The Oxford Handbook of Organizational Decision Making
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Print publication date: Sep 2009
Print ISBN-13: 9780199290468
Published to Oxford Handbooks Online: Sep-09
Subject: Business and Management, Organizational Theory and Behaviour, Business Policy and Strategy
DOI: 10.1093/oxfordhb/9780199290468.001.0001

# Structuring the Decision Process: An Evaluation of Methods

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DOI: 10.1093/oxfordhb/9780199290468.003.0028

## Abstract and Keywords

This article examines the effectiveness of methods that are designed to provide structure and support to decision making. Those that are primarily aimed at individual decision makers are examined first and then attention is turned to groups. In each case weaknesses of unaided decision making are identified and how successful the application of formal methods is likely to be in mitigating these weaknesses is assessed.

decision making, decision process, effectiveness of methods, individual decision makers, evaluation of methods, formal methods

## Introduction

This chapter examines the effectiveness of methods that are designed to provide structure and support to decision making. Those that are primarily aimed at individual decision makers are examined first and then attention is turned to groups. In each case weaknesses of unaided decision making are identified and how successful the application of formal methods is likely to be in mitigating these weaknesses is assessed.

## Supporting Decisions Involving Multiple Objectives

To make decisions, humans have evolved simplified mental strategies, or heuristics (Tversky and Kahneman 1974). These heuristics are well adapted to some environments and can be particularly useful where quick decisions need to be made with minimal cognitive effort (e.g., choose a brand of coffee that you recognize rather than an unknown brand) (Gigerenzer et al. 1999).

However, consider the problem of choosing a used car. The car buyer is likely to have a diverse set of objectives. The application of one well-known heuristic, lexicographic ranking (Tversky 1969), would involve the buyer simply comparing the cars on the attribute that is judged to be most important (e.g., price) and selecting the car that performs best on this attribute. If several cars offer the best performance on this attribute (i.e., if there is a tie) then performance on the second most important attribute will be compared and so on. Clearly, the heuristic avoids complexity by making no attempt to consider all of the attributes associated with the cars or to consider trade-offs between them—a car that was rejected because it was relatively expensive may offer other features that would have more than compensated for its greater cost. A more demanding heuristic, elimination by aspects (EBA) (Tversky 1972), *would* consider all of the cars features. Cars would be eliminated from consideration if they failed to meet a minimal requirement on any attribute. For example, any car that had a top speed of below 90 mph would be ruled out, as would any car that did not have electric windows, and so on. However, EBA still fails to consider trade-offs between the attributes. Thus, a car that was rejected because it had a top speed of only 85 mph might have had many other desirable features that would have made it worth purchasing despite its slightly lower top speed. Such heuristics characterize the way in which busy decision makers make choices between alternatives with multiple objectives.

A number of methods have been developed to support decision makers faced with multiple objectives. These methods, which fall within the discipline of decision analysis, include the simple multiattribute rating technique (SMART) (Edwards 1971), the simple multiattribute rating technique exploiting ranks (SMARTER) (Edwards and Barron 1994), the analytic hierarchy process (AHP) (Saaty 1990), and outranking (e.g., Roy 1991). The common idea underlying these methods is that the complexity of the judgments required from the decision maker can be reduced if the problem is decomposed into a set of separate smaller problems—the so-called divide and conquer principle. The decision maker can then apply his or her judgments to each of these (hopefully) simpler problems in turn. The resulting judgments are then recomposed, in accordance with a set of axioms, so that the best course of action can be identified.

For example, in SMART the objectives are decomposed into "subobjectives" that are specific enough for the decision maker to make a relatively straightforward comparison of how well the options perform on that subobjective. Thus the objective of minimizing pollution might be decomposed into subobjectives of minimizing CO2 emissions, minimizing sulphur emissions, and minimizing noise. Each subobjective is then considered separately and independently, and the options rated according to their performance on that subobjective (usually on a 0 to 100 scale). Weights are then assigned to these subobjectives to reflect their importance in the decision (technically swing weights should be used, see Goodwin and Wright 2004) and the "best" option is identified as the one achieving the highest weighted average score.

It can be seen that SMART enables the decision maker to take into account all of the objectives that are pertinent to the decision (unlike lexicographic ranking). Furthermore, by requiring the assignment of weights, it also ensures that the decision maker evaluates trade-offs between these objectives (unlike EBA).

However, there are several other advantages that emanate from this formal structuring of the decision process. The decision model, at the heart of the technique, automatically documents the rationale for the decision, effectively providing an audit trail that allows the reasons for the decision to be made explicit and, if necessary, defended. Also, methods like SMART are straightforward and transparent so that individuals from a range of specialisms can easily participate in the process and see how their judgments impact on the overall decision. Participation, in turn, can lead to a commitment to the chosen course of action. Decision makers can also use the "common language" of the model to clearly communicate their thinking to other participants (French 1996). Where there are disputes between individual decision makers about the weights to assign to different objectives, sensitivity analysis can often reveal that the same decision should be made regardless of which set of proposed weights is used, thereby avoiding unnecessary debate. Finally, the recommendations of the model may seem counter-intuitive to the decision makers upon whose judgments it is based. However, this challenge to intuition can serve to motivate decision makers to explore their problem more deeply. Indeed Phillips (1984) argues that formal decision models can be at their most valuable when these discrepancies occur because the ensuing exploration yields deeper insights and understanding of the issues. This in turn leads to enhancements of the model until eventually the intuitive view and the model converge, at which point the model is described as being “requisite”. (The section on decision conferencing explores this idea further.)

Published examples of the application of SMART include the selection of a wide area network system by a logistics company (Marples and Robertson 1993), systems acquisition decisions by the US military (Buede and Bresnick 1992), the selection of a clinical information system (Graeber 2001), priority setting for research funds by the New Zealand Ministry of Agriculture (Mabin et al. 2001), the design of a bioreserve network in Canada (Rothley 1999), and fisheries management in the Shetland Islands (Hilden 1997).

The role of these models is not to take the responsibility for decisions from decision makers or to identify “optimal” courses of action. Instead, they merely provide support and their purpose is to yield insights and to promote creativity so that better informed decisions can be made. However, even in this support role their usefulness is not assured. As Goodwin and Wright (1993) point out, decomposition is unlikely to aid judgment where the decision maker is skeptical about the technique that is being employed. For example, there may be a reluctance to try to represent one's preferences, particularly for qualitative attributes, on a numeric scale (Boyle 2000). Decomposition is also likely to be unsuccessful where the judgments required by the technique are poorly understood, or are less familiar and more complex than the holistic judgments that the decision maker may be used to making. Similar problems are likely to occur when the number of judgments required by the decomposition increases to a level where the decision maker experiences fatigue or boredom.

There are two further potential limitations associated with the application of structured models to decisions made by individuals where there are multiple objectives. The first relates to a criticism by Keeney that traditional decision analysis methods are “alternative focused” in that they start with a list of alternative courses of action (Keeney 1992), allowing the decision maker to focus on the objectives that he or she would like to achieve. Keeney argues that this sequencing of the process severely restricts the decision maker's perception of opportunities that may be available. Values are fundamental to decision making and therefore any support method should commence with the recognition and articulation of these values—so called "value focused thinking." In this way the decision maker will be enabled to identify opportunities and create better alternatives. Such an approach would seem to be particularly appropriate for major strategic decisions where there may be a need to review and explore the key values and objectives of an organization and to develop innovative ways forward. However, Keeney's approach, perhaps, would be enhanced if it provided more guidance on how fundamental values might be identified. Exhortations to ask yourself, "What would you like to achieve in this situation?" and, "If you had no limitations at all, what would your objectives be?" may not be sufficient to stimulate the creativity required. Wright and Goodwin (1999a) discuss this issue in more detail.

The second potential limitation of structured modeling approaches is that they can serve to reinforce the decision maker's existing decision frame (i.e., his or her current way of defining the decision problem) when "thinking outside the box" is likely to lead to a superior solution. There is nothing inherent in the application of decision analysis models that will cause the decision maker to question the frame and this may lead to considerable effort being wasted on solving the "wrong" problem. This suggests that, in many circumstances, "softer" techniques, such as scenario planning or soft systems analysis, should be used to explore the dimensions, nature, and context of the problem first (see, e.g., Rosenhead and Mingers 2001).

## Supporting Decisions Involving Risk and Uncertainty

When faced with the complex task of assessing risk, it appears that people again resort to the use of heuristics. While these heuristics can allow risks to be assessed quickly and efficiently in some circumstances their use is also associated with biased judgments.

For example, the availability heuristic (Tversky and Kahneman 1974) is invoked when people assess the probability of an event according to how easily similar events can be recalled or imagined. Thus the probability of a major corporate customer going into receivership may be judged to be higher if the person making the assessment can recall a recent example of the bankruptcy of a similar company. Such assessments will be biased when ease of recall or ease of imagination are not associated with the true risk.

Thus rare events, that have been highlighted in the media precisely because they are rare, may be overassessed in terms of their risk, while mundane events that pass largely unnoticed but actually pose greater dangers will have their risks underestimated.

Another heuristic, anchoring and adjustment, is employed when people are required to provide a numerical estimate of a quantity. It involves starting with an initial estimate, the anchor, and adjusting from it to obtain the final estimate. Problems arise when the anchor is a long way from the true value of the quantity because people tend to make insufficient adjustment from it. For example, suppose it is thought that the most likely time that it will take to launch a new product is 35 weeks, but a pessimistic estimate is also required (assume that this will be a launch time that only has a 1 percent chance of being exceeded). It is likely that the 35 weeks will act as an anchor and the pessimistic estimate will be set too close to it. This may lead to insufficient contingency planning for a launch that turns out to be considerably delayed.

Many other biases have been documented when people face uncertainty and risk. In estimating the costs and durations of major projects there is usually a bias towards optimism (indeed several UK government web sites provide optimism bias calculators that are intended to enable the effect of this bias to be removed from estimates). Similarly, when people receive new information that should cause them to substantially revise their original estimates they tend to display conservatism in that they pay too little attention to this information and make insufficient changes to their estimates.

Can managers be helped to produce better assessments of the risk they face? As in the case of multiobjective decision support, decomposition methods seek to improve the accuracy of management judgment by breaking the assessment task down into smaller tasks. Typical tools include probability trees and fault trees. In
the former, a tree diagram is used to depict the sequences of events that need to occur for the target event to take place. For example, suppose that it is necessary to assess the risk of an explosion at a chemical plant in the course of a year. Rather than assessing the probability directly the combinations of events that might lead to an explosion are identified (e.g., leakage of a coolant *and* overheating of a processor *and* failure of a reserve cooling system *and* failure of a shutdown mechanism). Probabilities are estimated separately for these precursor events and the rules of probability

(e.g., the multiplication rule) are applied to combine the estimates and obtain the desired probability. Fault trees adopt a similar procedure. Note that the decomposition procedure allows the decision maker to focus on each precursor event separately, rather than being forced to consider simultaneously all of the combinations of events that might impact on the target event.

Risk analysis based on simulation, is another decomposition-based approach to assessing risks. Consider the problem of assessing the probability that an investment in a new confectionery product will yield a negative net present value (NPV). The manager making the assessment would first be asked to identify all of the factors that would affect the NPV (e.g., the price of raw materials, manufacturing costs, packaging costs, distribution costs, the extent of competition from rival companies, and sales). For each of these factors a probability distribution would be elicited. A computer risk analysis package would then be used. For example, if it was estimated that there was a 5 percent chance that raw material costs would exceed £5 per tonne then there would only be a 5 percent chance of the simulated combination including raw material costs of over £5. The package would then calculate the NPV that would result from the combination. After repeating this simulation process thousands of times the proportion of combinations resulting in a negative NPV could be obtained. Recent published examples of risk analysis include its use in designing corporate investment, financing, and risk management strategies for financially constrained firms (Casey 2001), decisions relating to the restoration of contaminated land (Oberg and Bergback 2005) and oil and gas estimates for a region of Alaska (Rocha-Legorreta and Lerche 2004).

Decisions involving risk and uncertainty often have another attribute that creates further difficulties for the unaided decision maker: a complex structure. Events may occur in the future that require further decisions to be made or rule out other options. For example, if a decision is made to launch a new product but first year sales are low then a subsequent decision on whether to advertise, relaunch or abandon the product will need to be faced. Decision trees enable this sort of complexity to be represented in a diagrammatic format so that the decision maker can understand the underlying structure of the problem and communicate it to others. Published applications where decision trees have been found to be effective tools include decisions on petroleum exploration (Hess 1993), a decision on automation by the US postal service (Ulvila 1987), forestry management decisions (Cohan et al. 1984), management-union bargaining (Winter 1985), and a decision on an auction bid for the salvage rights of a ship (Bell 1984).

There are limitations associated with these techniques. Many of the potential problems of decomposition that were discussed earlier can reduce the effectiveness of probability and fault trees and risk analysis. For highly complex problems, decision trees can become “bushy messes” and the benefits of clarity that they bring to the decision process can be lost. Decision trees also emphasize the alternative focused approach to decision making criticized by Keeney (Keeney 1992), and they require estimates of probabilities, which may be subject to biases. Indeed, the fundamental structure of decision trees encourages the assumption that outcomes and risks are predicated on the course of action that is being selected. Thus they might reinforce managers' existing views of the world and not alert them to potential changes that could have serious implications for their business. Wright and Goodwin (1999b) discuss this issue in more detail.

## Support for Groups of Decision Makers

Do groups of individual decision makers make better decisions than the average of the individuals who make up the groups? This section of the chapter reviews research into the quality of group judgment and then considers the ways that have been proposed and implemented to aid the judgment of groups of individuals.

### Unstructured Group Decision Making

One of the major conclusions of research work on descriptions of group decision making is that of shortcomings. Irving Janis (1982) has documented a phenomenon that he has termed “groupthink” within group decision processes. Groupthink is essentially the suppression of ideas that are critical of the “direction” in which a group is moving. It is reflected in a tendency to concur with the position or views that are perceived to be favored by the group. Of course, such forces may produce speedy judgments and commitment to action. However, such cohesive groups may develop rationalizations for the invulnerability of the group's decision and inhibit the expression of critical ideas. These pitfalls of groupthink are likely to result in an incomplete survey of alternative courses of action or choices. Such an incomplete search through the decision space may result in a failure to examine the risks of preferred decisions and a failure to work out contingency plans if the preferred course of action cannot be taken.

Overall, there have been very few laboratory tests of Janis's theory. One main reason is that laboratory researchers have found it difficult to achieve high levels of group cohesiveness, a primary antecedent of groupthink. Another approach to the verification of the theory has been the study of case histories.

One study, by Esser and Lindoerfer (1989) analyzed the decision to launch the space shuttle Challenger on January 29, 1986. The outcome of that flight—the death of all seven crewmembers within minutes of launch—focused attention on the process leading to the decision to launch. In these researchers' content analysis of the verbal transcripts of a presidential commission report on the disaster, statements therein were coded as either positive or negative instances of the observable antecedents and consequences of groupthink. During the 24 hours prior to the launch of the Challenger the ratio of positive to negative items increased significantly. During this time, the Level III NASA management were facing increased difficulties in maintaining their flight schedule, and this was expressed as direct pressure on the dissenters who wanted to delay the flight (the engineers) and “mindguarding”. Mindguarding essentially refers to the removal of doubts and uncertainties in communications to others. In this instance, the Level III NASA management said to the engineers that they would report the engineers' concerns to the Level II NASA management, but they did not.

Janis argues that the group-based “victims” of groupthink feel invulnerable in their decision making and so fail to re-appraise initially rejected alternative courses of action and do not search for information that could disconfirm the selected course of action—the so-called confirmation bias. Edmondson et al. (2005) provide a discussion of groupthink as a potential explanation of the second ill-fated shuttle launch—that of Columbia.

## Structured Group Processes

Awareness of the factors that can degrade group decision making, combined with the implicit belief that group judgment can potentially enhance decision making, has led to a number of *structured* methods to enhance group decision making by removing or restricting interpersonal interaction and controlling information flow. One such major method has been Delphi. Essentially, Delphi consists of an iterative process for making *quantitative* judgments. The phases of Delphi are:

1. Panelists provide opinions in answer to questions about issues such as the likelihood of future events, when events will occur, what the impact of events will be. These opinions are often given as responses to questionnaires that are completed individually by members of the panel.
2. After tallying the results, individual panelists are provided with *statistical* feedback of the whole panel's opinions (e.g., range or medians), before a
re-polling takes place. At this stage, dissenting opinion is aired so that anonymous discussion (often in written form) may occur.
3. The output of the Delphi technique is a quantified group "consensus," which is usually expressed as the median response of the group of panelists.

After the feedback at phase 2, the Delphi method assumes that the median response of the re-polled individuals is likely to shift nearer to the true value of the outcome to be predicted. Improvement is thought to result from opinion changes in "swingers," who change their less firmly grounded opinions, and the opinion stability of "holdouts," who are assumed to be more accurate than "swingers."

Indeed, Delphi was designed to improve upon the traditional group by adding structure to the process. Results generally suggest that Delphi groups are more accurate than traditional groups. Rowe and Wright (1999, 2001) found that Delphi groups outperformed traditional groups by a score of five studies to one, with two ties, and with one study showing task specific support for both techniques.

The research studies seem to show that collections of individuals make judgments that are more accurate and forecasts in Delphi groups than in unstructured groups, and that Delphi should be used in preference. One point of caution, however, is that the groups used in Delphi studies are usually highly simplified versions of real-world groups, comprising individuals with a high degree of expertise who genuinely care about the result of their meeting and have some knowledge of the strengths and weaknesses of their colleagues (or think they do). On this basis they may be able to selectively accept or reject their opinions. It may be that in a richer environment, the extra information and motivation brought to a task by those in a traditional group may make it of greater value than the limiting Delphi procedure.

## Would it be Better to Simply Average the Forecasts of Several Individuals Rather Than Use Delphi?

Averaging of probability forecasts, scores, or weightings is one approach to reconciling differences in group judgments in applications of decision analysis. Another approach is to conduct sensitivity analysis to see if differences between individuals—in terms of probability judgments and value scores/weights—have any impact on the decision recommended by the modeling approach. Sensitivity analysis and averaging are a practical response to situations where individuals differ in their assessments and there is no "gold standard" against which to compare the relative validity of individuals' assessments.

Researchers have compared the *accuracy* of such statistical groups to Delphi groups in two ways: through a straightforward comparison of the two approaches, and through a comparison of the quality of averaged estimates on the first and the final round in a Delphi procedure. The first, pre-interaction, round is equivalent to a statistical group in every way except for the instructions given to individuals: Delphi panelists are led to expect further polling and feedback from others, which may lead panelists to consider the problem more deeply and possibly to make better "statistical group" judgments on that first round than individuals who do not expect to have their estimates used as feedback for others. A first round Delphi may, however, provide a better benchmark for comparison than a separate statistical group, because the panelists in the two "conditions" are the same, thus reducing a potential source of great variance.

Rowe and Wright (2001) reviewed the evidence for the relative values of statistical groups and Delphi groups. Although it should be possible to compare averages over rounds in every study of Delphi accuracy or quality, researchers in a number of evaluative studies have not reported the differences between rounds (e.g., Fischer 1981; Riggs 1983). Nevertheless, in their review of those studies that have examined such differences Rowe and Wright found that results generally support the advantage of Delphi groups over first round or statistical groups by a tally of 12 studies to two. In five studies, the researchers reported significant increases in accuracy over Delphi rounds. Seven more studies produced qualified support for Delphi: in five cases, researchers found Delphi to be better than statistical or first round groups more often than not, or to a degree that did not reach statistical significance. Two further studies, found Delphi to be better under certain conditions but not others. Parenté et al. (1984) found that Delphi accuracy was worse. The overall weight of empirical evidence, however, suggests that Delphi groups should be used instead of statistical groups whenever feasible, because generally they lead to judgments that are more accurate. This could result from the additional interaction during Delphi following the averaging of first round estimates.

Delphi has value in a number of situations. When experts are geographically dispersed and unable to meet in a face to face group, Delphi would seem an appropriate procedure. It enables members of different organizations to address industry wide issues, or experts from different facilities within a single organization to consider a problem without traveling to a single location. Indeed, experts with diverse backgrounds are liable to have different perspectives, terminologies, and frames of reference, which might easily hinder effective communication in a traditional group. The facilitator (or monitor team) can iron out such difficulties before the structured rounds of a Delphi.

Delphi might also be appropriate when disagreements between individuals are likely to be severe or politically unpalatable. Under such circumstances, the quality of judgments and decisions is likely to suffer from motive conflicts, personality clashes, and power games. Refereeing the group process and ensuring anonymity should prove beneficial.

Rowe and Wright (2001) summarize the following principles for using expert opinion in applications of Delphi:

- Use experts with appropriate domain knowledge.
- Use heterogeneous experts.
- Use between five and 20 experts.
- For Delphi feedback, provide the mean or median estimate of the panel plus the rationales from all panelists for their estimates.
- Continue Delphi polling until the responses show stability; generally, three structured rounds are enough.
- Obtain the final forecast by weighting all the experts' estimates equally and aggregating them.

In contrast to Delphi techniques, decision conferencing presents a socially interactive approach to decision making in order to generate a shared *understanding* of a problem and to produce a commitment to action.

## Decision Conferencing

Decision conferencing brings together decision analysis, group processes, and information technology over an intensive two- or three-day session attended by people who wish to resolve a complex issue or decision. In this context, a small group of people who have an input to a major decision often sit on the perimeter of a round table and talk through their problem with a decision analyst, who acts to facilitate group interactions and knowledge sharing. In the background, another decision analyst uses interactive decision aiding technology to model individual and group views on such issues as multiattribute option evaluation and resource allocation. However, as can be inferred from the earlier discussion of unaided decision making, the outputs of such modeling seldom agree with unaided holistic judgments. One major responsibility of the decision analyst is to explain the underlying logic of the modeling methods to the decision makers. Only if the decision makers can fully appreciate the methods are they likely to accept model-based choices over their own intuitive judgments. To quote Phillips (1984):

> As the results of the modeling become available to the participants, they compare these results to their holistic judgments. It is the inevitable discrepancies that arise, especially early in the modeling process, that drive the dialectic. By exploring these discrepancies, understanding deepens and changes and new perspectives are reflected back as adjustments. Eventually, participants are satisfied with the model and unable to derive any further insights from it…The model has served its purpose.…(p. 32)

Phillips is concerned not to impose an optimal solution by black box methods:

> If exploration of the discrepancy between holistic judgment and model results show the model to be at fault, then the model is not requisite—it is not yet sufficient to solve the problem. The model can only be considered requisite when no new intuitions emerge about the problem…Requisite models are not produced from people's heads, they are *generated* through the interaction of problem owners. (p. 34)

Participants gain a sense of common purpose and a commitment to action. Sensitivity analysis allows participants to see if individual disagreements make a difference in the final preferred alternative or decision. Decision analytic principles provide a *guide* to action, not a black box prescription for action.

It is intuitively reasonable that discussions about decisions leading to consensus are more likely to be implemented than the output prescriptions of complex black box decision analyses, which involve but a single decision maker who may well have to justify his or her decision to others in the organization. In addition, decisions made by such groups are likely to be "made" to work because of the group commitment.

Are such more or less valid than unaided judgment or prescriptive solutions? For example, does the situational context of decision conferencing produce conditions for groupthink? Phillips (1984) has argued that this is not so, since:

1. Participants are not on home ground. Often decision conferences take place in hotels or an especially designed room on the decision analyst's premises.
2. The small group is carefully composed of people representing *all* perspectives on the issue to be resolved so that adversarial processes operate in the group to check bias and explore alternative framings of the decision problem.
3. The decision analyst who acts to facilitate the conference is a neutral outsider who is sensitive to the unhelpful effects of groupthink and reflects this back to the group.

In a pioneering study, McCartt and Rohrbough (1989) addressed the problem of evaluating the effectiveness of decision conferencing. These investigators argued that attempts to link good decision outcomes to particular types of group decision support are extraordinarily difficult, since virtually all real-world applications of group decision support do not provide enough baselines of comparison (e.g., tests of alternative methods/techniques or alternative decisions) to satisfy laboratory-based experimental researchers.

For example, with group commitment, poor decisions may be "made" to produce good outcomes, otherwise the credibility of the senior executives who attended the decision conference would be in trouble. Good judgment and decision making have been seen as one of the major characteristics of good managers! McCartt and Rohrbough conclude that any assessment of the effectiveness of a group decision process must look at the *process* itself and not subsequent outcomes. In their study, these investigators followed up a cross-section of 14 decision conferences held by Decision Techtronics at the State University of New York at Albany. Using mailed questionnaires, they enquired about the perceived organizational benefits in the form of improved information management, planning, efficiency, and morale. Effective decision conferences were found to be ones where participants perceived real benefit in the support of the decision analysis techniques and in the opportunity for open and extended discussion about the models that had been built. Ineffective decision conferences were characterized by executive teams who convened to discuss a problem but felt little pressure to reach consensus or construct a plan of action.

## Scenario Planning

The practice of scenario planning implicitly accepts that managers are *not* able to make valid assessments of the likelihood of unique future events and that "best guesses" of what the future may hold may be wrong. Advocates also argue that it can counter groupthink by allowing minority opinions about the future to have "airtime," relative to majority opinion, although not always successfully (see, e.g., Hodgkinson and Wright 2002).

A scenario is not a forecast of the future. Multiple scenarios are pen-pictures of a range of *plausible* futures. Each individual scenario has an infinitesimal probability of actual occurrence but it is possible to construct the *range* of a set of individual scenarios in such a way as to bound the uncertainties that are seen to be inherent in the future—like the edges on the boundaries surrounding a multidimensional space.

Scenarios focus on key uncertainties *and* certainties about the future and use this information to construct pen-pictures in an information rich way in order to provide vivid descriptions of future worlds. In contrast, subjective probabilities entered into a decision tree provide numerical values that can be used in an expected utility calculation. The judgment process that produced such values is often not justified. When individuals disagree about their subjective probabilities for a critical event within decision analysis, practice is often to take an average, or weighted average. The relationship between the *critical* uncertainties, important predetermined trends (such as demographics, e.g., the proportion of the US population who are in various age bands in, say, ten years' time) and the behavior of actors who have a stake in the particular future (and who will tend to act to preserve and enhance their own interests within that future) are thought through in the *process* of scenario planning such that the resultant pen-pictures are, in fact, seen as plausible to those who have constructed the scenarios.

The outcome of the decision process in scenario planning is *not* the selection of the option with the highest expected value or utility but the selection of the most “robust” decision in the face of an unpredictable future. However, even if the development of a fundamentally robust option is not possible, scenario thinking also provides other benefits. Communication of world views can be easy in an organization via the medium of the scenario “stories”. Additionally, rehearsing a future can provide a better understanding of the reasons underlying a situation. Thus, once the early events in a scenario occur, the decision maker will be able to anticipate how the future will unfold. These trigger events will be seen as *information* among the stream of *data* that impacts upon the decision maker.

Table 28.1 The Components of the Three Techniques to Aid Group-Based Decision Making

| | **Scenario planning** | **Decision analysis** | **Delphi** |
|---|---|---|---|
| Future orientation: | Scenario planning constructs multiple frames of the future. | Decision analysis is conventionally undertaken within a single general frame of the future. | Delphi is usually focused on forecasting the occurrence of a single event or quantity. |
| Structure of judgment inputs: | Structuring is achieved by qualitative decomposition into critical uncertainties and trends. An emphasis on understanding causality. | Structuring is achieved by quantitative decomposition into probabilities, payoffs, and decision trees or values and weights. | Structuring is achieved by the controlled exchange of information between anonymous panelists over a number of rounds (iterations). |
| Information orientation: | Scenario team members exchange existing opinions on issues of concern and systematically provide insight on issues of critical uncertainty. | Fresh information may be sought if the analysis indicates that a decision is sensitive to small changes in judgmental inputs. | Expert panelists exchange their existing estimates. Individual experts can hold, or change, their estimates on the basis of feedback |

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|---|---|---|---|
| | | | of the estimates of other panelists. |
| Process orientations: | Dissenting opinions are given “airtime” that is preserved, and combined with the opinions of others, while maintaining divergence. | Divergent opinions are combined by averaging and reduction. | The statistical average of the estimates on the final Delphi round is taken as the group judgment. |
| Action orientation: | The result is shared understanding within the management team, of causally determined futures that can galvanize managerial action to avoid unfavorable futures or facilitate the occurrence of favorable ones. | The result of the analysis is a single recommended decision for subsequent implementation. | None. |

Just as the new purchaser of a particular make of car becomes very sensitive to the number of models of that make on the road and the differences in levels of equipment, etc., the scenario thinker becomes sensitive to a scenario starting to unfold and becoming reality. Such sensitivity can lead to *early* contingency action towards an unfavorable future (see Wright and Goodwin 1999b; Wright et al. 2004). Alternatively, new business opportunities can be quickly grasped as soon as favorable scenarios begin to unfold. Some practitioners see early recognition and reaction to an emerging future as more useful than the creation of robust strategic options (see van der Heijden et al. 2002).

Typical outcomes of the scenario planning process include:

1. Confirmation that the business idea is sound or that new strengths need to be added to create more robustness.

2. Confirmation that lower level business choices are sound or that alternative new options are more robust.
3. Recognition that none of the business options are robust and, therefore, contingency planning against unfavorable futures is necessary.
4. Sensitivity to the "early warning" elements that are precursors of desirable and unfavorable futures.

Often, in practice, scenario workshops invoke an "organizational jolt" to routine, "business as usual," thinking. A major insight can be that continuing with business as usual is a fragile strategy against the constructed futures. Wright et al. (2004), and Cairns et al. (2004, 2006) discuss these issues in more detail.

Comparative views on scenario planning, decision analysis, and Delphi as aids to group decision making are given in Table 28.1.

## Conclusions

This chapter has illustrated the use of heuristics in unaided decision making at both the individual and small group level of analysis. In individual decision making, individuals tend to use simplified mental strategies to make choices between multiattributed alternatives. Such strategies often don't involve trade-offs and so are non-compensatory. By contrast, decision aiding techniques such as SMART, SMARTER, and the AHP aid the decision maker to make trade-offs and so provide support in compensatory decision making. These decision tools have been used in a wide variety of practical business applications. Such compensatory decision aiding techniques are based on the principle of decomposing the decision maker's judgmental task into attribute identification, value scoring, and attribute weighting. The recomposition of these judgments, via the decision modeling, is likely to challenge the decision maker's unaided choice preference. This challenge is the essential value of the decision aiding approach. A similar approach, that of decomposition and recomposition of judgmental estimates, underpins the decision aiding of decisions involving risk and uncertainty. In such decisions, also, heuristics are commonly used by busy decision makers assessing the likelihood of future events. Here, techniques such as fault trees, risk analysis, and decision analysis rebuild decomposed judgmental assessments in ways that will, likely, also challenge unaided, holistic intuition.

With the sphere of group decision making, Delphi can aid convergence of opinion between group members through anonymous interaction. The structuring of group interaction can overcome the process loss inherent in unstructured groups—such as the domination by assertive and talkative individuals. In contrast, decision conferencing and scenario planning interventions allow group members to interact but the interaction is moderated by facilitators who either: (1) implement decision analysis technologies; or (2) implement scenario construction methodologies. As in individual decision making, both decision conferencing and scenario construction, involve the decomposition, and subsequent recomposition, of judgment. As was shown, Delphi, decision analysis and scenario planning can be compared and contrasted in terms of differences in: (1) future orientation; (2) structure of judgmental inputs; (3) information orientation; (4) process orientation; and (5) action orientation.

In summary, there exists a range of methods to aid both individual and group decision making. This chapter has described and contrasted the domains of applicability of a range of well utilized decision aiding technologies. The key, of course, is to match particular methods to particular decision situations.

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