Knowledge and Process Management Volume 12 Number 2 pp 77–88 (2005)
Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/kpm.223

Research Article

Knowledge Management and Collaborative Model Building in the Strategy Development Process

Emmanuel Adamides* and Nikos Karacapilidis

Industrial Management and Information Systems Lab, MEAD, University of Patras, Greece

Strategy formulation is a knowledge-intensive social process that involves managers with diverse cognitive spheres. The quality of its outcome depends on the efficient and effective construction of shared context that enables issue-specific knowledge creation through a process of dialectical argumentation. Group model building is an approach that has been proved to facilitate knowledge externalization, recombination and diffusion for sense making and decision making in strategic discourse. In this line, this paper presents a novel approach for enhancing the strategy process on the basis of collaborative model building and selection through structured dialoguing. Contrary to other approaches, *group model building and selection by argumentation* (G-MoBSA) adopts a market perspective of the strategic issue resolution space, on which participants propose their models of the issue and its resolution. Models represent the proponents' particular beliefs and views and are subject to consideration and modifications by all group participants, through a process of formal argumentation. Gradually, models that represent the shared context of the organizational and environmental characteristics with respect to the specific strategic issue emerge. The rationale behind our approach, its elements and suitability to strategy formulation, as well as the characteristics and functionality of *Knowledge Breeder*, an IS framework that supports it, are presented through a sample session of strategy development in a software development company. Copyright © 2005 John Wiley & Sons, Ltd.

INTRODUCTION

Strategy formulation, at both corporate and functional levels, is a knowledge-intensive social process that involves managers with diverse cognitive spheres. For the strategy process to produce a useful outcome, shared mental models are constructed as a result of the communication, exchange and adaptation of the participating managers' cognitive models and the creation of new issue-specific knowledge. What drives strategic dialoguing is a form of persuasive argumentation (Vinokur and Burnstein, 1974), and what creates shared models is the construction of new knowledge through argumentative discourse. From the knowledge management point of view, knowledge is created as the result of the integration/recombination of different contexts within the *ba* (place) (Nonaka and Toyama, 2003) of the strategic process, which contexts are then modified according to the developed shared beliefs (Demsetz, 1988; Kogut and Zander, 1992).

On the other hand, there is a growing belief that the long-term strategy of a firm, if it is not a purely emergent process, at least has an emergent component (Mintzberg and Waters, 1985) realized through a cycle of sense making (construction of shared meanings and common goals, selection of problems and opportunities for the organization),

*Correspondence to: Emmanuel Adamides, Industrial Management and Information Systems Lab, MEAD, University of Patras, 26504 Rio Patras, Greece.
E-mail: adamides@mech.upatras.gr

knowledge creation (development of new capabilities and innovations) and decision making (selection and initiation of action) (Choo, 2002). The micro-instantiation of the *organizational knowledge cycle* is activated over particular issues and problems. Therefore, while the process of strategy is spatially distributed, its content extends in time (it is a pattern of decisions). Increasing the productivity and effectiveness of this knowledge cycle provides the basis for achieving sustainable competitive advantage. Towards this objective, the provision of as many diverse perspectives as possible and the promotion and support of collaboration among decision-makers act as mechanisms for developing shared context and creating new knowledge in an economically efficient way (Grant, 1996). Furthermore, the problem-solving efficiency and effectiveness, as measures of an organization's capability to deal with the issues and problems it faces, can be augmented by the collaborative development and manipulation of structured models (Vennix, 1996; Eden and Ackermann, 1998), and by the embedment of dialectic logic in the form of argumentation schemes in the collaboration processes (dialectic logic facilitates synthesis of perceptions) (Buckingham-Shum and Hammond, 1994; Metcalfe, 2002; Nonaka and Toyama, 2003). Moreover, the provision of a technological infrastructure that supports virtuality (dispersed groups, asynchronous collaboration) can attract wider membership and hence increase the diversity and richness of knowledge, promote active participation and further increase the productivity of strategic issue resolution.

To achieve these objectives, various methodologies and systems have been developed in the last two decades. They include participative systems methodologies (Checkland, 1981; Flood and Jackson, 1991; Mitroff and Linstone, 1993; Wilson, 2001), methodologies that rely on simulation modelling (Vennix, 1996), methodologies that use collaborative information technology (Eden and Ackermann, 1998) and information systems supporting collaboration and argumentation (e.g., Conklin and Begeman, 1987; Fischer *et al.*, 1989; Lee, 1990; Karacapilidis and Papadias, 2001). None of them, however, addresses the above requirements in their entirety, i.e. allows for a holistic issue and argumentation representation, explicitly addresses knowledge creation as a design requirement, supports concurrent issue (and, consequently, knowledge) exploration and exploitation, allows asynchronous exchange of information and implements an apparent face-to-face argumentation dialogue in a structured manner.

In an attempt to address all the above requirements, this paper describes a technology-supported methodology for collaborative strategic issue resolution. We present the *group model building and selection by argumentation* (G-MoBSA) methodology and its implementation in a collaborative IS framework, namely *Knowledge Breeder*. G-MoBSA views collaborative problem resolution as a process of collaboratively 'breeding' a pool of models of the issue, of which the models that best fit its developing shared understanding and map the best course(s) of action (as these have been collectively perceived) emerge. Shared understanding and knowledge integration are achieved through argumentative dialoguing on the models under consideration.

Our paper is further organized as follows. First, we discuss group model building as a generic problem-solving and organizational knowledge-creation process. Then, we present the G-MoBSA methodology. We continue by demonstrating the main characteristics of *Knowledge Breeder* through an example of collaborative resolution of a strategic issue in a software development company. Finally, we conclude by discussing the applicability and importance of the approach and the system presented and by outlining directions for further work.

FORMULATION OF STRATEGY BY COLLABORATIVE MODEL BUILDING

In a knowledge-based perspective, the role of strategy is to resolve contradictions between the organization and its environment. Organizations, however, are complex systems of interacting elements and are influenced by their external environment. In order to assess and resolve organizational issues, managers form abstractions of these systems in the form of models. Models are highly subjective and depend on the managers' world-views (*Weltanschauung*), as well as on their previous knowledge regarding the situation (Checkland, 1981). This implies that models are not descriptions of the real world, but rather descriptions of ways of thinking about the real world (Vickers, 1983; Wilson, 2001).

The impact of executive cognition in the strategy formulation processes and outcomes has been a subject of great interest in the strategic management literature. According to upper echelons theory (Hambrick and Mason, 1984), the organization is a reflection of its top managers whose beliefs have a decisive impact on strategic orientation (Chaganti and Sambharya, 1987), innovation (Bantel and Jackson, 1989; Adamides *et al.*, 2003), diversification strategies (Song, 1982), decision-making processes (Melone, 1994), quality of decisions (Hitt and Tyler, 1991; Barr and Huff, 1997), timing of strategic responses (Barr and Huff, 1997), amount of risk taking (Schwenk, 1984), as well as on the coordination of strategic choices and activities (Walsh *et al*., 1988). The factors and processes that shape executives' beliefs include executive demographics (Finkelstein and Hambrick, 1990), functional position and professional background (Beyer *et al*., 1997; Chattopadhyay *et al*., 1999; Hodgkinson and Johnson, 1994; Bowman and Daniels, 1995), peer-assigned roles and performance metrics (Tetlock, 1983) and organizational issues such as size, structure, strategy and (recent) financial success (Barr and Huff, 1997; Schwarz, 2003). Moreover, strategic processes per se influence executive beliefs in the same way that their outcome is influenced by them (Chattopadhyay *et al*., 1999; Weick, 1995). In knowledge management terms, different perceptions/beliefs are the result of managers' association with different sources of principally tacit, cultural and, to a lesser extent, codified, knowledge.

Although the more diverse the perspectives in the strategy process, the greater the potential for knowledge creation and the smaller the chances of addressing the wrong issue and achieving an inadequate outcome (Hogarth, 1987), this diversity is an obstacle towards achieving an outcome efficiently. To synthesize different world-views and their associated models in a productive and effective way, the concept of methodology comes into play. In the design of such a methodology, not only the outcome of the collaborative process is of concern, but also the long-term effects of the (repeated) execution of the process itself. In addition to efficiently achieving an action programme, the collaborative issue resolution process should lead to team learning and organizational knowledge creation. Towards this end, the use of a structured modelling formalism acts as a common language, increasing the productivity of the process and facilitating efficient knowledge integration (Grant, 1996). The model of the problematic situation acts as a medium through which tacit, codified and cultural knowledge is externalized and recombined through focused dialoguing. In addition to providing a common basis for dialoguing, by formalizing views in a consistent way the model can act as a vehicle for capturing the 'why' of tacit knowledge which, in contrast to the 'what' and 'how', is difficult to extract. Humans have an inability to think in terms of complex causal relationships that may be responsible for the problematic situation, and they cannot envision the full consequences of their interventions, which may extend to distant organizational contexts. What can overcome this problem is a methodology that supports the collaborative construction and evaluation of a cause–effect model of the issue and the proposed interventions. Towards this end, collaborative modelling processes are focused on synthesizing mental models and contexts, rather than on compromising the different views of the participants.

Various participative model-building methodologies have been proposed, most of them originating from the systems discipline (Flood and Jackson, 1991). They include Soft Systems Methodology (Checkland and Scholes, 1990), which uses human activity system models, SODA (Eden and Ackermann, 1998), which relies on cognitive mapping, and system dynamics group model building (Vennix, 1996). These are essentially synchronous and facilitated methodologies, implemented in workshop-like settings, lacking a formal dialectic-logic basis for argumentation and conflict resolution with respect to both the problem and the solution. In addition, seen from a knowledge construction perspective, one can argue that they are too stimulus–response oriented and facilitator dominated. They do not provide the means for individual participants to articulate their own *complete* and *integrated* interpretations of what they see as the issue and its solution, i.e. to express different perspectives of the entire issue. Nor do they provide participants with the means to include argumentation about their views in a transparent, consistent and complete manner. Furthermore, they exhibit an 'urgency' for the integration of the different perspectives into a single problem/solution model, on which the whole discussion is then focused.

In practice, strategy formulation is a process that is initiated by a specific idea or proposal on a specific or a more generic issue, and continues with the exploration of alternative ideas and proposals, before it focuses on the exploitation of the most appropriate of them. Empirical evidence shows that in strategy formulation by teams there is an interplay between social and knowledge processes (Schwarz, 2003). Groups-within-groups of managers with similar views can emerge at any instance. The group with the most persuasive idea or solution attracts a critical mass of supporters which argue in its favour. Other groups/views attract less support and more opinions against their proposals. In this way, as social processes result in the formation of groups, knowledge is clustered around specific ideas, solutions or views.

From the above, it is apparent that a methodology that allows many different problem–solution models to be under construction and evaluation at the same time supports both the knowledge integration and the strategy process social dynamics in a more complete manner. In practice, such methodology can be realized only if it is supported by the appropriate information technology. Similarly, information technology infrastructure is required to support teams with members in different physical places, as well as for guaranteeing the continuity of a strategy process that is not confined within specific time limits. Asynchronous processes allow participants to formulate their models and arguments more precisely and to provide supporting evidence of higher quality (as they have more time to research the issue and provide more evidence for supporting or defeating specific views).

THE G-MoBSA METHODOLOGY

General features and process

G-MoBSA is essentially a systems methodology (Checkland, 1981; Flood and Jackson, 1991) enriched with argumentation to provide the interaction mechanisms needed to make a structure (model) (Giddens, 1984; Meyers and Seibold, 1989). The basic idea is that participants provide complete models/representations of the issue, as they understand it, with their proposed solutions supported by causal relationships, i.e. they express complete rationales for what they propose. Participant models are the result of individual sense making of the organization and its environment, which includes the outcomes of past strategic decisions. The models are subject to argumentation by all the team members. Gradually, in addition to providing their own situation–solution models (*positions* in the argumentation glossary), the other participants may enrich the existing models with further elements and/or links among the elements. The validity of each model is subject to argumentation at various levels (as a whole, in its supporting elements, or in specific links). As the validity of a model cannot be determined in a subjective manner, what can give a more objective indication is its *defensibility*, i.e. how well the proponent and other participants defend it.

The models proposed are shaped by the proponents' 'appreciative systems' (Vickers, 1983). Vickers distinguished human systems from natural and man-made systems by identifying judgment as the additional aspect of the former (Vickers, 1984). Judgment is an inherent attribute of decision making's three principal functions: noticing things about the situation (receiving information), evaluating the information (comparing to a 'standard') and acting on the interpretation (selecting a response). This was termed by Vickers as an appreciative system and the mental activity and social process of attaching meaning to perceived signals as appreciation. The appreciative system determines what facts to select from those related to the situation, the meaning that is given and the means that are used to fill the gap between existing and desired situations. The standards or criteria by which actions to be followed are judged are not given from outside. They are generated by the previous history of the system (past) and its interaction with the environment (culture).

This means that in the strategy formulation context managers set standards or norms subjectively (rather than objective measurable goals of Simon's rationalistic tradition (Checkland and Holwell, 1998) and they focus on managing relationships according to standards generated by their own culture, history and power status, and maintained through their self-reference attribute. The discussion and debate which leads to action is one in which those taking part make judgments about both 'what is the case' (reality judgments) and about its evaluation as 'good' or 'bad', 'satisfactory' or 'unsatisfactory' (appreciative judgments). Under this prism, strategy making can be thought of as social action based upon personal and collective sense making rather than a one-off task performed on the basis of objective scientific foundations.

For a firm to prosper, a shared appreciative system or a set of compatible appreciative systems that can turn information about events, relationships and expectations into effective decisions is required. Vickers (1984) distinguished seven overlapping and coexisting levels of shared appreciation, of which dialogue is the ultimate level corresponding to a state where people reason together (Bohm, 1996). The modelling formalism presented in the following section explicitly supports the making and representation of judgments, whereas the G-MoBSA methodology promotes dialoguing for developing a shared appreciative system.

To overcome the problem of knowledge–power distribution (Flood and Jackson, 1991), the implementation of Knowledge Breeder promotes the attachment of objective codified knowledge (in the form of fact-supporting data) to the models under consideration. Conflict resolution is through formal argumentation rules. In addition to collaborative model creation, argumentation is a social construction methodology that provides structure and outcome to dialoguing, thus placing group interaction at the centre of knowledge acquisition

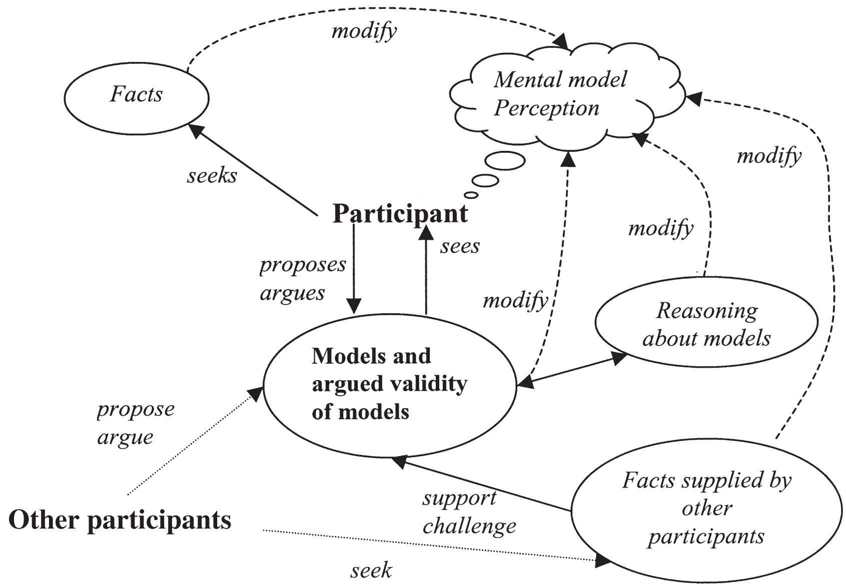

Figure 1 Model and perception convergence in G-MoBSA

(Metcalfe, 2002). The defensibility of each model is determined as a guide to its validity, which leads to its eventual selection.

The process of mental model adjustment and knowledge creation is shown in Figure 1. On the basis of their own perception of the issue, each team member can construct and propose a model of the problem and its solution using the language of the problem–solution modelling formalism. As participants have access to the whole set of models proposed, they each may adjust their mental models and contribute to the construction of models accordingly. Both the model per se (completeness) and its defensibility (fact-supported argumentation) can change a participant's perception. At the same time, the participant seeks facts/information to further support their proposed model, which may have the indirect effect of reviewing their own perception and knowledge base (Figure 1). The same modification processes take place with respect to the mental models of the other participants. As a result, mental models are converging around specific models and some of the models attract more attention concentrating the argumentation on them. Normally, the model that is best supported by facts and attracts the favourable views of the community is finally selected. In this way, G-MoBSA aligns the model-building process with the social dynamics of the team involved in the resolution of the issue.

In general, in a group modelling session, a group member participates in four distinct activities with respect to the model: *construction* of the model, *presentation and understanding* of the model, *critique* to the model and *intervention* on the model. Model construction is synonymous with the externalization phase of knowledge construction (Nonaka and Takeuchi, 1995). The model construction activity involves an intensive interaction between the modeller's world and its knowledge base on one hand, and the context on the other. It is a process of knowledge transformation from more tacit to more codified forms. In trying to codify, pieces of knowledge are critically reviewed, associated and receive new meaning. The development of a model by a single participant allows each of them to organize their knowledge base and arguments in a more complete and consistent way. The construction of the model indirectly defines the space of possibilities that the participant sees and is a proposal for action.

Model presentation and understanding result in the reorganization of a participant's knowledge base. In trying to interpret another participant's model, someone either deletes elements and associations from its own knowledge, or strengthens their own views by associating different facts and different (new) meanings. This is a more personal and tacit process (knowledge internalization) compared to the critique and intervention activities that involve, as in model construction, externalization of knowledge.

The G-MoBSA modelling formalism

Figure 2 shows the basic structure of the modelling formalism used in G-MoBSA. It consists of seven parts: *problem definition, causes of the problem, symptoms, solution, justification* of the solution with respect to the roots of the problem and its

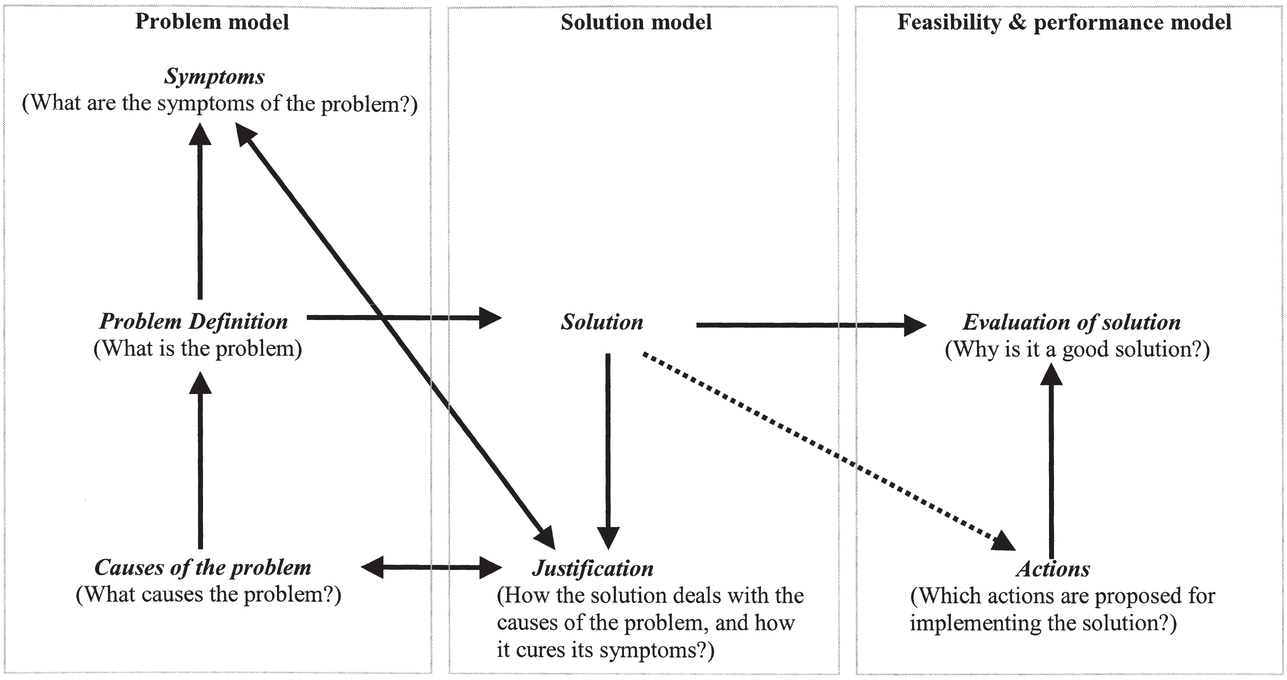

Figure 2 The basic G-MoBSA modelling formalism

symptoms, *evaluation of solution* and proposed *actions*.

In problem definition, a participant's perception of what constitutes the problem is asserted. The section for the causes of the problem provides participants with a template to answer the question 'why this is the problem'. The reasons that cause the problem can be described in a hierarchical cause–effect manner. Logical connections (e.g. '*A AND B cause C*') can be inserted and are used for argumentation and conflict resolution. In the symptoms section, the results of the existence of the problem (again, as they are seen through the specific participant's eyes) are defined in the same hierarchical cause–effect manner. In the solution proposal clause, the proposed solution is briefly defined, while justification provides the proponent with the means to argue why the proposed solution cures the causes of the problem and, directly or indirectly, eliminates its symptoms. Attached to the proposed solution is its evaluation, which allows the proponent to argue why the proposed solution is a feasible and effective one. Finally, proponents can insert a set of proposed actions to justify their evaluation with respect to them. In the framework of appreciative systems, the three first parts of the model can stimulate and represent a judgment of *what is* based on notions of cause–effect and beliefs, the next two an assessment of *what might be, could be* or *should be* based on self-interest, moral constraints and individual and group goals, and the last two, the means for getting from what is to what could or should be, given the constraints of available resources. As a whole, the modelling formalism provides the means for expressing complete arguments on *what* constitutes the problem, *why* this is the problem, and *how* the proposed solution cures it in the most suitable way for the company.

The argumentation schema

Although different argumentation schemata can be used, the current implementation of G-MoBSA relies on the logical propedeutic of the Erlangen school (van Eemeren *et al*., 1996). In our methodology, complete arguments are represented by means of simple statements related by logical connectives (operators). The logical connectives used are confined to: AND (conjunction), OR (disjunction), IF ... THEN (implication) and NOT (negation). The argumentation schema provides the rules for conducting the dialogue among participants and resolving conflicts, i.e. it indicates which argument or clause holds and which is defeated.

More specifically, the *starting rule* indicates that the participant who asserts a complete model (thesis) is the *proponent* who starts the dialogue. Participants who defend elements of the model are the *opponents*, while participants who support statement are the *supporters*. In a specific dialogue instance, a supporter may become proponent as a different participant challenges their argument. There is no predefined priority rule as far as the assertion of positions is concerned. The *general dialogue rule* indicates that, at any instance, a proponent can attack one of the statements put forward by an opponent or defend themselves against an opponent's attack. The opponent, in turn, can attack the statement made by the proponent in a preceding move or defend themselves against the proponent's attack in the preceding move.

The structure of the models implies that the *winning rules* focus on combined statements (elementary statements connected by logical connectives), rather than on simple assertions. Consequently, *ultimate victory* results from the successful defence of elementary statements on which argumentation has been exercised. The specific winning rules are:

- If a node in the model is supported by two or more statements connected with the AND operator, then an opponent may argue against this statement by attacking the supporting elements individually. If the proponent of the model can defend the attacks on the supporting statements, the model is considered to be defensible (*holds*). Otherwise, this part of the model, including any reasoning based on it, is *in doubt*.
- If an argument is composed of two statements connected with an OR operator, then an opponent may attack the whole statement at once. The defender has two chances to defend the argument, corresponding to the two constituent parts of it (three if the argument consists of three statements, and so on). Depending on the outcome of the conflict (defended or not fully defended argument), the supported argument may be declared as defensible or in doubt.
- If a participant attacks an argument based on the implication relation, then they are obliged to provide either a different cause or a different effect/implication. This provides the main reason for supplying a different model of the problem and/or solution. The defender may defend the cause or the result of the implication.
- Finally, if the proponent of a negative thesis is challenged, the opponent has to assert that the argument holds. If the proponent succeeds in defending the negation, the argument is considered as defensible. Otherwise, it is in doubt.

Information technology support: the Knowledge Breeder environment

In G-MoBSA methodology, the different stages of the model-building and selection process are not executed in a linear mode, but every time a member of the community interacts with the shared modelling space the thread of the execution of the methodology moves there. This is facilitated through Knowledge Breeder, an IS framework operating on the web. The kernel of Knowledge Breeder is the model base that stores the models under discussion and models of terminated discussions. Models are stored hierarchically, on the basis of the hierarchy of the issues addressed. Managers can upload the current issues under consideration in which they are involved, see the current state of the dialogue and contribute accordingly. The inference engine of the tool determines the defensibility of each model, at any instance in the resolution process, by taking into account the structure of the model, the arguments placed and the argumentation rules.

The interface of Knowledge Breeder is in hypertextual form with menus associated with the features provided and buttons serving folding and unfolding purposes. As was observed during the evaluation phase in a software company that develops simulation systems, this results in easier asynchronous interaction (complex graphs are more difficult to be understood by participants involved in the discussion asynchronously).

Knowledge Breeder was initially used over an issue of technology strategy for sustaining the growth of the company. The team formed to deal with the issue was exposed to all the functionalities of the system. However, it initially used the system as a groupware application for broadcasting opinions and views. Exchange of arguments and more thorough discussions were taking place in face-to-face meetings. It was only the persistence of a senior technical executive in discussing the issue solely through Knowledge Breeder that pulled other group members into using the system for problem structuring and resolution. In addition, the partnering of the company with a research group in France led to the use of additional system features and to the increase of its overall credibility within the company. The sample session described in the following section refers to the same company and the same issue.

A SAMPLE SESSION OF USING KNOWLEDGE BREEDER IN THE STRATEGY PROCESS

It is clear that the G-MoBSA methodology supports a strategy development process that simultaneously considers both the outside-in (positioning) and inside-out (resources and capabilities) perspectives of strategy development. The modelling formalism guides managers to consider the firm's capabilities and resources with respect to the requirements of the external environment.

In the sample session presented, a group of managers of the case company are engaged in a discussion over the growth of their company. Figure 3 shows the problem–solution model proposed by the company's CTO. In his view, 'Limited growth' (the upper-level *symptom*) is the result of 'Cost-leadership strategies' (lower level *symptom*) which, in turn, is the result of 'Market saturation' caused by all the competitors offering products with the 'Same product functionality', addressing the 'Same application (domains)', and by adding on their products the 'Same services' (lower level *symptoms*). In his view, these are the results of the 'Technological homogeneity' of all competitors (the *problem*). For the CTO, the problem is caused by 'Similar interface technology' AND 'Same technology in simulation engine', which are both the result of the use of the 'Same modelling paradigm (discrete-event)'. The latter constitutes the principal *cause* (root) of the problem. As a *solution* to the problem, he proposes the adoption of 'New product technology: Agent-Based Simulation'. He *justifies* his proposal by linking it to the root of the problem ('It is a new modelling paradigm', which 'refers to id: 1.c2'). In this way, the system infers that his model is complete, as far as the problem–solution relationship is concerned. To accomplish this task, Knowledge Breeder uses the structure of the

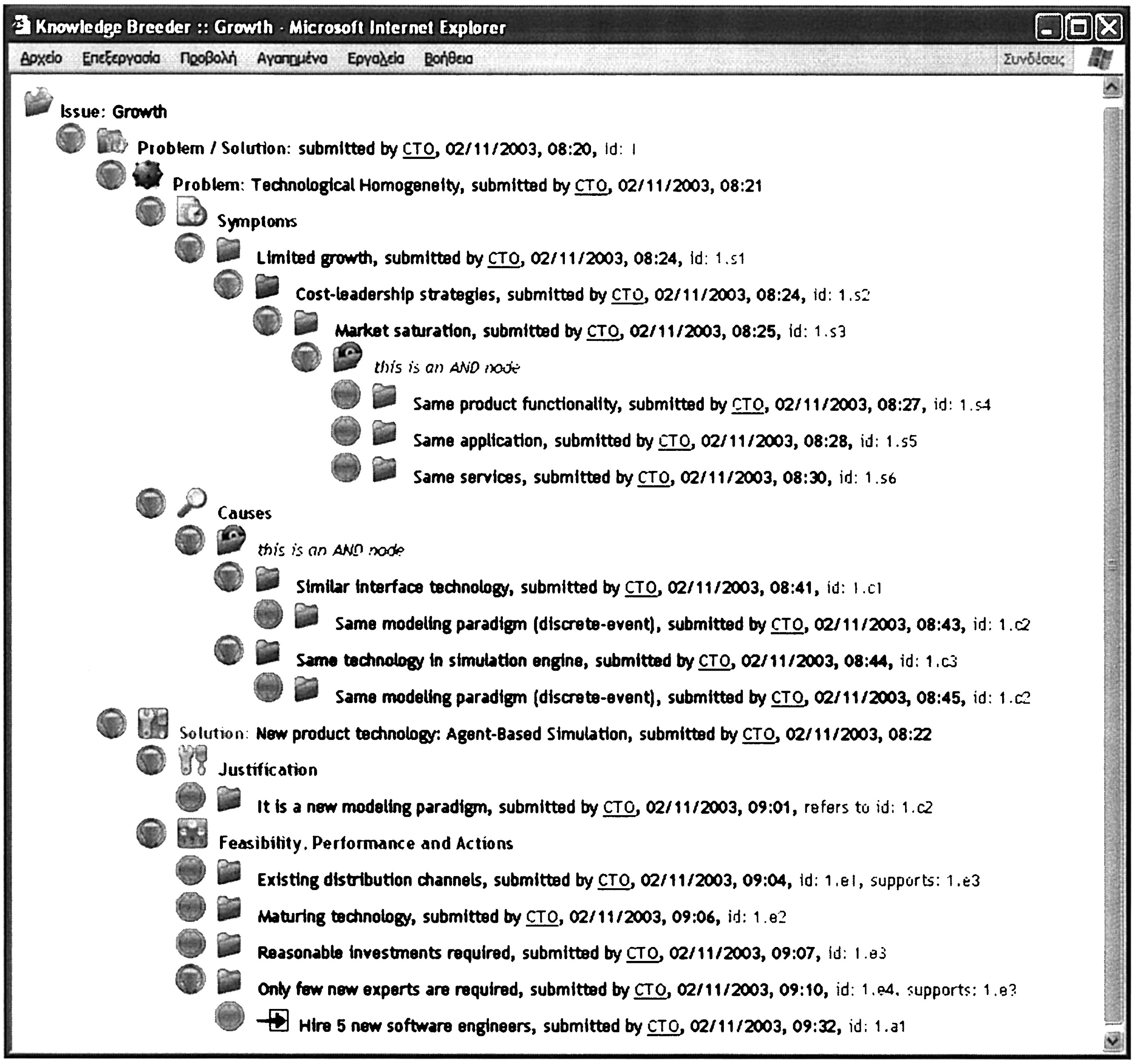

Figure 3 A view of a participant's model

proposed model and the *implication* relationships that hold between elements in succeeding levels. In the specific example, by having the proponent indicate that the solution defies the clause 'Same modelling paradigm (discrete-event)', the system infers that the problem does not exist any more, since the cause of technological homogeneity in the simulation engines and the graphical interfaces has been eliminated. In addition, in the *Feasibility, Performance and Actions* part of the model, the proponent provides reasons why he thinks this solution is a feasible and good one (e.g., 'Existing distribution channels', 'Maturing technology'). To make his evaluation more concrete, he indicates specific *actions*. For instance, he estimates and proposes to the company to 'Hire 5 new software engineers' (which particularizes his conclusion that 'Only few new experts are required'). He also indicates relationships holding among the elements of this part of the model. For instance, by providing the links 'supports: 1.e3' to the appropriate statements ('Existing distribution channels' and 'Only few new experts are required'), he further justifies his evaluation that the adoption of the new modelling paradigm requires reasonable investment.

Knowledge Breeder provides to each participant interested in placing a model for consideration a template structured on the basis of the G-MoBSA modelling formalism. By selecting the specific model section, the system prompts for inputting model elements/statements. In turn, by selecting a statement, the user can input elements that support it further. By clicking on each statement, a proponent can provide additional information in a free-text form or through links to web pages and documents (this is achieved through a pop-up window). The construction of individual statements and their associations is facilitated through dynamic interfaces.

Figure 4 shows another instance of the same model, which includes additional arguments placed during the discussion. One can observe the agreeing and re-enforcing argument of the Services Manager with respect to the homogeneity in services ('All competitors offer training, support hotline etc.') and the attacking argumentation of the Senior Project Manager that indirectly prompts participants to his own argumentation/model. This participant criticizes the model by first placing an additional element ('Same modelling process') in the *causes* section, asserting that this is the principal reason for the (same) problem. In addition, he asserts that the symptom 'Market saturation' is also the result of his view of the problem ('Support same modelling process'). Then, he argues that the proposed model's solution does not take this fact into account ('But what about same modelling process?') and prompts participants to his own proposition ('consider: 2'). At this stage, since 'Same modelling process' is under an AND connective, using the predefined conflict resolution rules the system infers that the whole model is in doubt. The result of the insertion of an argument under an OR connective would have been different, as the parts of the model rooted in both operands of an OR relation may be considered independently as holding or in doubt. To defend the model, the proponent (or any other participant) has to defy the arguments of the Senior Project Manager by providing opposition. Alternatively, the argumentation of the Senior Project Manager may result in the strategy team (including the proponent of the first model) concentrating on his model, or on other participants' models that deal with the same issue.

Positions asserted as models are evaluated with respect to their defensibility (validity in relation to the shared understanding of the strategy formulating team). The defensibility of each model is a qualitative and indicative measure summarized at any instance in the discussion, in the form presented in Figure 5 (after eight rounds of argumentation). There, participants can see which models, parts of models, or arguments are in doubt. By clicking on specific parts of the models, participants can see details of the argumentation, as well as more detailed statistics, e.g. the number of attacks on an argument, the number of successful defences, replies, etc. Of course, it is up to the participants' own judgment to make the final selection.

CONCLUSIONS AND FURTHER WORK

Strategic problems cross the boundaries of a single function and can only be solved by exploiting the collective knowledge and experience through an apparent process of constructive discussion and collaboration among the parties involved. As knowledge and experience reside in a diverse set of organizational assets including employees, structure, culture and processes, a consistent approach for synthetic, problem-specific use of tacit and codified knowledge for decision making is necessary.

Having this in mind, in this paper we have considered the strategy process from both the social dynamics and the knowledge management perspectives. We argued that a process of collaborative development and evaluation of a set of issue models, which follows the dynamics of a strategy team, facilitates knowledge elicitation, recombination and diffusion in a more consistent and productive

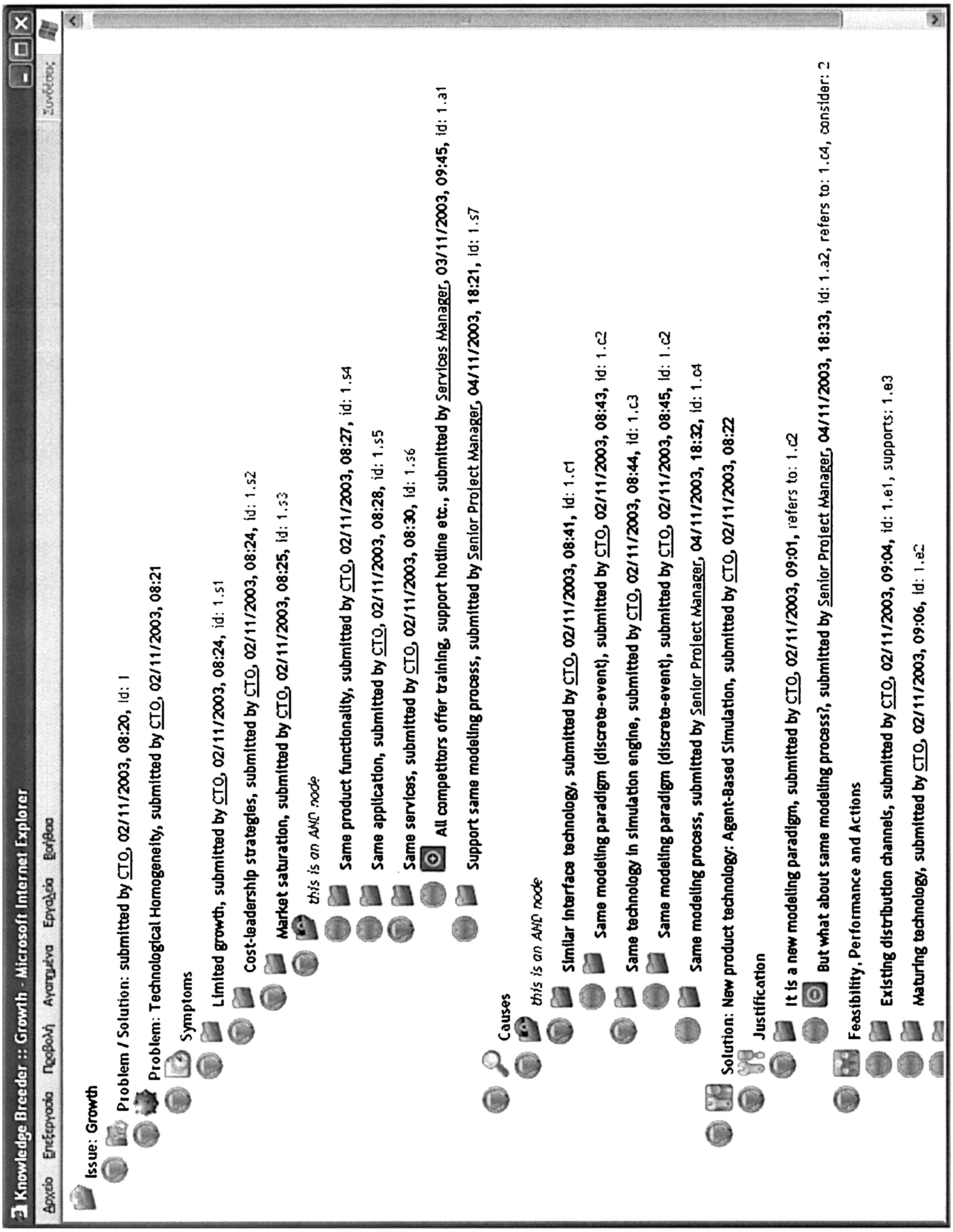

Figure 4 Another instance of the same model with additional argumentation

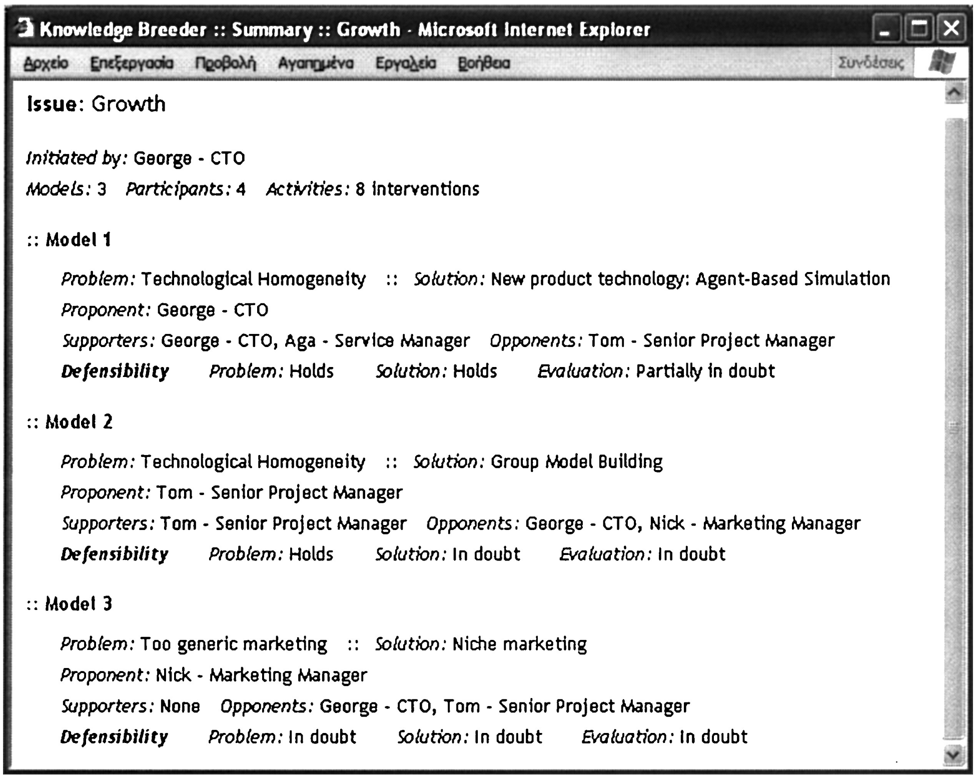

Figure 5 Summary information for the issue under consideration

way. Towards this end, we have described a novel methodology for accomplishing the above process. The G-MoBSA methodology views issue resolution as a co-evolution of the issue models with the shared understanding and knowledge of the team. The core of the methodology consists of a problem–solution modelling formalism for providing consistent views of the issue and a formal argumentation schema for conducting the dialogue among team members.

In addition, we presented Knowledge Breeder, a software tool that implements this methodology over the web. Knowledge Breeder provides the mechanisms for the participants' interaction and argumentation, and gives suggestions over the collectively perceived defensibility/validity of the models. The tool has been evaluated in the strategy development process of a software company in Greece. During its evaluation phase, modifications regarding the exact structure of the modelling formalism and its interface to the managers/users were accomplished. There was a consensus among users that Knowledge Breeder enhances team learning and provides an efficient environment for strategic dialoguing. Current efforts of the development team are directed towards integrating system dynamics simulation features, as well as developing a more focused version that fully supports the innovation and product development process.

REFERENCES

Adamides ED, Stamboulis Y, Kanellopoulos V. 2003. Economic integration and strategic change: the role of managers' mental models. *Strategic Change* **12**(2): 69–82.

Bantel KA, Jackson SE. 1989. Top management and innovations in banking: does the composition of the top team make a difference? *Strategic Management Journal, Summer Special Issue* **10**: 107–124.

Barr PS, Huff AS. 1997. Seeing isn't believing: understanding diversity in the timing of strategic response. *Journal of Management Studies* **34**(3): 337–370.

Beyer J, Chattopadhyay P, George E, Glick WH, Ogilvie D, Pugliese D. 1997. The selective perception of managers revisited. *Academy of Management Journal* **40**: 716–737.

Bohm D. 1996. *On Dialogue*. Routledge: London.

Bowman C, Daniels K. 1995. The influence of functional experience on perceptions of strategic priorities. *British Journal of Management* **6**: 157–167.

Buckingham Shum S, Hammond N. 1994. Argumentation based design rationale: what use at what cost? *International Journal of Human–Computer Studies* **40**(4): 603–652.

Chaganti R, Sambharya R. 1987. Strategic orientation and characteristics of upper management. *Strategic Management Journal* **8**(4): 393–401.

Chattopadhyay P, Glick WH, Miller CC, Huber GP. 1999. Determinants of executive beliefs: comparing functional conditioning and social influence. *Strategic Management Journal* **20**: 763–789.
Checkland P. 1981. *Systems Thinking, Systems Practice*. Wiley: Chichester.
Checkland P, Scholes J. 1990. *Soft Systems Methodology in Action*. Wiley: Chichester.
Checkland P, Holwell S. 1998. *Information, Systems and Information Systems*. Wiley: Chichester.
Choo CW. 2002. Sense making, knowledge creation, and decision making: organizational knowing as emergent strategy. In *The Strategic Management of Intellectual Capital and Organizational Knowledge*, Choo CW, Bontis N (eds). Oxford University Press: Oxford; 79–88.
Conklin EJ, Begeman ML. 1987. gIBIS: a hypertext tool for team design deliberation. In *Proceedings of the Hypertext'89 Conference*. ACM Press: New York; 247–252.
Demsetz H. 1988. The theory of the firm revisited. *Journal of Law, Economics and Organization* **4**: 141–163.
Eden C, Ackermann F. 1998. *Making Strategy: The Journey of Strategic Management*. Sage: London.
Finkelstein S, Hambrick DC. 1990. Top management team tenure and organizational outcomes: the moderating role of managerial discretion. *Administrative Science Quarterly* **35**: 484–503.
Fischer G, McCall R, Morch A. 1989. JANUS: integrating hypertext with a knowledge-based design environment. In *Proceedings of the Hypertext'89 Conference*. ACM Press: New York; 105–117.
Flood RL, Jackson MC. 1991. *Creative Problem Solving: Total Systems Intervention*. Wiley: Chichester.
Giddens A. 1984. *The Constitution of Society*. Berkeley University Press: Berkeley, CA.
Grant RM. 1996. Prospering in dynamically competitive environments: organizational capability as knowledge integration. *Organization Science* **7**: 375–387.
Hambrick DC, Mason PA. 1984. Upper echelons: the organization as a reflection of its top managers. *Academy of Management Review* **9**: 193–206.
Hitt MA, Tyler B. 1991. Strategic decision models: integrating different perspectives. *Strategic Management Journal* **12**(5): 327–351.
Hodgkinson G, Jonhson J. 1994. Exploring the mental models of competitive strategists: the case for a processual approach. *Journal of Management Studies* **31**: 425–448.
Hogarth R. 1987. *Judgment and Choice* (2nd edn). Wiley: Chichester.
Karacapilidis N, Papadias D. 2001. Computer supported argumentation and collaborative decision making: the HERMES system. *Information Systems* **26**: 259–277.
Kogut B, Zander U. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science* **3**: 383–397.
Lee J. 1990. SIBYL: a tool for managing group decision rationale. In *Proceedings of the CSCW'90 Conference*. ACM Press: New York; 79–92.
Melone NP. 1994. Reasoning in the executive suite: the influence of role/experience-based expertise on decision processes of corporate executives. *Organization Science* **5**: 438–455.
Metcalfe M. 2002. Argumentative systems for IS design. *Information Technology and People* **15**(1): 60–73.
Meyers RA, Seibold DR. 1989. Perspectives on group argument. *Communications Yearbook* **14**: 268–302.
Mintzberg H, Waters JA. 1985. Of strategies deliberate and emergent. *Strategic Management Journal* **6**: 257–272.
Mitroff II, Linstone HA. 1993. *The Unbounded Mind*. Oxford University Press: Oxford.
Nonaka I, Takeuchi H. 1995. *The Knowledge-Creating Company*. Oxford University Press: Oxford.
Nonaka I, Toyama R. 2003. The knowledge-creating theory revisited: knowledge creation as a synthesizing process. *Knowledge Management Research and Practice* **1**(1): 2–10.
Schwarz M. 2003. A multilevel analysis of the strategic decision process and the evolution of shared beliefs. In *Strategy Process: Shaping the Contours of the Field*, Chakravarthy B, Mueller-Stewens G, Loramge P, Lechner C (eds). Blackwell: Oxford; 110–136.
Schwenk CR. 1984. Cognitive simplification processes in strategic decision-making. *Strategic Management Journal* **5**: 11–128.
Song I. 1982. Diversification strategies and the experience of top executives in large firms. *Strategic Management Journal* **3**(4): 377–380.
Tetlock P. 1983. Accountability and complexity of thought. *Journal of Personality and Social Psychology* **45**: 74–83.
van Eemeren FH, Grootendorst R, Henkemans FS, Blair JA, Johnson RH, Krabbe ECW, Plantin C, Walton DN, Willard CA, Woods J, Zarefsky D. 1996. *Fundamentals of Argumentation Theory*. Erlbaum: Mahwah, NJ.
Vennix JAM. 1996. *Group Model Building: Facilitating Team Learning Using System Dynamics*. Wiley: Chichester.
Vickers G. 1983. *The Art of Judgment*. Harper & Row: London.
Vickers G. 1984. *Human Systems are Different*. Harper & Row: London.
Vinokur A, Burnstein E. 1974. Effects of partially shared persuasive arguments on group induced shifts: a group problem solving approach. *Journal of Personality and Social Psychology* **29**: 305–315.
Walsh J, Henderson C, Deighton J. 1988. Negotiated belief structures and decision performance: an empirical investigation. *Organizational Behavior and Human Decision Processes* **42**: 194–216.
Weick K. 1995. *Sensemaking in Organizations*. Sage: Thousand Oaks, CA.
Wilson B. 2001. *Soft Systems Methodology: Conceptual Model Building and its Contribution*. Wiley: Chichester.