CHAPTER

6

MODELING GROUP DECISIONS

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There are many occasions in which a group, rather than an individual, has to make a decision. A good example is the board of director's decision about a major capital purchase. Conflict can arise in these decisions, and there are at least three ways to reduce this conflict:

1. *Majority rule.* This group model includes any aspect that the majority of the group has included in their individual models.
2. *Average differences.* This group model is defined as the average of the parameters of each individual model.
3. *Behavioral consensus.* This group model is based on unanimous agreement reached through discussions and without the use of majority rule, averaging, or any other mathematical resolution of differences.

This chapter discusses how an analyst can bring about a behavioral consensus around a model of a group decision. A model of a group of decision makers could be thought of as an average of the individual models of various members of the group. In this way, a model is built for each member, and the parameters of the models are averaged to represent the group. But groups are not just a collection of individuals; there is a synergy of thought and ideas that emerges from successful groups. Mathematical aggregation of the individuals' models into a group model loses the real advantage of having the group, which is to arrive at better decisions than the best member of the group could arrive at alone. To effectively model a group's decision, one should create a model that reflects the group's behavioral consensus, which may be very different from the average of each individual's input.

Decision analysts have for some time focused on mathematical methods of aggregating the judgment of various experts or decision makers (Jacobs 1995; Meyer and Booker 1991). This chapter does not review the literature on mathematical aggregation of experts' opinions. Instead, this chapter focuses on the behavioral methods of getting a group to come to a consensus around a model. The goal of this chapter is to design a process

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where group members can, after reasonable deliberation, agree about a specific model and its parameters.

The processes described in this chapter can be used to help the group generate, share, discuss, and prioritize ideas to reach a final decision. Decision making is more than choosing among alternatives. Often, the choice itself is the tip of the iceberg. Much more needs to be done to articulate the options available and to clarify the process of decision making. This is especially important in group decision making, where key ideas belong to different people; there should be an organized and systematic effort to solicit and arrange these ideas in ways that help the deliberation of the group. This chapter helps an analyst go beyond immediate choices and build a model of the group's collective insights and reasoning. Much of the advice provided in this chapter focuses on how to help group members articulate their ideas.

The task of structuring a decision and estimating the parameters of the model requires a great deal of input from the group. Most decision makers see the process of building models as awkward and artificial. The questions posed by the analyst may seem to be a contorted way of looking at the decision at hand. The analyst's frequent interruptions to structure and assess various estimates may interfere with the group's free-flowing deliberations. If a group's decision has to be modeled effectively, then a process needs to be found that constructs a model without interfering with the group's interactions. This chapter provides one such group process.

The chapter starts with a history of commonly used approaches to structured group meetings. After the history, a new approach called *integrative group process* (IGP) will be presented. This approach borrows from many of the existing methods of improving group processes.

A Short History of Consensus Building

Research on group processes started in earnest in the late 1960s and early 1970s. It has grown in recent years to studies of group decision-support systems, in which computers are used to facilitate meetings. Note that this review of approaches is selective as the literature is vast.

Group Communication Strategy

To understand what works in group processes, this review starts with one of the simplest group processes, the *group communication strategy*. This approach originates from a set of normative instructions proposed by Hall and Watson (1970). Before a group meeting starts, members are instructed to

1. avoid arguing;
2. avoid win-lose statements;
3. avoid changing opinions to reduce conflict;
4. avoid conflict-reducing techniques, such as majority votes and bargaining; and
5. view differences of opinion as natural and initial agreements as suspect.

No other process changes are made. Group members talk freely about topics they choose, with no break in how or when various components of the meeting are accomplished. During these conversations, the analyst constructs a model of the group, with each member contributing at will and commenting on what is relevant. After the start of the meeting, group members may or may not follow the recommended rules for interaction. The expectation is that most will follow these simple instructions if reminded to do so at start of the meeting.

In the decade following Watson and Hall's work, a number of studies evaluated their recommendations. Their findings suggested that when there are large status differences, group members weigh the opinions and suggestions of high-status persons more heavily (Forsyth 1998; Pagliari and Grimshaw 2002). In these groups, the group communication strategy may not do well. Furthermore, little is known about the success of normative instructions in situations in which group members are in conflict or have substantial stakes in the final group judgment.

Nominal Group Process

Another approach to helping groups talk through their differences is the *nominal group process* (Gallagher et al. 1993). This is a generic name for face-to-face group techniques in which group members are instructed not to interact with each other except at specific steps in the process. The following are the steps in the process:

1. Silent idea generation
2. Round-robin sharing of ideas
3. Feedback to the group
4. Explanatory group discussion
5. Individual reassessment
6. Mathematical aggregation of revised judgments

The nominal group process produces a prioritized list of ideas as well as numerical estimates in a short time frame. For example, an analyst can use this process to solicit attributes for a value model and then repeat the process to solicit weights for the attributes. This approach remains popular despite the fact that it has been more than 30 years since its inception (Moon 1999; Carney, McIntosh, and Worth 1996). It is one of the key group processes used to develop treatment algorithms and consensus panels (Cruse et al. 2002). Research on the nominal group process is extensive. A recent review (Black et al. 1999) shows that in numerous circumstances the process produces better results than unstructured group interactions. The performance of the nominal group process may depend on the task structure, selection of participants, presentation of the scientific information available to the group, structure of the group interaction, and method of synthesizing individual judgments. Given the various factors that affect the performance of the nominal group process, analysts should rely on it when the process makes sense for the situation at hand. Three components of the nominal group process may explain the success of the process.

1. Ideas should not be evaluated one at a time. The analyst should collect many ideas before any one of them is evaluated. Postponing evaluation increases creative solutions.
2. In estimating numbers, rethinking improves the accuracy of the numbers. A sort of bootstrapping occurs, where the group members better themselves by listening to other group members and revising their own opinions.
3. Individual generation of ideas leads to more creative ideas than generating ideas while listening to other group members.

Despite widespread use of the nominal group process in consensus panels (Jones and Hunter 1995), the process is not without serious problems. In tasks that require judging the worth of several alternatives, for example, in developing a multi-attribute value (MAV) model, this technique may produce judgments inferior to the judgment of the most knowledgeable group member. But by far, the most serious problem with the process is that participants feel awkward about restrictions in their interactions. After the group meeting, they may feel that the conclusions were forced through the process and not through group interaction. Therefore, they may not be committed to the group's consensus. When acceptance of the group's decision is crucial in determining whether the model is put to use, less structured group processes produce more widely accepted group decisions (Rotondi 1999).

Delphi Process

Another technique widely used by consensus groups in healthcare settings is the *Delphi process* (Jones and Hunter 1995). This process was designed as a procedure for aggregating group members' opinions without face-to-face interaction. It is frequently used with e-mail or other web-based platforms. When using this technique, group members answer three interrelated questionnaires; the analyst summarizes the responses from each survey and mails the synthesis back to the same or other groups for further comment (Ryan et al. 2001). For example, the first questionnaire may ask the group members to describe the attributes in a value model; the second may present the attributes, ask for revisions, and request weighting of the relative importance of the attributes; and the third may continue with the revisions of the model, present a set of scenarios, and ask the respondents to rate them. In some applications, such as in forecasting technological changes based on insights of a large group of experts, the Delphi process has proven useful. The Delphi process is also useful in situations in which conflict or status differences among group members are so strong as to render the group dysfunctional. The most insightful feature of the Delphi process is that a meeting of minds can occur without an actual face-to-face meeting.

Nevertheless, studies have been that face-to-face interaction is superior to Delphi's remote and private opinion gathering (Cho, Turoff, and Hiltz 2003; Woudenberg 1991). Even limited interaction can help improve the Delphi process. In one study, for example, the Delphi process's remote feedback was compared to the nominal group process's in-person feedback. The Delphi process's remote feedback reduced the accuracy of the group members' estimates (Gustafson et al. 1973).

Social Judgment Analysis

Difficulty with existing group processes has led a number of investigators to design their own modeling process that can be used in group settings. These approaches often use computers to help model the decision maker in a group setting. In the 1990s, many studies were published regarding what affects the performance of group decision-support systems (see, for example, Fjermestad and Hiltz 1998). The *social judgment analysis* is a group process that uses computers to model each member as they interact with each other (see Toseland and Rivas 1984). It was designed to reduce the pressure for group members to comply with the group's mind-set just to feel more accepted by the group. Following are the steps in the process:

1. Group members meet in face-to-face meetings, in which they have access to a computer.
2. Each group member rates a series of scenarios. A scenario is a combination of clues that affect a judgment. For example, in judging creditworthiness of companies, the clues may be last year's profit, changes in market share, and management changes. A scenario is constructed by varying levels of these three clues. In the first scenario, the company was not profitable last year, has gained a significant market share, and has stable management. In the second scenario, the company was profitable last year, has a small market share, and has stable management. More scenarios can be constructed by using different levels of each clue.
3. The computer analyzes the group members' ratings to see which factors most affect the judgment. This is usually done through regressing the scenario ratings on the elements of, or the clues in, the scenarios.
4. The group members review the results of the computer analysis. The computer analysis indicates that the way group members rated the scenarios suggests that certain clues are most important in their judgment. The analysis then lists these clues.
5. Group members often do not agree with the results of the analysis and revise their ratings of the scenarios so that the ratings best fit with what they consider most important.
6. Once group members come to terms with the way they wish to judge the scenarios, a consensus model is developed and used to represent the group's judgment.

Computer-facilitated meetings in general and social judgment analysis in particular may seem to be too much work for some meetings. But with the growing use of computers, many meetings are occurring through computers anyway. Many decision makers are in different locations and must use the computer to collaborate. In these settings, group decision-support systems can help improve the self-insight of individual group members and eventually the quality and speed of arriving at group consensus. The value of this technique is demonstrated in recent studies focused on helping clinicians understand their own judgments (Holzworth and Wills 1999). Social judgment analysis works well because it focuses the decision maker's attention on why an alternative is preferred rather than on which alternative is preferred. It provides group feedback that helps decision makers focus their reasoning. Data show that people change their opinions to conform to group norms. Although this behavior is healthy for keeping the peace in the group, it is counterproductive if ideas are being judged based on their popularity as opposed to their merits. Rohrbaugh's (1979) study showed that when feedback focused on why an idea was preferred as opposed to which idea was more popular, the group's final judgment was more accurate. Rohrbaugh also showed that social judgment analysis is more accurate than the Delphi process and the nominal group process.

Cognitive Mapping

Interest in the use of computers in group processes has led to many innovations. Eden, Jones, and Sims (1983) were among the first to develop a process for modeling how a group arrives at its judgments through *cognitive mapping*. This process starts with constructing two parallel statements of the problem: one showing the factors leading to the problem, the other showing the factors leading to a satisfactory solution. For example, the problem may be stated as "high labor costs," and the solution may be stated as "lowering the labor cost." The causes of high labor cost and the factors leading to lowering labor costs are also organized. For example, a cause of the problem may be a "shortage of qualified workers." A solution may be "more availability of qualified workers." Causes of the problem and factors leading to the solutions are related—usually, the solution can be produced by rephrasing the causes. Through linguistic manipulation of the statement of the problem, cognitive mapping hopes to stimulate new ideas.

Eden and colleagues, when they use cognitive mapping, often collect the group members' ideas about the problem and its solutions separately and then revise these ideas in a face-to-face meeting. Occasionally, they quantify the influence of causes and effects through a round-robin process, where group members write down their estimates and share them afterwards. They then simulate how changing one factor may affect the problem. These simulations may lead to new insights into the problem. Cognitive mapping of groups of decision makers continues to be an active area of research (Vennix 2000).

Computer-Facilitated Group Process

Social judgment analysis and cognitive mapping were the start of many innovative methods of computer-facilitated collaboration. McLeod (1992) summarized the group decision-support literature and found that *computer-facilitated group process* increased the quality of the decision and led to more equal participation by group members, more focus on task, and less focus on social networking and support. At the same time, McLeod identified that computer-facilitated group interaction decreased consensus and member satisfaction with the group meeting. The reduction in member satisfaction with computer-facilitated group process might be attributable to the central role of a facilitator in controlling who speaks when in group processes (Austin, Liker, and McLeod 1993). Strauss (1997) showed that computer-facilitated groups have lower cohesiveness and group satisfaction than face-to-face groups, primarily because of the rate with which the group members interact. Even a simple technology such as teleconferencing has been shown to have detrimental effects on group discussion and processes (Alemi et al. 1997). Face-to-face meetings, when possible and when they are run well, are more efficient at getting ideas across to group members; as a consequence of this improved efficiency, group members think others have heard their point of view.

Lessons Learned

Many group processes can be used to model a group's decision. A review of some of these processes creates a bewildering number of methods of teamwork. This section reviews key lessons learned from research on effective team processes. Three and half decades of research on effective group work point to the following lessons:

1. *Postpone evaluation.* It is best to separate idea generation from idea evaluation. When evaluation is postponed, more ideas and more creative ideas emerge.
2. *Think again.* It is best to think through the decision again, especially when numerical estimates are involved. In repetition, people gain confidence in what they are doing and can see pitfalls they missed previously.
3. *Meet before the meeting.* It is useful to get input from group members individually, before they can influence each other. This can often occur through use of computers and might be one way of combining computer-facilitated decision support with face-to-face meetings.
4. *Judge the merit of ideas.* It is important to evaluate ideas based on their merit and not based on their popularity. Successful group processes separate ideas from the originator of the idea. In this fashion, ideas are judged on the basis of their merits rather than on who proposed them.
5. *Instruct the group to behave.* It is best to instruct group members to keep calm and accept conflict as productive. Simple instructions at the start of the meeting can set the tone of the group discussions to come.

6. *Use computers to facilitate components of the meeting.* It is best to use technology to help groups arrive at a consensus, but such use should not reduce the rate of the exchange of ideas or the ease with which members interact.

Integrative Group Process

Integrative group process (IGP) is designed to model a group's decision while helping the group come to a behavioral consensus. This is an eclectic group process based on more than 30 years of research on teamwork and group interaction literature:

- Like the nominal group process, IGP postpones the evaluation of ideas until the analyst has collected the ideas of all members. In addition, both approaches improve estimates of relative importance of ideas through repetition (i.e., both require the group member to assess, discuss, and revise their numerical estimates).
- Like the Delphi process, IGP obtains remote and private opinions. But unlike Delphi, these remote contributions are followed by face-to-face interactions.
- Like the group communication strategy, IGP sets ground rules for free-form group interaction.
- Like social judgment analysis and cognitive mapping, IGP focuses discussion on the group members' reasoning rather than the group's decision. Thus, group members can better understand why they disagree on a point, if they come to see each other's reasoning.
- Like computer-facilitated group processes, IGP collects ideas from group members via computers: typically by e-mails. Integrative group process and computer-facilitated group process differ in what occurs after the initial collection of ideas; IGP emphasizes face-to-face meetings after computer-facilitated collection of ideas.

Integrative group process has six steps:

1. Select the best experts, despite their conflicts.
2. Meet before the meeting to make a "straw model."
3. Redo the straw model during the meeting.
4. Estimate the model's parameters.
5. Discuss major differences and reestimate the parameters.
6. Ignore small differences and prepare a report.

The output from IGP is a mathematical model (e.g., MAV model, Bayesian probability model). Some administrators tend to use the ideas behind IGP to guide a committee's or a group's decision making when there is no need for a mathematical model. In these circumstances, all aspects of IGP are followed, but no parameters for the model are estimated. Such uses of the process are encouraged.

Step 1: Select the Best Experts

The composition of the group is an important and generally controllable aspect of the group. Occasionally, an analyst may avoid putting too many high-status members in the group, fearing that they will not be able to work together—this is a mistake. The best experts and decision makers must be invited to participate in the meeting; without them, crucial information will be missing from the meeting, and the quality of the decision may be affected. Instead of avoiding conflict, the IGP process helps manage conflict among group member so that productive quality work can be accomplished despite status differences or a prior history of conflict.

The analyst needs to think about what portion of the group should come from inside versus outside the organization. If employees closest to the process are invited to join the decision-making group, then the group's decisions are more likely to be implemented. If people removed from the process, perhaps experts outside the organization, are engaged, then more radical solutions may be proposed and more rapid change may occur. In the end, a balance needs to be struck between the percentage of the group that is selected from inside and outside the organization.

There is very little data regarding ideal size for a team. In general, there are two considerations: (1) the more people, the more difficult it is to manage the team; (2) the fewer the people, the smaller the pool of ideas that the team has access to (de Dreu 2006). Teams of three to seven people are the most common size. The size of the group should depend on its purpose. Experiments with groups of various sizes have shown that if the quality of the group's solution is of considerable importance, it is useful to include a large number of members (e.g., seven to nine) so that many inputs are available to the group in making its decision. If the degree of consensus is of primary importance, it is useful to choose a smaller group (e.g., five or six) so that members' opinions can be considered and discussed. It is a general rule of thumb that the group size should not be smaller than three to five. Groups that meet face-to-face should not have more than nine members, or each member may not be able to participate adequately. A recent study showed that groups of five are more likely to have dialog and groups of ten are more likely to have monologs (Fay, Garrod, and Carletta 2000). If the purpose is to encourage interaction among group members, then groups of five seem more practical.

Heterogeneity of the group's background is closely related to the size of the group and is another important aspect of the design of successful groups. A necessary, though not sufficient, requirement for adequate group judgments is to have an appropriate knowledge pool in the group. Because no one person is an expert in all aspects of a problem, diverse backgrounds and expertise are imperative. Involving people from different functional units of the organization helps bring different expertise to the problem. Differences in background and knowledge could, however, accentuate the conflict between the group members. If neither originality nor quality are criteria for evaluating the team's work, the analyst should select group members to minimize differences in their backgrounds.

Getting people to devote their time to a meeting is difficult. Many people remember wasted efforts in other meetings and avoid new meetings. The analyst can take several steps to increase participation. First, the analyst should examine the purpose of the meeting. If it is difficult to obtain participation, perhaps the problem being addressed is not important. People who are close to a problem invariably care about it and are willing to address it. But if they think the problem is not real, or the search for a solution is only a formality, they are less likely to participate.

Second, the analyst can improve meeting participation by clear communications concerning the meeting logistics and expectations. The communication should clarify why the meeting is important, why it is useful to model the task, and what can be expected at the end of the meeting. It should clarify the logistics of the meeting (i.e., when, where, and how) and emphasize that the meeting is an ad hoc group.

Third, it may be useful to remind the invited group members about who else is being invited. People are more likely to come to meetings if people they admire will be present. The analyst should emphasize (1) who nominated the potential group member and (2) that very few people were asked to participate. It should be clear that the group member's contribution is unique and valued. Finally, it helps if group members are reimbursed for their time with an honorarium.

Step 2: Meet Before the Meeting

Before a face-to-face meeting, group members are individually interviewed and modeled. If group members live far apart, the interviews are done by phone, via a series of e-mails, or through computer connections. Whether done remotely or face-to-face, the interviews are scheduled before the meeting. During each interview, which takes roughly one hour, the analyst explains the group's task, elicits the participant's model (i.e., attributes or clues), asks the participant to estimate utilities or probabilities, and walks

The analyst introduces herself, explains the group's task and agenda, restates the importance of the task, and asks members to introduce themselves. These introductions are an important part of the group process. If members are not explicitly introduced, they will do so implicitly throughout their deliberations.

The analyst presents the straw model, asks the group to revise the model, and focuses the group's attention on one of the components in the straw model as a starting point. The focus on one component at a time is an important way of managing the group's time and conflicts. As group members suggest new ideas or modifications, the analyst records them on the appropriate pages in front of the group. Thus, the analyst serves as a secretary to the group, making sure that ideas are not lost. Recording the comments reassures the group members that their ideas are being put in front of the group for further consideration. The process continues until the group identifies, discusses, and revises all relevant components in the decision structure.

Through active listening (e.g., nodding, asking for clarification) and recording group members' ideas on the flip charts, the analyst plays the important role of directing the discussion, preventing premature closure of ideas (Van de Ven and Delbecq 1974), focusing the group on task-related activities, distributing the group's time over different aspects of the task, postponing evaluation of ideas, and separating people from ideas so that ideas are judged on their own merits. The analyst uses the instructions developed for the group communication strategy as guidelines for this phase of interaction. The analyst should not participate in the content of the discussions and should not restate what has been said in her own words.

Step 4: Estimate the Model's Parameters

In this step of IGP, the analyst helps the group put numbers to the decision components (e.g., assess weights for the utility models, assess likelihood ratios associated with various clues). This task is done individually and without discussion until a major difference between the group members is identified. While working individually, the group remains in the presence of one another. Seeing each other working helps the group members exert more effort on the task at hand. As the group proceeds, the analyst collects the group's responses and puts the answers on a flip chart. The scores are listed on the flip chart in a manner that does not identify who has said them.

Step 5: Discuss Major Differences

IGP focuses the group's discussion on the group's logic. Instead of discussing differences in numerical ratings, the group discusses the reasons

- Whether group participants arrived at a consensus regarding model parameters
- Extent of agreement in the final numerical ratings of various group members
- The average parameters assessed by the group
- Conclusions and next steps in the group's task

A document about the group's deliberation is important not only to people who were in the meeting but also to people who were not. Vinokur and Burnstein (1978) had individual subjects list the persuasiveness of pro and con arguments. The net balance of the persuasiveness of the arguments correlated with attitude changes produced by group discussion. But more importantly, other individuals not present in the group discussion, who were exposed to the same arguments, changed their attitudes in the same way. These results show that the information content of group discussion is important in convincing people outside the group. Similar results have been reported in patients' decisions to conduct breast examination. The more persuasive the arguments for breast examination are, the more likely it is that a patient will do it (Ruiter et al. 2001). Similarly, a well-documented decision model can help convince others.

Summary

There are many occasions in which a group, rather than an individual, has to make a decision. A good example is a board of director's decision about a major capital purchase. This chapter discusses how to build a model for a group's decision. Our approach is based on creating a group consensus around the parameters of the model. There are many different approaches to help a group arrive to a consensus. The group communication strategy instructs group members on the ground rules for discussion and then invites group members to talk freely about topics from which the analyst constructs the decision model. The nominal group process differs in that group members only interact at specific steps in the decision-making process. Discussion is postponed until all ideas are listed. The outcome of the process is a prioritized list of ideas and corresponding numerical estimates. The Delphi process relies on aggregation of group members' opinions without face-to-face interaction. Interrelated questionnaires are sent to decision makers to query them about their choices and their reasons for their choices. Difficulty exists with these established group processes. As a result, researchers have begun to design novel modeling processes for use in group

Rapid-Analysis Exercises

Using your classmates or work colleagues, conduct an IGP on a decision topic of your choice. One classmate should be the facilitator, and two or three others should be the experts in the group. Select the topic in a manner that your classmates have expertise in. Conduct all the steps in IGP, including the construction of a straw model and the numerical estimation of the mode. Make sure you allocate sufficient time for each component: a week to interview classmates and create a straw model, half a day to review the straw model, four to six hours to generate the scenarios, and half a day to conduct the numerical estimation and related discussion. Prepare a report analyzing the agreement among the experts as well as between the experts and the model.

Audio/Visual Chapter Aids

To help you understand the concepts of modeling group's decisions, visit this book's companion web site at ache.org/DecisionAnalysis, go to Chapter 6, and view the audio/visual chapter aids.

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