Cognitive Structures of the Board of Directors: Managerial Cognitions as Bayesian Networks

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Presented at the Academy of Management Meetings, August 2003
In a study of CEOs and board members in three companies, we asked respondents to recollect events that led to a controversial decision. We asked respondents to estimate the subjective probability that events they listed would lead to others if this problem was to occur again. We found, among other things, that CEOs and influential board members differed from others in their recollection of events and the importance attached to events. CEOs recollected more complex cognitive maps of events, and influential board members and CEOs were more pessimistic than others about the successful resolution of a problem, but they were more optimistic than others that board actions could influence decisions.
Democratic decision-making by boards of directors is a foundational principle of corporate governance. Yet recent corporate scandals, such as the Enron and WorldCom debacles, have brought the process of board decision-making into question. Amidst a clamor from the public for more democratic decision-making by boards, and a change in the role of boards to becoming more proactive in overseeing the organization, it is time to begin to understand the processes in the boardroom that lead to decisions about strategy and performance. Recent reviews of the board of directors literature (Forbes & Milliken, 1999; Johnson, Daily, & Ellstrand, 1996) have indicated a need to move beyond studies linking board composition to firm performance (Baysinger & Hoskisson, 1990; Daily & Johnson, 1997; Pearce & Zahra, 1992; Zahra & Pearce, 1989) to the studies of the internal processes of boards that are currently lacking in the literature. Understanding the thinking of board members and CEOs and the differences in their perspectives is an important first step in understanding the internal processes of boards that leads to effective board performance (Nutt, 1986).

Although there are few empirical studies of the differences in thinking of board members and CEOs when confronted with decisions, there are large literatures on how managers and top management teams make decisions (Nemeth, 1986, O’Reilley, Caldwell & Barnett, 1989, Hambrick, Cho & Chen, 1996; Latane & Wolf, 1984), how theories of cognition are linked to managerial decision making (Ensley & Pearce, 2001), and how cognitive reasoning can be mapped and analyzed (Huff, 1990). We know from cognitive theory, for example, that position in the organization makes a difference in how information is categorized and how categories of information are linked to each other in an individual’s cognitive map (Starbuck & Milliken, 1988).
Applying this cognitive theory to boards of directors, the cognitive maps of board members and CEOs can be expected to differ due to the difference in their position and duties on a board. As a first step in understanding differences in thinking on the board, in this exploratory study we looked at how board members and CEOs categorized events when faced with a difficult board decision, how these events were linked together in cognitive maps, and how these maps differed between board members and CEOs in three organizations. We found that there is a diversity of categories and maps among board members and CEOs, and this diversity was linked to the position and influence of the actor on the board of directors.

**CORPORATE GOVERNANCE AND MANAGERIAL COGNITION**

It has been assumed by many researchers and theorists that board members are unable to contribute effectively to strategy making due to their lack of firm specific knowledge or due to their lack of independence from the company (Rindova, 1999). Board members who only attend quarterly meetings are assumed to be ill-informed about the workings of the company (Patton & Baker, 1987). Board members appointed by the CEO are considered unlikely to oppose the strategic initiatives of the CEO (Mace, 1971; Lorsch & MacIver, 1989), and board members who already have a position in the company are also considered to be unlikely to oppose the strategic initiatives of the CEO (Cochran, Wood & Jones, 1985; Byrd & Hickman, 1992).

Others have argued that directors can be influential, but their relationship with the company may influence their perspective on decisions and their independence from the CEO. Agency theorists, for example, have argued that as firms become large and management and ownership become separate, it is necessary to separate the initiation and implementation of decisions from the overseeing and ratification of decisions (Fama & Jensen, 1983). Senior
managers initiate strategic decisions and the board of directors ratifies the decisions. A board of directors, however, may be composed of those who work for the company as inside directors, and those appointed from outside the company as outside directors. Inside directors may have an entirely different perspective compared to outside directors. Boards dominated by inside directors may prefer control strategies based on the evaluation of the quality of the process leading to financial performance outcomes, whereas boards dominated by outsiders, lacking insider information on how the firm is operating, may prefer to reward top management on the basis of objective financial criteria (Baysinger & Hoskisson, 1990). This suggests that directors may have differences in their perspectives on board governance.

Some would regard boards with more outside directors to be more effective because outside directors are more independent in their decision-making. The ratio of insiders to outsiders is the most frequently used measure of board effectiveness (Walsh & Seward, 1990, Davis & Greve, 1997, Westphal, 1998), probably because this ratio is easy to measure. A review of the literature by Johnson et al. (1996) found, however, that board research has failed to connect board independence measured in terms of the ratio of insiders to outsiders with effectiveness.

**A Cognitive Perspective on Boards**

The composition of the board or demographic perspective (Jackson, Stone, & Alvarez, 1992; Pearce & Zahra, 1992) has had some difficulties in providing clear guidelines for board effectiveness, as seen, for example, in the ratio of insiders to outsiders research (Zald, 1969; Pfeffer, 1972, 1973; Pfeffer & Salancik, 1978). What is lacking in this research is an empirical examination of how the position of the director and CEO affects the process of decision-making. A cognitive perspective that considers how board actors categorize events
and link events together in cognitive maps is a first step in understanding the process of board decision-making.

Several authors have recently advocated taking a cognitive perspective on board decisions as a way of understanding the process of strategic decision-making (Forbes & Milliken, 1999; Rindova, 1999). There are a variety of paradigms that may be applied to understanding decision making from a cognitive perspective. Individuals can be considered to reason based on mental models, schemas, scripts, or rule systems, for example. All of these paradigms share a concern for cognitive structures that represent and organize knowledge, as well as cognitive processes of acquiring knowledge, and cognitive styles reflected in differences in structures and processes across actors (Schneider & Anglemar, 1993).

Here, as an exploratory first step in understanding board processes, we focus on cognitive structures and how they differ among board members. Cognitive structures are composed of categories and relationships between categories. Individuals categorize information on the basis of similarity, and use these categories to form more complex causal systems (Schneider & Anglemar, 1993). Causal systems are based on hypothesized relationships of cause and effect. These causal systems can be mapped. Mintzberg, Raisinghani & Theoret (1976), for example, mapped 25 decision processes in terms of the causal connections among routines invoked while searching for solutions. From this and other early efforts at mapping decisions, there has been a steady increase in attempts to map the mental processes of managers, (e.g. Huff, 1990).

Here we focus on the categories of events that are remembered in describing the decision making process and how these categories of events are linked to each other. It is important to note that we expect differences between board members in the remembrance of events that
led to a decision. We are not trying to determine the actual sequence of events that led to a board decision. As discussed below, we allowed the respondent to list the important events that he remembered (all of the board members were male), instead of providing a list of events. Although others (e.g., Schwenk, 1985) advocate comparing recollections to archival records to insure the accuracy of the steps in a decision process, we were more interested in the “retrospective sense making” (Weick, 1979) of board members complete with perceptual biases and selective recall. In addition, in this case accurate archival records did not exist because we found that these issues were sensitive, and the minutes of the board meetings did not accurately reflect the decision process.

Categories of cognitions. As this is an exploratory study, we hesitate to state formal hypotheses. We do expect some differences in recollection of events between CEOs and other board members based on cognitive theory. We would expect that the categories used by board members when confronted with a problem would differ in several respects, based on cognitive theory. Cognitive theorists note that our perceptions of events are biased by our position and our actions undertaken to influence events. Given that cognitive theorists maintain that our role and experience affects how the world is perceived, we would expect that CEOs would categorize events leading to decisions differently than board members. According to information processing theory, individuals act to affect outcomes, and remember their efforts when the outcome is successful (Huff & Schwenk, 1990). We would expect CEOs to think of events leading to decisions in terms of interactions with those outside the organization because they have an important role to play in dealing with other organizations, while board members would think of more events involving interactions among the board of directors. Similarly, we would expect CEOs to be more likely to emphasize deadlines in accounting for decisions. We would also expect that board members
would remember more board meetings as influencing decisions, and would rate events occurring inside the organization as more important than events occurring outside the organization.

**Causal relationships.** The events leading to decisions can also be organized into causal sequences. Because so little is known about how CEOs and board members link events together in cognitive schemas, we hesitate to hypothesize concerning the differences in their schemas. We simply speculate that CEOs and board members may differ on whether events as more likely to lead to decisions.

**METHODOLOGY**

**Sample**

The starting point for the data collection began with interviews conducted with the CEOs of three organizations, two private companies and one publicly traded company, as part of a larger study of boards of directors. During these 30 to 60 minute interviews, CEOs described the most difficult and controversial issue the board faced in the past twelve months. Detailed notes were taken during each interview, which were then transcribed. Each issue was summarized into a paragraph, approved by the CEO, and then included in a questionnaire for each member of the board to complete. Six out of seven board members in the Norwood Company, four out of five board members in the Gloucester Company, and five out of seven members of the Uxbridge Company agreed to complete the questionnaire. (See Appendix 1 for a description of each company and event.)

**Methods**

With the issues finalized, telephone interviews were scheduled for board members and CEOs to complete the questionnaire. Respondents were given the starting and end-point of each issue. Generally, the first event involved the CEO informing the board of the issue at a
board meeting while the final event involved the entire board bringing the issue to closure at a board meeting. For example, Lou Parker, the CEO of the Norwood Company (all company and individual names are pseudonyms) notified the board of the prospective client’s equity requirement in event one and the board approved the negotiated arrangement in event six. Jim Grant, the CEO of the Gloucester Company notified the board of capital requirements in step one and the capital raising effort concluded in step six with a failure to raise capital. John Sunday, the CEO of the Uxbridge Company described the board approving an acquisition in step one and the board re-affirmed its commitment to that acquisition in step six.

Respondents were asked to describe a maximum of four important events that occurred between the first and sixth events that were pre-printed on the questionnaire. Respondents were then asked to rate the importance of each event on a five to one scale ranging from extremely important to not important. Each event described by the respondent was placed in a cognitive map (See Appendix 2 for a sample). Respondents were then asked to link boxes with arrows according to whether events were connected to one another and estimate the probability of one event leading to another using an eleven to one scale, ranging from virtually certain to almost never. The final step was to place events with no arrows linked to them on a list with the respondents selecting a probability from the same eleven to one scale and determining the probability of the event occurring though no arrow was linked to it.

**Bayesian networks as cognitive maps.** The data were analyzed as Bayesian networks. The events listed by the respondents were the nodes of the network with causal links connecting the nodes. Each node could be considered to be true or false, either the event happened or it didn’t. The respondents were asked to assess the probability that one event would lead to another if this were to happen again. Each node has an associated probability
table attached to it. For nodes that have “parents” that cause them, a table was created showing the distribution of the probability of node values dependent on each combination of the parent values.

Bayesian networks can be used to model chains of reasoning. Once the respondent has attached a subjective probability to each causal path that he thinks connects events, we have a model of the probability of each event happening conditional on other events. Using software available through the Internet (http://www.hugin.com) we can set particular events to be true and use Bayesian propagation to propagate the results throughout the model. (Anderson & Lenz, 2001 and Nadkarni & Shenoy, 2001 discuss details of the Bayesian network model.)

This technique has been used to model expert systems where experts give estimates of the probabilities of the connections between events, and then the Bayesian model of the events can be used to predict the likelihood of an outcome. Bayesian networks have been used, for example, in the early diagnosis of congenital heart disease in newborn babies. A list of symptoms and test results are given over the telephone, and, based on the network of probabilities of symptoms and test results, the model produces a preliminary diagnosis (Spiegelhalter, et al., 1993).

Here we are not trying to create an expert decision-making system or provide an accurate assessment of the probability of events affecting the outcome. Instead we use Bayesian networks to find each respondent’s estimate of the likelihood of a decision based on the probabilities linking the sequence of events leading to the decision. Given the initial model of subjective probabilities linking events provided by the respondent, we set the initial event to be true. The probability of the initial event being true was propagated throughout the network using Bayesian probability to produce the probability that the decision was made or
“true”. Appendix 2 provides an example of a Bayesian network model. In this model, the board member was told the initial event and the ultimate decision. The board member then filled in the intermediate boxes, connected the boxes with arrows, and attached a probability that one event would lead to another next to his arrow. The scale numbers were converted to probabilities based on a scale for quantifying probabilistic statements modified from one developed by Mosteller and Youtz (1990) with modifications suggested by Kadane (1990).

**Characteristics of the event.** For each event, the authors coded whether the event involved individuals inside and outside of the organization or just individuals inside the organization, coded as 0 for events involving actors inside and outside the organization, and 1 if only those inside the organization were involved (InOut). We also noted whether no actors, two actors, or more than two actors were involved in the event by coding the Group variable 0, 2, or 3. The event was also characterized as an event that was a deadline, or a financial analysis, or an interaction such as a communication, negotiation, blow-up, or a relationship-building episode by coding the Type of Event variable 1, 2, or 3. In the case of deadlines, no individuals were considered to be involved in the event; hence the Group variable was treated as missing. In all cases of coding, we coded the events separately and then reached a mutual agreement on the code. No interrater reliability analysis was conducted because this was a exploratory study in which the co-authors consulted each other intensively during coding.

**Importance of events.** Events were rated by respondents on a 1 to 5 scale ranging from not important, somewhat important, important, very important, or extremely important.

**Similarity of events.** We reviewed the events looking for similarities in them. Some events across respondents were similar enough, such as “board discussion was conducted” to be considered the same across respondents.
Influence on events. We asked respondents to rate the other board members on their influence on the specific decision and their influence overall on the board on a 1 to 5 scale. We averaged across the other board members to calculate an influence score for the individual.

RESULTS

Our cognitive model posits that board members will put events into categories and then link categories into causal networks. We begin our analysis by considering how the respondents categorized events. We then look at the estimates made by the respondents of the probability that one event was linked to another if this problem was to occur again.

Categories. We expected that CEOs would remember important events differently than board members. As we can see from the top panel of Table 1, overall the board members remembered events involving internal events. The CEOs saw an even split between events inside the organization and events outside the organization, as compared to other members who remembered many more internal events. Looking at the middle panel the CEOs were similar to other board members in remembering events that involved more than two people. In the bottom panel it can be seen that CEOs differed from other board members, however, in seeing more deadlines and fewer interactions than other board members. These results are congruent with our expectation that position would affect the recollection of events. CEOs as the people who act as agents of the organization with the environment would be expected to remember more events involving those outside the organization. We would also expect that CEOs would remember more deadlines, as they are directly responsible for executing actions by those deadlines.

We also asked the board members to rate the importance of the events they listed, and the correlation between importance and two variables describing the event are shown in Table 2.
From Table 2 we can see that the board members considered events involving people from inside and outside the organization as more important than events involving those inside the organization. (All correlation matrices presented here show the Pearson correlation coefficient, but the results are the same for the nonparametric Kendall’s Tau correlation coefficient that some would regard as more appropriate for ordinal data.) The respondents also rated events that involved more than two people as more important.

**Causal connections as Bayesian networks.** Table 3 shows the results of propagating the Bayesian conditional probabilities if the first event, identified as the baseline event, was to happen again. As shown in Table 3 for the Norwood Company, respondent 3 thought that the final decision to approve the contract was fairly certain, given the initial event with a probability of making the decision of 72.44%. (This result is based on the diagram in Appendix 2.) In some cases the board members mentioned similar events. We identified similar events from the questionnaires and coded the events as similar. In cases where similar events were identified across respondents, we could also set the similar events equal to true to find out how much these events altered the subjective probability of the decision. In the Norwood Company, for example, Respondent 4 mentioned a board discussion as an intermediate event, as did respondents 1, 2, and 3. However, if the board discussion was to happen again, respondent 4 thought it would affect the final decision by less than 1% (.56%). Respondents 1 and 3 also did not think it would have much effect (less than 1%), respondent 2 however felt that the final decision would be 24% more likely if board discussion was to occur.

Table 3 tells us several interesting things about how events were linked in the minds of these board members. First, CEOs seemed more pessimistic about final outcomes as compared to other board members. The CEOs of the Norwood Company and the Uxbridge
Company had much lower probabilities of a final outcome based on the initial event happening compared to most other board members. The CEO of Gloucester had a higher probability of the final event happening. In this case, however, the outcome was a failure, making the CEO also pessimistic. This pessimistic result was not entirely due to rating the probability of intermediate events as low. Two out of three CEOs showed more variance in their estimates of probabilities than other board members, and the third CEO was the second highest of four board members. This may reflect the greater cognitive complexity required for those most involved in the competitive environment (Hodgkinson, 1997). As cognitive researchers have found that cognitive complexity varies depending on organizational role (Hodgkinson, 1997; Huff & Schwenk, 1990), this result may reflect the CEOs’ greater knowledge of the difficulties in the competitive environment and their greater awareness of the difficulties of one event leading to another compared to most other board members.

It can also be seen from the table that some board members saw similar events occurring, but the recollections of the board members was not always unanimous. Even when several people mentioned a similar event, the probability that the event would affect the outcome varied between board members. The only unanimous agreement on an important event occurred at Gloucester, where all four board members in the study saw the investors’ reluctance to proceed as an important event. Even in this case, there is variation in the effect that the event was considered to have on the final outcome. Of course, there is a ceiling effect for the amount of increase for this variable for the CEO at Gloucester, and this ceiling effect can be seen in several other instances. That is, if a respondent believes that, given the initial event, the outcome was virtually certain, then adding an additional event would have a small effect. In this case the CEO was pessimistic about the success of this initiative, and he felt that intermediate events would not make much difference. This is not always the case, as can
be seen by respondent 2 at Gloucester, who thought the investors’ reluctance would not affect the final outcome by much, but who thought the missed quarter for the company would have a strong effect.

The respondents also felt that the importance of events was connected to the probability of the outcome. As shown in Table 4, the higher the influence of the respondent on the specific decision (Decision Influence), the less likely they thought the outcome would be, given the initial event as measured by the Baseline Probability (r= -.547). This would seem to be the opposite of the expectation of cognitive theorists that when you have an active role in a series of events, you see yourself as influential and one who makes things happen (Huff & Schwenk, 1990). As discussed above, we know, however, that the CEOs, all rated as very influential by other board members, seemed more pessimistic than others. This may be further evidence that those more in the know and influential are more cautious about outcomes. When you have the responsibility for making things happen, you may make a lower estimate about events leading to outcomes because you are more aware of the probability of failure, and more aware that many of the events that you have listed such as economic downturns are out of your control.

The one event that seemed to be recalled the most across the companies was board actions. Eleven out of 15 respondents mentioned some type of board action in their recollections of events. To adjust for the small number of observations, Decision Influence and Board Action was recoded into two parts by splitting the variables at the median and correlating. (Once again Pearson correlation coefficients are shown, and the results remain the same using non-parametric correlation coefficients.) It can be seen from Table 4 that the more influential board members rated board action as more important to the outcome of events compared to the less influential (r=.633). (Board Action Recoded is also very highly
negatively correlated with the Baseline Probability, but this is an artifact of the ceiling effect. The higher the baseline, the less anything else could influence the outcome.) This reflects cognitive theory in the sense that board actions are the actions that the members could control. Cognitive theorists suggest that individuals act to influence outcomes, and, if the outcome is successful, they will be remembered. Events less linked to the individual’s plans are less likely to be remembered (Huff & Schwenk, 1990). Board members were optimistic that their actions could affect events. Although the influential may have been pessimistic in general about outcomes, they were optimistic about their own efforts to influence events.

**DISCUSSION**

This research represents a first step in considering the cognitive structures of CEOs and other board members. Position made a difference in how board members saw the world. CEOs, as those with the most responsibility for outcomes, recalled outside events more often than other board members, and recalled deadlines more often than other board members when considering a past decision.

All board members considered events that involved people outside the organization as more important than events inside the organization, and events involving groups rather than pairs of people as more important. This reflects a realization that events involving those outside the organization were crucial to organizational performance.

Board members also linked their events together into a structure of events. Some people remembered similar events, but board members differed in what events they remembered, and how important those events were to the outcome. There were some similarities across respondents, however. Those with more influence over the specific decision considered were more pessimistic about the success of the decision. The three CEOs were all more pessimistic than other board members about the decision outcome, and had more variance in their
estimates of the connections between events compared to most board members. The influential did see board actions as having a larger influence on outcomes than those with less influence.

These results show that there are differences in perspectives in the recollection of events by CEOs and board members. These differences reflect cognitive theories that argue that organizational members will differ in their cognitive categories and structures based on the position that they occupy in the organization and their own interests. These results also portray the influential members of these boards and the CEOs as being cautious about the likelihood of decision outcomes, but optimistic about board actions influencing outcomes. This is congruent with the cognitive theory expectation that those who participate more in events are more positive about outcomes, but more cautious about events they can not control.

We are left with a picture of boards as composed of the influential and the not so influential. This ability to affect events is reflected in the cognitive categories and cognitive structures of the board members, leading to differences in the mental models of those on the board. This difference in perspectives is likely to lead to conflict, which may be productive or non-productive for board effectiveness. If we had found virtually identical recollections from all board members, we may have been looking at completely cohesive boards with an absence of conflict. This result may have reflected completely ineffective boards that simply rubber stamped the decisions of the CEO, and this lack of differences in perspective and lack of conflict could have been detrimental to the functioning of the boards. Here, we saw many differences in the perspectives of the board members when faced with difficult decisions. These differences are somewhat predictable, given the interpretivist emphasis on how reality
is perceived differently by people depending on their organizational position and influence on events.

Our conclusions must be tempered by the drawbacks in our exploratory study. We could not objectively assess the effectiveness of the boards, and had too few cases to draw conclusions about the similarities of individuals across boards or the effects of cognitive differences on the economic performance of the organizations. Our sample was limited and our response rate was high but less than 100 percent because we were hampered by the difficulties of getting board members to participate in our study. Two out of three boards were from privately held companies where board member involvement in setting strategy may be higher than in public companies, limiting the generality of our results. Future research is needed to fill out the picture of cognitive structures among board members.
REFERENCES


Mace, M., 1971. *Directors, myth and reality*. Division of research, Harvard Business School


Table 1
Categories of Events

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>CEO</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Out</td>
<td>22%</td>
<td>50%</td>
<td>14%</td>
</tr>
<tr>
<td>Inside Only</td>
<td>78%</td>
<td>50%</td>
<td>86%</td>
</tr>
<tr>
<td>(N)</td>
<td>(55)</td>
<td>(12)</td>
<td>(45)</td>
</tr>
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</table>

Number of People in Events

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>CEO</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two People</td>
<td>15%</td>
<td>20%</td>
<td>14%</td>
</tr>
<tr>
<td>More than Two</td>
<td>85%</td>
<td>80%</td>
<td>86%</td>
</tr>
<tr>
<td>(N)</td>
<td>(27)</td>
<td>(5 )</td>
<td>(22)</td>
</tr>
</tbody>
</table>

Type of Event

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>CEO</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deadline</td>
<td>62%</td>
<td>75%</td>
<td>58%</td>
</tr>
<tr>
<td>Task</td>
<td>4%</td>
<td>-</td>
<td>5%</td>
</tr>
<tr>
<td>Interaction</td>
<td>34%</td>
<td>25%</td>
<td>37%</td>
</tr>
<tr>
<td>(N)</td>
<td>(55)</td>
<td>(12)</td>
<td>(43)</td>
</tr>
<tr>
<td>Variable</td>
<td>Mean</td>
<td>s.d.</td>
<td>1</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>------</td>
<td>----</td>
</tr>
<tr>
<td>1. In Out</td>
<td>0.78</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>2. Group</td>
<td>2.85</td>
<td>0.36</td>
<td>-.074</td>
</tr>
<tr>
<td>3. Importance</td>
<td>3.95</td>
<td>1.00</td>
<td>-.293*</td>
</tr>
</tbody>
</table>

¹ N=55 except for the Group variable which excludes events without actions such as deadlines (N=27)
* p < .05
** p < .01
### Table 3
The Probabilities of Events

<table>
<thead>
<tr>
<th>Event</th>
<th>Norwood Company Respondents</th>
<th>Gloucester Company Respondents</th>
<th>Uxbridge Company Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Baseline</td>
<td>98.11</td>
<td>42.00</td>
<td>70.55</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board Discussion</td>
<td>0.89</td>
<td>24.00</td>
<td>0.37</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negotiations</td>
<td>-</td>
<td>-</td>
<td>19.45</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turnaround</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Customer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>26.94</td>
<td>54.77</td>
<td>87.91</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board Looks to Future</td>
<td>33.06</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turnaround</td>
<td></td>
<td></td>
<td>25.23</td>
</tr>
<tr>
<td>Increase due to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Customer</td>
<td></td>
<td></td>
<td>22.39</td>
</tr>
</tbody>
</table>
### Table 4
Correlation Matrix of Decision Influence on Decision Probabilities $^1$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Decision Influence</td>
<td>3.95</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Overall Influence</td>
<td>4.16</td>
<td>0.84</td>
<td>.787*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Baseline Probability</td>
<td>61.83</td>
<td>25.28</td>
<td>-.547*</td>
<td>-.361</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Decision Influence Recoded$^2$</td>
<td>1.47</td>
<td>0.52</td>
<td>.856**</td>
<td>.774**</td>
<td>-.658**</td>
<td></td>
</tr>
<tr>
<td>5. Board Action Recoded$^3$</td>
<td>1.45</td>
<td>0.52</td>
<td>.480</td>
<td>.486</td>
<td>-.898**</td>
<td>.633*</td>
</tr>
</tbody>
</table>

$^1$ N=15  
$^2$ Decision influence recoded into a binary variable split at the median, N=11  
$^3$ Board action recoded into a binary variable split at the median, N=11
Appendix 1  
Description of the Three Companies and the Three Decisions

Norwood Company

The Norwood Company (all company names and individual names are pseudonyms) is a service company that serves the financial services industry. The CEO, Lou Parker has been with the company for three years, while the company has been in existence for five years. Venture capital funds and private investors privately own the company. The company has achieved strong financial results in its short history and it plans to pursue a public offering of its stock when the capital markets become more favorable.

The company negotiated a contract with a major customer and believed that the deal was complete subject to signature. The customer communicated a new requirement, refusing to complete the transaction without a large equity stake. Negotiations ensued and an amicable transaction was reached with revenue guarantees in exchange for equity.

The first and last events included in the questionnaires for Norwood Company are the notification of the equity requirement and the CEO presenting the revised contract to the board and receiving approval to proceed.

Gloucester Company

The Gloucester Company is a software and e-commerce company that serves several industries. The CEO, Jim Grant (a pseudonym) has been with the company for four years, and is the founder. Venture capital funds and private investors privately own the company. The company has achieved strong revenue growth but has not achieved a positive cash flow.

The company was in need of a capital infusion but was unable to raise capital outside of the existing investor group. A proposal to fund the company was proposed by the CEO, though two members delayed their decision subject to the company achieving specific performance metrics. When the company failed to achieve the required metrics, two members of the board withdrew their support and the company raised less capital than requested.
The first and last events included in the questionnaire included a proposal by the CEO to re-capitalize the company while the final event describes the round of financing closing with less capital than the CEO requested.

**Uxbridge Company**

The Uxbridge Company is a manufacturing company that provides products used in technology industries. The company has been in existence for over thirty years and the CEO, John Sunday, has been in place for seven years. The company’s equity is traded publicly on one of the major stock exchanges.

Uxbridge acquired a company in an adjacent market, which was dependent of a few large customers. Shortly after the acquisition was completed, the largest customer gave notice of its intention to terminate the relationship. With the loss of the customer, the projections upon which the board approved the acquisition were no longer valid and a process ensued to consider the strategic significance of the acquired company on a going forward basis considering this new reality. Several positive events occurred within a short time span indicating that future prospects were promising and the board voted to reaffirm its commitment to the adjacent market.

The first and last events included in the questionnaires are both board level events that describe the board approving the acquisition and the board reaffirming its commitment to the acquired company.
Appendix 2  
Cognitive Mapping

Connect the boxes with arrows and estimate probabilities:
Consider how the events are connected to each other. Using the diagram below, draw arrows from each event to other target events that were caused by the initial event. The number of the boxes should correspond to the events numbered above. Now estimate the probability that one event would lead to another by writing a number next to each arrow based on an 11 point scale below (Make sure that every arrow has a number):

Probability Scale
11 Virtually certain
10 Very high probability
9 High probability
8 Probable
7 Better than even chance
6 About an even chance
5 Less than even chance
4 Sometimes
3 Infrequent
2 Seldom
1 Almost never

1. In November 2000, A large prospective customer notified the company of a 10% equity stake in Norwood as a condition to completing the long-term agreement.  
10

2. Board discusses the issue focusing on economic benefit to the shareholders.  
9

3. Norwood performs an economic analysis, resulting in a game plan.  
6

4. Norwood responds with an offer, which is rejected and subsequently counter offers the prospective customer.  
11

5. Norwood sweetens offer to get the deal done.  
6

6. The CEO presents the revised contract to the board and receives approval.  
10