Effectiveness of Group Model Building in discovering hidden profiles in strategic decision-making

Marleen H.F. McCardle-Keurentjes[1]
Etiënne A.J.A. Rouwette
Jac A.M. Vennix

Institute for Management Research
Radboud University Nijmegen

Thomas van Aquinostraat 1.2.19
PO Box 9108
6500 HK Nijmegen
The Netherlands
tel +31 24 3611473
fax +31 24 3611599

m.mccardle@fm.ru.nl
e.rouwette@fm.ru.nl
j.vennix@fm.ru.nl

Work in progress

Abstract

A hidden profile is said to exist when (a) information relevant to the decision at hand is distributed over different members of a decision-making group in such a way that each of the group members possesses unique information and (b) group members will need to pool these unique pieces of information in order to select a superior decision alternative. Hidden profiles give rise to inefficient sharing of information, therefore leading to suboptimal decisions.
Strategic decision-making is hampered by difficulties in gathering, sharing and integrating information. Information feedback that is dispersed over group members is often ignored. This reflects the existence of hidden profiles.
Group Model Building seems capable of discovering hidden profiles in strategic decision-making. The methodology needs investigation in controlled settings to further ground its value. We have conducted an experiment to test the effectiveness of Group Model Building on its contribution to enhancing information sharing and decision quality.

Key words: Group Model Building, experimental research, strategic decision-making, information processing, hidden profiles

[1] Contact author

1. Introduction

In organizations, there is a widespread belief that it is wise to bring together employees with diverse perspectives or technical background for developing new products or to accomplish complex task(s) while working together as a group. Multi-disciplinary teams are part of organizational structures in the expectation that representatives of diverse perspectives will improve the teams' performance (Jackson, 1996).

The same belief in the usefulness of bringing together diverse perspectives can be seen in strategic decision-making situations. Whether or not a decision-making process is facilitated by a group decision support system, as organizations have to make important decisions, they often call in a group of persons that have diverse functional expertise. One category of group decision support, i.e. the model-driven approaches, explicitly takes the different views as point of departure. These decision support methodologies seek to deliver a 'problem consultation service' (Morton, Ackermann, & Belton, 2003, p. 115). In these approaches, strategic problems are viewed as 'messy' problem situations in which lack of information and different views on the problem hinder the decision-making process.

So, different views on the problem are considered to be obstacles for effective decision-making. Simultaneously, however, these are assumed to enhance the performance of decision-making groups. In other words, the process of decision-making seems to be hindered by diversity of informational input, but on the other hand, the outcomes of the decision-making process seem to profit from this diversity. These observations lead to the basic assertion in this paper: effective strategic decision-making (i.e. reaching a well-informed group decision based on the exchange and use of information which individual group members possess) is a function of the quality of information processing at the group level. Accordingly, the extent to which a group decision support system enhances information processing at the group level affects its effectiveness with regard to group decision quality in strategic-decision making.

Group Model Building is one of the model-driven group decision support systems. The methodology needs investigation in controlled research settings to further ground its value (Rouwette, Vennix, & Felling, 2008). We propose that facilitating information processing at the group level and thereby enhancing decision quality is an important aspect of the effectiveness of Group Model Building (GMB). Recently, we started experimental research to test these ideas. In this paper, we present the arguments for the study, the hypotheses and we report on the way we conducted a first experiment.

2. Information processing in strategic decision making

While classical views on strategic decision-making concentrate on rationality as a central concept, in recent years the focus of group decision-making research has shifted towards information distribution and exchange in groups (Hinsz, Tindale, & Vollrath, 1997; Kerr & Tindale, 2004). Groups performing cognitive tasks, such as (strategic) decision-making, are increasingly understood as information processors (De Dreu, Nijstad, & Van Knippenberg, 2008; Hinsz et al., 1997). At the group-level, information processing is: 'the degree to which information, ideas, or cognitive processes are shared, and are being shared, among the group members and how this sharing of information affects both individual- and group-level outcomes' (Hinsz et al., 1997, p. 43). This has also been referred to as the degree to which a group 'elaborates' information which is the extent to which group members exchange information and perspectives, individually reflect on the input of other members and bring their reflections, in turn, into the discussion where the integration of its implications takes place (Van Knippenberg, De Dreu, & Homan, 2004).

Most recently, the view of groups as information processors has gathered strength with the motivated information processing in groups (MIP-G) model. De Dreu, Nijstad, and Van Knippenberg (2008) view groups as *motivated* information processors; social and epistemic motivation of individual group members are thought to determine information processing at the individual and the group level which subsequently is expected to affect group decision quality. Contextual factors such as features of the decision task are conceptualized as moderating effects.

In strategic decision-making, decision tasks are more complex than those in static choice situations that may have demonstrable correct solutions. In strategic decision-making, decision tasks are typically dynamic in nature since decision-makers need to consider the impact of decisions over time. Various factors contribute to the complexity of strategic decision-making. For instance, unclear problem definitions, intertwined elements, and connections of strategic problems with other organizational problems make the gathering, sharing and integration of information more difficult (Beers, 2005). Uncertainty about consequences and alternatives adds to the complexity of strategic decision-making. Moreover, political tactics such as the manipulation and control of crucial information increase the social complexity of strategic decision-making (Dean & Sharfman, 1996; Elbanna, 2006). As a result of the complexity of strategic decision-making, decision-makers (most often teams of managers) may not be able to identify important aspects of the problem situation and ignore information feedback (Sterman, 2000). Subsequently, this can lead to disappointing decision quality.

As strategic problems are connected with other organizational problems within the organization as well as in the environmental context, decision-relevant information is often distributed over diverse knowledge domains. The dependency of distributed information in strategic decision-making especially becomes apparent while identifying the system structure in a problem situation. The knowledge on underlying feedback loops which is needed for a better understanding of the problem situation is typically dispersed over several decision-makers. The exchange and use of uniquely owned (by different group members) decision-relevant information is required to enable the group to make a decision that is based on a better understanding of the structure of the system. Thus, the fact that individual group members have information on single elements of a feedback loop, but not on the whole loop, makes the sharing of the unique pieces of information a necessary condition for uncovering the underlying feedback loops of the system. The latter is crucial for increasing the decision quality.

This situation, i.e. the group's dependency of distributed information related to the quality of the decision, points to the existence of what in (small) group decision literature is called a 'hidden profile'. A hidden profile is said to exist when (a) information relevant to the decision at hand is distributed over different members of a decision-making group in such a way that each of the group members possesses unique information and (b) group members will need to pool these unique pieces of information in order to select a superior decision alternative (Stasser 1992).

In the following, we will make clear why it is important to consider the existence of hidden profiles in strategic decision-making.

3. Hidden profiles

The emphasis on information processing in group decision-making was particularly stimulated by a study of Stasser and Titus (1985) in which they question the thought that a collective decision is more informed than a decision made by individuals alone. Stasser and Titus revealed that when information about the best option is hidden from individual members, groups have difficulties discovering the best alternative. A hidden profile is created when information is distributed in such a way that group members each have unique, decision-relevant information and have to pool the information to identify the superior decision (Stasser, 1992). Stasser and Titus' study (1985) has shown that the tendency of group members to discuss shared (common) information rather than information which is known by only one person or a minority (unique information) affects decision quality negatively. Their findings have been further empirically supported by many studies (for reviews, see e.g. Argote, 2005; Kerr & Tindale, 2004; Stasser, 1999; Stasser & Titus, 2003); when information about the best option is distributed, decision-making groups quite consistently follow the pattern of insufficiently sharing unique information and subsequently making a suboptimal decision.

By definition, the existence of a hidden profile cannot be observed in real-life decision-making situations. However, detrimental consequences of the failure to discover hidden profiles can be noticed in retrospect. Failing to adequately share distributed decision-relevant information can have severe consequences such as the space shuttle Challenger accident (Report of the Presidential Commission on the Space Shuttle Challenger Accident 1986 in Galinsky & Kray, 2004).

For the failure to discover hidden profiles, a number of different explanations have been invoked such as limited human cognitive capabilities (e.g. failure to recall and mention information), (biased) psychological and social processes (e.g. impact of pre-discussion preferences), and sampling opportunities generated by the distribution of information (for a review, see e.g. Stasser, 1999).

Based on possible explanations for the hidden profile pattern, many studies have been conducted to find ways to increase the exchange and use of distributed information. Factors have been identified such as facilitation (Wheeler & Valacich, 1996), assignment of expert roles (Stasser, Stewart, & Wittenbaum, 1995), process accountability (Scholten, van Knippenberg, Nijstad, & De Dreu, 2007), and (awareness of) a shared task representation (Van Ginkel, 2007). Substantial effects have been achieved by priming groups with norms like critical thinking (Postmes, Spears, & Cihangir, 2001) and counterfactual thinking (Galinsky & Kray, 2004; Liljenquist, Galinsky, & Kray, 2004). The MIP-G model (De Dreu et al., 2008) captures many of these person- and context-related factors.

Yet, most of the studies which were conducted use cognitive decision tasks with a limited number of options to decide on. It is unclear if group priming also improves group decision-making for strategic problems which do not have a correct answer (Liljenquist et al., 2004) and are characterized by complexity. Which elements help to discover hidden profiles in strategic decision-making is an important research question that until now remains unaddressed.

Although not explicitly recognized as such in strategic decision-making, knowledge of underlying feedback loops is part of a hidden profile. Only when feedback loops are identified can the group select and test the (supposed) optimal solution on its implications. Ignoring information feedback, one of the core problems of strategic decision-making, reflects the lack of sharing of unique information in the hidden profile pattern. For examples of strategic decision-making situations where information feedback was not identified, affecting important economic outcomes, see Hall (1984) and Sterman (2000).

These considerations and empirical observations of severe consequences highlight the importance of discovering hidden profiles in strategic decision making. It is not only important that hidden profiles are detected to prevent detrimental outcomes, but also to enhance the quality of 'suboptimal' outcomes in strategic decision-making. Notice that suboptimal outcomes are usually not recognized as such, but are considered as optimal outcomes.

We propose GMB as a methodology that is capable of offering a fruitful contribution to discovering hidden profiles in strategic decision-making. First, we shall take a closer look at group decision support and research on its effectiveness. Then, we shall go into the reasons for investigating GMB as a methodology for enhancing information sharing and decision quality.

4. Strategic decision-making support and its effectiveness

Since the 1970s, recognition of the complex nature of strategic problems and increasing knowledge about shortcomings in group decision-making (Hogarth, 1987; Tversky & Kahneman, 1974) has given rise to the development and use of methodologies to support group decision-making. These are known as group decisions support systems (GDSS). All GDSS take as their point of departure that groups show biases and shortcomings when it comes to making decisions. Some of these systems support decision-making primarily by means of technology (e.g. electronic meeting systems), others, that are model-driven, primarily use facilitation (Morton et al., 2003). The latter methodologies, also known as wide-band methods, explicitly focus on decision support with respect to strategic problems (viewed as 'messy' problems). The representation of the strategic problem in a decision model that is built interactively aims to give the group insight into the problem at hand and to help the group decide on the best course of action. Overall, the model-driven GDSS focus on facilitating learning and fostering consensus and commitment.

The processes and outcomes of technology-driven GDSS have been extensively investigated (for a review, see e.g. Fjermestad & Hiltz, 2000; Stasser, 1999). There are also many case studies which describe the effectiveness of model-driven methodologies (for reviews, see Mingers & Rosenhead, 2004; Rouwette, Vennix, & van Mullekom, 2002). But, there is a salient difference between research in technology-driven and model-driven decision support approaches: the amount of experimental research. In technology-driven approaches experimental research is a commonly used strategy to investigate process and outcome of decision support. In studies of model-driven approaches, experimental research has rarely been used to measure effective ways to improve strategic decision-making. Huz (1999) and Rouwette (2003) conducted field experiments and Shields (2001; 2002) is one of the very few who report studies in a controlled setting. The fundamental reason for the small amount of experimental research appears to be that evaluation of the model-driven approaches in an experimental setting seems at odds with the complexity of real-life strategic decision-making, which was the trigger for the design of these decision support methodologies (Eden, 1995). Detailed field studies do provide rich accounts of the process and outcomes of particular model-driven supported decision-making situations.

Yet, differences in context and the way a specific methodology is employed hinder the comparison of studies (Rouwette & Vennix, 2006). There is a concern that effects found in field studies and ascribed to the specific approach that is used, are confounded with elements of the context of the situation such as the client setting and the person of the faciltator (Rouwette & Vennix, 2006). A bias towards the more successful applications of model-driven methodologies is not inconceivable (Andersen, Richardson, & Vennix, 1997; Rouwette & Vennix, 2006). Moreover, it is unclear which elements of the methodology contribute to decision quality (Andersen et al., 1997). Studies on the generic factors at work by using a model-driven methodology in supporting strategic decision-making are clearly needed (Eden, 1995; Rouwette, Vennix, & Felling, 2007).

GMB is one of the model-driven methodologies and is a particularly interesting methodology to investigate because of the resemblance to factors that promote the discovery of hidden profiles. If we contrast characteristics of GMB to factors that show beneficial effects on the sharing of information and decision quality in hidden profile studies, it can be seen that there are similarities. The decision-makers are explicitly invited because of their unique information with regard to the strategic problem (*expert roles*), different views on and stakes in the problem. When GMB is used, a causal model is built with group members who have a *shared cognition* about the task and the way to structure the problem. Building a causal model in an interactive way can not be realized without posing clarifying questions and contrasting information as part of the discussion, which comes close to several elements of 'information elaboration' and to a *critical thinking group norm*. Further, building a causal model means identifying causes and effects which constitutes a *counterfactual approach* to information exchange. GMB structures and *facilitates* the cognitive process by means of the translation of the agreed-upon information in a shared model that is visible for each member of the group. Simultaneously, it structures and facilitates the communication process through a decision procedure guided by a facilitator, which also (partly) counteracts the strategic/political use of information by group members. Thus, in this specific methodology, various factors that have been proven helpful in discovering hidden profiles seem to come together.

However, the fact that all these elements are present in GMB is no guarantee that GMB would be effective in discovering hidden profiles in strategic decision-making. There is, for instance, a salient difference in the nature of decision tasks which are used in hidden-profile studies and in strategic decision-making. In hidden profile studies, decision tasks generally concern relatively clear-defined, static problem situations with a limited amount of options to decide on. This is quite different from the tasks that strategic decision-making groups usually face.

5. Hypotheses

We propose that GMB is of particular importance in preventing the basic effect of hidden profiles in strategic decision-making, i.e. in overcoming the pattern of inadequate sharing of information followed by a suboptimal decision. The effectiveness of GMB can be tested by comparing decision-making groups who are supported by GMB (GMB groups) to 'freely interacting' groups. The latter groups are groups who are not facilitated by any GDSS and who work together with a chairman as is usually the case in real-life strategic decision-making. Hence, our hypotheses are:

Hypothesis 1 GMB groups will share more unique information than freely interacting groups in strategic decision-making.

Hypothesis 2 GMB groups make better decisions than freely interacting groups in strategic decision-making.

A first experiment is conducted to test these hypotheses.

6. Overview of the first experiment

To test the effectiveness of GMB with regard to information sharing and decision quality we created a controlled research situation in which information was distributed in such a way that only by combining unique pieces of information a decision-making group would be able to discover feedback mechanisms underlying the strategic problem.

Participants

In the experiment, both hypotheses have been tested with a sample of 23 groups (12 experimental groups, 11 control groups) of five persons each. This group size resembles the minimum size of a typical group that is supported by GMB. Participants were undergraduate students (bachelor Business Studies 3rd year). The experiment was part of a course and the participants received course credits. The timing of the experiment was at the end of the course.

Decision-making groups were formed out of teams of students who had intensively worked together on assignments of the course, in which they took an expert role or the role of a manager. This means that the students had a history together and were accustomed to a specific role. In the experiment each individual got the role of a manager, i.e. CEO, manager Finances, manager Marketing, manager Productions & Logistics, and manager Human Resources Management. We strived to assign the students the same role as the one they previously had while working on the assignments of the course. Using groups with a shared history regarding the decision task or with a future together is assumed to improve the external validity of the study (cf. Stasser & Stewart, 1992).

Decision task

The decision-making task was based on a management game called LEARN! (Größler, Maier, & Milling, 2000; Milling & Lehmann, 1994). The strategic problem was situated in an environment which most students were knowledgeable about, because they played it in the second year of their study. On the basis of the game we created a fictitious problem situation. The participants of the experiment, being managers of a mobile phone company, got the instruction to decide what to do in preventing an imminent bankruptcy. Further, they had to carefully evaluate the information so that the company could survive in the long run. The management team was given one hour to fulfill this task.

Each group member received (a) general information about the group task and the problematic situation of the organization and (b) information specifically linked to their management position in the team. The general as well as the specific information covered approximately one page each. The information pieces that together make up the feedback structure of the system constituted the hidden profile. These information pieces were carefully distributed amongst the group members. Each member received the same amount of relevant unique (owned by one member of the group) as well as relevant common information (owned by all group members). Also some redundant unique and common information was given to each of the group members in order to reflect real-life decision-making.

Measurements
As we have mentioned above, the information cues have been carefully distributed over group members so that a hidden profile was created. 'Information sharing' is measured and will be analyzed by counting the amount of information cues mentioned, repeated and integrated in the discussion and by comparing the percentage of common information to the percentage of unique information exchanged (cf. measurement of 'information elaboration' in Van Ginkel, 2007, p. 37).

'Decision quality' is measured and will be analyzed by comparing the results of the decision made by the group to the optimal decision using the simulation model of the management game on which the decision task was based. The simulation model makes it possible to determine the performance of the decision itself - without interference of factors in the environment –, thereby functioning as an external standard for measuring decision quality. Decisions mentioned by the group which happen to be outside of the model boundary will be submitted for judgment to experts in the field. Besides that, for comparison with and to supplement results of field studies, decision quality is measured and will be analyzed by internal reference as is usually done in field studies of model-driven methodologies (i.e. by self assessment of the group members, cf. Rouwette et al., 2002).

Each discussion is audio recorded and videotaped. Data will be analyzed using content analysis as well as statistical techniques to determine significant differences between groups.

Time table on the day of the experiment
Before the day of the experiment, we gave instructions to the five facilitators of the GMB groups. Four of them are skilled facilitators; one facilitator is a novice with some initial experience. The free-discussion groups were assisted by coaches who received instructions on the day before the experiment. At the beginning of the day of the experiment, there was a meeting with the facilitators and coaches to further explain the procedure of the experiment.

The participants were scheduled for participating in the experiment as part of their course as follows:

- 8:45-10:30 : 10 groups (5 GMB groups and 5 freely interacting groups),

- 10:45-12:30 : 8 groups (4 GMB groups and 4 freely interacting groups),
- 13:45-15:30 : 10 groups (5 GMB groups and 5 freely interacting groups).

Two more freely interacting groups have been scheduled on a different day and time, as they were unable to attend the original planned meeting. Not all groups produced usable data due to technical problems (video taping or audio recording did not work) or due to incompleteness of some groups. Thus, we have data at our disposal of 12 GMB groups and 11 freely interacting groups. In table 1 the procedure and materials which are used in the time-period 8:45-10:30 are summarized. The same procedure and materials are used in the other two time-periods (10:45-12:30 and 13:45-15:30).

All the meetings took place in the same building, in rooms that are comparable in size and atmosphere. The students were scheduled in groups of 10-12 persons (as they used to be in the course they were attending) and met in one room. After a short introduction by their coach, they were split up in two subgroups. One subgroup was told to go to another room. They were informed that their meeting would be supported by GMB. Then, these participants and the facilitator arranged their tables into the U-form as is usually done in GMB.

In all groups, in case a sixth individual was present this person fulfilled the role of observer.
At the start of the meeting, all participants filled in a pre-questionnaire, at the end of the meeting they filled in a post-questionnaire. These questionnaires included the assessment of characteristics of the participants, their pre- and post-discussion preference and their judgment of the quality of the group decision.

Time	Activities	Materials
8:45	- Welcome & introduction - Splitting up the student group - One subgroup goes to another room	- Explanation (including relation to goals of the course) - Instruction how to divide the group
9:00	- Assigning roles to participants	- Instruction role division
9:02	- Participants fill in consent forms - Participants read the decision task (general and specific information) - Participants fill in pre-questionnaire	- Research Consent forms - Descriptions: five management roles - Pre-questionnaire
9:15	- Start video- and audio-recording - Start group discussion	- Video- & audiotape - For GMB groups only: pencils, flips, tape, and form: 'Individual brainstorm of variables'
10:05	- Mentioning 'ten minutes rest for making a group-decision' and reaching the decision-form	- Form group-decision
10:15	- End of the video- & audio-recording - Participants fill in post-questionnaire	- Post-questionnaire
10:25	- Debriefing and explanation - Collecting all forms - Request for silence about the experiment	- Explanation of the experiment (including relation to the course and research in GDSS)
10:30	End	

Table 1 Time table procedure from 8:45 until 10:30

Work in progress

Now, we are analyzing the data. We intend to report our findings to the participants of the 2008 System Dynamic Conference in Athens, Greece.

References

Andersen, D. F., Richardson, G. P., & Vennix, J. A. M. (1997). Group model building: Adding more science to the craft. *System Dynamics Review, 13*(2), 187-201.

Argote, L. (2005). *Organizational learning: Creating, retaining and transferring knowledge* (1st Springer paperback pr. ed.). New York: Springer.

Beers, P. J. (2005). *Negotiation common ground: Tools for multidisciplinairy teams* (PhD dissertation, Open University). Maastricht: Author.

De Dreu, C. K. W., Nijstad, B. A., & Van Knippenberg, D. (2008). Motivated information processing in group judgment and decision making. *Personality and Social Psychology Review, 12*(1), 22-49.

Dean, J. W., & Sharfman, M. P. (1996). Does decision process matter? A study of strategic decision-making effectiveness. *Academy of Management Journal, 39*(2), 368-396.

Eden, C. (1995). On evaluating the performance of wide-band GDSS's. *European Journal of Operational Research, 81*(2), 302-311.

Elbanna, S. (2006). Strategic decision-making: Process perspectives. *International Journal of Management Reviews, 8*(1), 1-20.

Fjermestad, J., & Hiltz, S. R. (2000). Group support systems: A descriptive evaluation of case and field studies. *Journal of Management Information Systems, 17*(3), 115-159.

Galinsky, A. D., & Kray, L. J. (2004). From thinking about what might have been to sharing what we know: The effects of counterfactual mind-sets on information sharing in groups. *Journal of Experimental Social Psychology, 40*(5), 606-618.

Größler, A., Maier, F. H., & Milling, P. M. (2000). Enhancing learning capabilities by providing transparency in business simulators. *Simulation & Gaming, 31*(2), 257-278.

Hall, R. I. (1984). The natural logic of management policy making: Its implications for the survival of an organization. *Management Science, 30*(8), 905-927.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin, 121*(1), 43-64.

Hogarth, R. M. (1987). *Judgment and choice: The psychology of decision* (2nd ed.). Chichester: Wiley.

Huz, S. (1999). *Alignment from group model building for systems thinking: Measurement and evaluation from a public policy setting.* (Unpublished doctoral dissertation) Albany, New York: SUNY.

Jackson, S. E. (1996). The consequences of diversity in multidisciplinary work teams. In M. A. West (Ed.), *Handbook of work group psychology* (pp. 53-75). Chichester: Wiley.

Kerr, N. L., & Tindale, R. S. (2004). Group performance and decision making. *Annual Review of Psychology, 55*, 623-655.

Liljenquist, K. A., Galinsky, A. D., & Kray, L. J. (2004). Exploring the rabbit hole of possibilities by myself or with my group: The benefits and liabilities of activating counterfactual mind-sets for information sharing and group coordination. *Journal of Behavioral Decision Making, 17*(4), 263-279.

Milling, P. M., & Lehmann, F. (1994). *Management games for group decision making in a dynamic environment.* Paper presented at the 1994 International System Dynamics Conference, Sterling, Scotland.

Mingers, J., & Rosenhead, J. (2004). Problem structuring methods in action. *European Journal of Operational Research, 152*(3), 530-554.

Morton, A., Ackermann, F., & Belton, V. (2003). Technology-driven and model-driven approaches to group decision support: focus, research philosophy, and key concepts. *European Journal of Information Systems, 12*(2), 110-126.

Postmes, T., Spears, R., & Cihangir, S. (2001). Quality of decision making and group norms. *Journal of Personality and Social Psychology, 80*(6), 918-930.

Rouwette, E. A. J. A. (2003). *Group model building as mutual persuasion* (PhD dissertation, Radboud University Nijmegen). Nijmegen: Wolf Legal Publishers (WLP).

Rouwette, E. A. J. A., & Vennix, J. A. M. (2006). System dynamics and organizational interventions. *Systems Research and Behavioral Science, 23*(4), 451-466.
Rouwette, E. A. J. A., Vennix, J. A. M., & Felling, A. J. A. (2007). On evaluation the performance of problem structuring methods: An attempt at formulating a conceptual model. *Group Decision and Negotiation, accepted for publication 6 December 2007,* DOI 10.1007/s10726-007-9100-z.
Rouwette, E. A. J. A., Vennix, J. A. M., & van Mullekom, T. (2002). Group model building effectiveness: A review of assessment studies. *System Dynamics Review, 18*(1), 5-45.
Scholten, L., van Knippenberg, D., Nijstad, B. A., & De Dreu, C. K. W. (2007). Motivated information processing and group decision-making: Effects of process accountability on information processing and decision quality. *Journal of Experimental Social Psychology, 43*(4), 539-552.
Shields, M. (2001). *An experimental investigation comparing the effects of case study, management flight simulator and facilitation of these methods on mental development in a group setting.* Paper presented at the 2001 International Conference of the Systems Dynamics Society, Atlanta, GA.
Shields, M. (2002). *The role of group dynamics in mental develoment: An experimental comparison of the effect of case study and management flight simulator under two levels of facilitation.* Paper presented at the 2002 International Conference of the System Dynamics Society, Palermo, Italy.
Stasser, G. (1992). Information salience and the discovery of hidden profiles by decision-making groups: A "thought experiment". *Group Decision Making, 52*(1), 156-181.
Stasser, G. (1999). The uncertain role of unshared information in collective choice. In L. L. Thompson, J. M. Levine & D. M. Messick (Eds.), *Shared cognition in organizations: The management of knowledge* (pp. 49-69). London: Lawrence Erlbaum.
Stasser, G., & Stewart, D. (1992). Discovery of hidden profiles by decision-making groups: Solving a problem versus making a judgment. *Journal of Personality and Social Psychology, 63*(3), 426-434.
Stasser, G., Stewart, D. D., & Wittenbaum, G. M. (1995). Expert roles and information exchange during discussion: The importance of knowing who knows what. *Journal of Experimental Social Psychology, 31*(3), 244-265.
Stasser, G., & Titus, W. (1985). Pooling of unshared information in group decision-making: Biased information sampling during discussion. *Journal of Personality and Social Psychology, 48*(6), 1467-1478.
Stasser, G., & Titus, W. (2003). Hidden profiles: A brief history. *Psychological Inquiry, 14*(3-4), 304-313.
Sterman, J. D. (2000). *Business dynamics: Systems thinking and modeling for a complex world.* Boston: The McGraw-Hill Companies.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.
Van Ginkel, W. P. (2007). *The use of distributed information in decision making groups: The role of shared task representations* (PhD Dissertation Erasmus, University Rotterdam). Rotterdam: Erasmus Research Institute of Management (ERIM).

Van Knippenberg, D., De Dreu, C. K. W., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology, 89*(6), 1008-1022.

Wheeler, B. C., & Valacich, J. S. (1996). Facilitation, GSS, and training as sources of process restrictiveness and guidance for structured group decision making: An empirical assessment. *Information Systems Research, 7*(4), 429-450.