

2.1 Probability-Based Procedures

(*a*) *Estimate the probability of "other" states*. A key necessity for computing the potential value of unadded states is an accurate assessment of their probability. Unfortunately, experimental subjects have been shown to underestimate this probability (Gettys *et al.* 1986). When Fischhoff *et al.* (1978) showed automobile mechanics and college students fault-tree structures hierarchically categorizing the reasons why a car might not start, their assessments of the probabilities of different causes varied systematically depending on how much detail was provided on the various branches of the tree. Branches on the fault tree included "battery charge insufficient," "fuel-system defective," and "all other problems." Although subjects consistently underestimated the probability of the "other" category, when asked to focus on what causes were grouped together in this miscellaneous branch, its probability increased. Also, the probability of a particular branch was increased by presenting it as two separate component branches. However, increasing the amount of detail for the tree as a whole or just for some of its branches produced small effects on perceptions.

Thus, based on this study, two methods for improving the estimate of the probability of unadded states are suggested. First, a decision maker should focus on what states have been omitted, prior to estimating the probability of unadded states. Thus, activation will be diffused throughout the cognitive network in the general regions near the already modelled states. Even if this mental simulation does not produce well-formed "visions" of additional future states, it should at least cause a person to anchor on some vague added states and lead to a higher and more accurate estimate of the probability. A by-product of this is that added future states may have been generated which can be formally included in the model if their joint probability exceeds the threshold. Second, a related method would be to ask the decision maker to partition the "other" category into two or more parts. Then the total probability estimate for both "other" state categories is likely to be higher and the partitioning process may also lead to the generation of added states.

(*b*) *Assess preliminary probabilities for the variables which have been already identified.* When a person is temporarily unable to think of additional states, the task can be switched to a preliminary elicitation of the probabilities of the events which have been already specified. It will sometimes be the case that the decision maker will be unable to easily supply a probability since the event E is dependent on another event S. Thus a new event which should be explicitly modelled is S.

2.2 *State-Based Procedures*

(*a*) *Consider the variables in an example state one at a time.* Once a preliminary set of states has been identified, one state can be used as an example to focus thinking. First, the variables in the example state (such as the competitor's price and the coupon redemption rate) would be listed and the person would be asked to generate different states suggested by each individual component or variable. Experimental subjects who generated more hypotheses (states) also generated more uses for an object when the attributes of the object were prespecified. This provides indirect evidence that prespecifying the variables in a state may lead to generation of more states.

(*b*) *Force morphological connections among components of a state.* A variation on the above method also begins with identifying the components of an example state of nature. Then variations of each component are listed and "forced" combinations between all possible variations are enumerated, to help identify other possible states. For example, in the terrorist-plagued Middle Eastern countries, a well-known state of nature is that a free-standing small bomb will be delivered in the mail to a US Embassy, and pressure and motion will detonate an explosion. Varying the delivery system from the mail to a suicide-committing driver in a Mercedes truck creates the unforeseen state of nature that occurred when a bomb-carrying truck crashed into a US Embassy in Beirut, Lebanon. This situation resulted in concrete barriers being erected at government building such as the US Capitol building in Washington, DC.

(*c*) *Decompose states into subjudgements.* When the states are different levels of a numerical quantity (such as sales volume by competitors), prompting a person to use a problem-specific algorithm eliciting appropriate subjudgements should lead to a better partition of the environment into possible states. For example, the aggregate sales volume by competitors could be estimated by first estimating the advertising expenses and the resulting sales volume of each competitor, then arithmetically combining these to get the aggregate estimate.

2.3 *Option-Based Procedures*

(*a*) *Focus on one example option and generate best- and worst-case scenarios.* Once one possible alternative action is known, it can be used as a focal point to think about the best possible state of the world if that option is chosen. It may help to think about the emotional good feeling that would result if this good outcome occurred. This should stimulate activation of the person's cognitive network in the region surrounding the option in the direction of "good" outcomes and surrounding the node containing the induced "good" emotional state. Then the same option can be used to think about the worst possible state of the world that could occur if that option is chosen. This should stimulate activation of nodes around the option in the direction of "bad" outcomes and "bad" emotional states.

(*b*) *Generate states which discriminate among options in terms of the range of outcomes.* In this method triples of example options are compared. The decision maker is asked to supply a state in which two options get the same outcome and the third option gets a different outcome. This approach is the reverse of the one by Arbel and Tong (1982) who discuss how to use such "sensitive states" to guide generation of options.

2.4 General Creativity Methods

The general creativity techniques for eliciting options listed in Sect. 1.5 are also useful for state generation. First, the problem should be examined from varied perspectives. The perspective of the current place in time can be manipulated by drawing a causal map of the problem, then mentally moving forward or backwards in time. Moving backwards in time to list possible causes of current states is likely to result in a more complex cognitive map than the parallel one for moving forward in time to list possible consequences of current states, since we may tend to report all factors that were noticed in past events, and not just the more valued factors which are selectively thought of when projecting the future.

Working on state generation with a group of people with different propensities and abilities to reason probabilistically and to abstract from concrete situations is likely to result in a more complete set of states. People from different organizational levels are likely to bring different perspectives to the problem and they may have different abilities to abstract from the concrete situation. Also, the team of state generators should contain people from cultural backgrounds differing in their worldview of causality.

One of the key requirements of the brainstorming creativity method is the prohibition of any censoring of ideas during idea generation. However, there is experimental evidence that peoples' generated hypotheses are censored prior to giving their responses. Thus, requiring that evaluation of possible states be deferred to a later stage should increase the number of states generated.

2.5 Modelling Structures to Aid Probabilistic Thought

In conjunction with the methods presented above for stimulating creative state generation, probabilistic modelling techniques can be used with the preliminary states and options to visually represent the problem structure and stimulate deeper thinking about the problem, leading to the generation of additional states. These methods include inference trees, fault trees, event trees, cognitive maps, influence diagrams, interpretive structural modelling and diagnostic questioning.

Once the relevant variables are identified, a formal procedure for forecasting the probability distribution of outcomes will be useful. Various formal forecasting and planning procedures are used in organizations to augment individual judgements about possible future states of the environment and the probability of those states. These procedures include computer simulation models (probabilistic system dynamics), trend extrapolation, the Delphi method, cross-impact analysis and scenario analysis.

3. Methods for Generating Attributes for Evaluating Options

The attributes (or objectives or criteria) by which options will be evaluated can be represented in a hierarchical value tree. Higher-level attributes (such as degree of personal success) will be subdivided into more specific characteristics of success (e.g., personal appeal, monetary return) (see Fig. 1). Keeney and Raiffa (1976) present value trees for many example problems and describe criteria for evaluating the sufficiency of the set of attributes (see also von Winterfeldt and Edwards 1986). The set of attributes should be complete, operational, decomposable, nonredundant and as small as possible.

The methods for generating attributes are divided into four categories: attribute-based, state-based, option-based and general creativity techniques. Examples of methods in each category are briefly mentioned below.

3.1 Attribute-Based Procedures

(*a*) *Present examples of attributes and elicit more attributes.* For example, the attribute of "monetary return" for evaluating personal investments may suggest the additional attribute of the "financial risk."

(*b*) *Further partition attributes into subattributes.* In choosing vacation options, one might divide "entertainment" into nighttime and daytime entertainment in a hierarchical value tree. The investment decision maker should ask the question "How will I attain the higher-level attribute (e.g., personal success)?", answering the question with a means to attain it, i.e., "increase monetary return."

(*c*) *Generate higher-level attributes by answering why the lower-level attributes are important.* The problem–purpose expansion method, which was described in Sect. 1.1(*g*) can be used to generate higher-level attributes.

3.2 State-Based Procedures

Present states one at a time. Elicit attributes which will characterize the possible outcomes of the preliminary options in each state. When choosing among possible investment options, the state that "the worldwide economy is in a recession" can be focused on first (see Fig. 1). Then the option of investing in antiques may suggest the attribute of the "ability to hold the commodity long enough for the economy to turn around," or the attribute of the "ability to use an investment in an alternative function (i.e., furniture to sit on or paintings to look at)."

3.3 Option-Based Procedures

Present options one at a time. Elicit attributes which will possibly evaluate each option. For example, the option of investing in foreign currency may suggest the attribute of the "stability of various countries' current governments."

3.4 General-Creativity Methods

In addition to the general creativity methods described in Sects. 1.5 and 2.4 the K-J method by Kawakita Jiro for creatively structuring problems may be useful (Hogarth 1987 p. 170). First, observations (i.e., decision-problem attributes) are recorded on separate cards. Then the cards are considered in random order to detect associations linking elements, and the cards are classified into groups with closely connected elements. Then these groups are arranged into meaningful patterns, such as a hierarchical value tree consisting of different groups of attributes.

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See also: Collective Enquiry; Decision Analysis; Human Information Processing; Knowledge Representation

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