ELSEVIER

Improving decision-making with scenario planning

Thomas J. Chermack*

University of Minnesota, 1954 Buford Avenue, Suite 425c, Saint Paul, MN 55105, USA

Abstract

Decision makers struggle with four important contributors to decision failure, namely, 1) bounded rationality, 2) a tendency to consider only external variables, 3) the stickiness and friction of information and knowledge, and 4) mental models that include decision premises or policies. Whether independent or combined, these decision problems can form the ultimate in decision error—folly. The four problems in decision-making are reviewed in detail and scenario planning is posited as a tool for preventing the impact of each, ultimately with an aim of avoiding folly.
© 2003 Elsevier Ltd. All rights reserved.

1. Introduction

The purposes of this paper are 1) to provide a summary and introduction of the key issues prevalent in the decision sciences, and 2) to posit that scenario planning might aid in avoiding decision error in complex processes. Therefore, this article intends to expose the *conceptual* link between scenario planning and decision-making. While there appears to be a lack of research about scenario planning in general [3,17], the argument presented in this manuscript may provide the conceptual basis for constructing research questions that address some aspects of this lack.

Schwartz [22] revealed that a core espoused outcome of scenario planning is the improvement of organizational leaders' decision-making capabilities. Given this intended outcome, decision theory is useful to the scenario planning professional; however, current scenario planning literature does not reflect this importance. This paper explores the core problems that present themselves in dynamic

* Fax: +1-612-387-1951.
  E-mail address: tjcher@aol.com (T.J. Chermack).

decision-making processes and outlines the use of scenarios in potentially decreasing unexpected decision failure.

Of particular interest in this paper is the notion of folly. While folly will be described in depth as this paper unfolds, the basic premise of folly is that an erroneous course of action is maintained through poor decisions even though the negative effects are realized and avoidable. Random consulting activity in the name of corporate profits and billable hours is one example of folly that continuously appears in management consulting [12,26]. Further, training and organization development interventions without sound analysis and that lack comprehensive evaluation measures are another contribution to folly in organizations. It is a core argument in this paper that managers can reap benefits from the detailed and precise research in the cognitive sciences around decision-making by applying and exploring the principles and theories of decision-making in their practice.

2. The problem of decision failure

Decision failures are inevitable. Decision failures occur in two overarching categories: 1) simple explainable error or mistake (the decision-maker forgot to do something, became physically ill, or unable to make the decision) and 2) something unusual happens, the cognitive map is suddenly lost for some unexplainable reason [13]. This first category denotes the statistical necessity that *some* random error will occur—these are the inevitable errors. While this random error domain is not the focus of this inquiry, the fact that there will always be some natural error informs us that we had better spend at least *some* time in preparation for error recovery. The second category has fascinated decision theorists, psychologists, business leaders, and government policy analysts, among many others, and will be the focus of this inquiry. Decision failures that occur in this category are important because there is seemingly no logical explanation for the decision failure. Unexplainable or unexpected decision errors are almost always met with reactions like "how could this have happened?" which implies that the decision maker had produced high performance in what have appeared to be similar situations in the past.

There are four core interrelated causes for unexpected decision error, namely, 1) bounded rationality [15,25], 2) the tendency to consider only exogenous variables [18], 3) stickiness and friction of information and knowledge [7], and 4) mental models with decision premises [9,10,34]. Each of these decision problems will be explored in detail and then it will be argued that scenarios and scenario planning have the potential to address all four of these core causes of unexpected decision error.

3. Dynamic decision-making

Decisions do not occur in a vacuum. Decisions must be made in dynamic and increasingly rapidly changing environments. Brehmer [1,2] suggested that decisions

in applied contexts differ from the traditional cognitive decisions studied by psychologists in the following four ways:

1. There are a series of decisions rather than a single decision.
2. The decisions are interdependent—current decisions constrain future decisions.
3. The environment changes autonomously and as a result of decisions made.
4. It is insufficient for the correct decisions to be made in the correct order—they must also be made at a precise moment in real time.

These four criteria reflect the complex and dynamic nature of the business environment in which decisions must occur. Research conducted by both Brehmer [2] and Dorner [6] has shown that in dynamic contexts, human decision-making results in remarkably common failure. The conceptual model displayed in Fig. 1
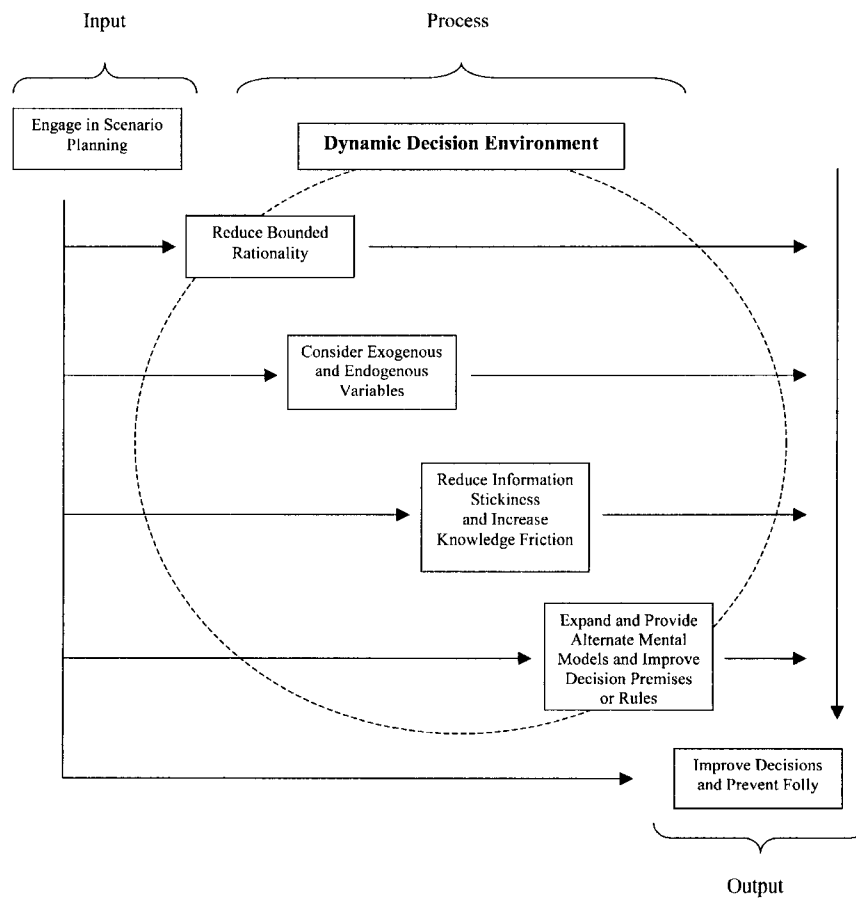

Fig. 1. Conceptual model of improved decision-making through scenario planning.

depicts a system of scenario planning addressing these core interrelated causes of decision error and failure within this kind of a decision-making context. With such a decision environment established, the four core causes of decision failure can be considered.

3.1. Bounded rationality

Bounded rationality is one main source of decision failure. Put simply, there are limitations on the mental abilities of human decision makers. Morecroft [15] outlined the notion of bounded rationality as developed by the "Carnegie School of Thought", a pioneering research foundation for decision-making. Bounded rationality is defined as "the severe limitations on the information processing and computing abilities of human decision makers" [15, p. 133], and according to Simon [25] bounded rationality is a property of decision-making that inhibits objectively rational decisions because: 1) all feasible alternative courses of action cannot be generated by the individual, 2) individuals cannot collect and process the information that would predict the consequences of an alternative, and 3) individuals cannot accurately asses the values of anticipated consequences. This simply means that humans cannot effectively cope will all of the available information and alternatives in making decisions. Further, bounded rationality predicts that three main features will be present in human organizations:

1. Factored decision-making—decision-making will be broken down into sub-decisions for sub-groups.
2. Partial and certain information—research shows that ultimately, "decisions are made on relatively few sources of information that are readily available and low in uncertainty" [16, p. 133].
3. Rules of thumb—rules of thumb, or heuristics are built up over time and through experience that make the gathering of information unnecessary.

3.2. Exogenous variables

Exogenous variables are variables that are external to the process under consideration. These variables come from outside the system and there has been a tendency for decision makers to think of all variables as exogenous. Primarily, this has been because these variables are easily recognizable as external and are not often hidden by being coupled to the system. Forrester [9] was among the first to take issue with a tendency for models (and therefore decisions) to incorporate only exogenous, or external variables. Forrester argued that some variables are actually coupled to the system and are embedded in the information feedback loops. These were referred to as endogenous variables. Endogenous variables are internal variables that are often produced in the feedback within the system and they then become coupled with the inputs to the system. Discussions around exogenous and endogenous variables included the notion that policies often have endogenous variables associated with them. Decisions that consider only exogenous variables,

therefore, overlook critical inputs to the system and decisions made without considering such variables have consequences that become magnified because of their association with feedback processes.

3.3. Stickiness and friction

Stickiness and friction are characteristics of information and knowledge, respectively. Generally the term stickiness refers to a characteristic of information and is associated with to cost of its transfer. Friction is a characteristic of knowledge that dampens motions in a social setting. Socialization itself causes a friction that catches minor errors before they can be magnified through feedback processes to a point at which they can cause a catastrophe. Stickiness, or the cost associated with transferring information causes a problem for decision makers when expertise is needed. With automation threatening to replace humans in many work and decision-related settings (thus eliminating social friction) a concern has emerged about potential increases in minor errors that lead to drastic decision failures.

3.3.1. Stickiness

Organizations are increasingly relying on knowledge intensive processes managed and operated by interdisciplinary teams [8]. Stickiness refers to the difficulty in information transfer between or among people. Von Hippel [31] defined "stickiness" as "the incremental expenditure required to transfer that unit of information to a specified locus in a form useable by a given information seeker. When this cost is low, information stickiness is low; when it is high, stickiness is high" [31, p. 629]. Discussions of stickiness have included the simple recognition that there is a cost associated with the transfer of information, and second, in differentiating stickiness and friction [8]. That information becomes "sticky" is important in decision-making because often expertise or knowledge of a specific domain is required for decisions. For example, McKinsey consultants who are on call will fly anywhere in the world to make their expertise available are a result of the fact that knowledge becomes incredibly sticky and an example that the costs associated with transferring the information or knowledge can become quite high [13].

3.3.2. Friction

In social and political realms, "morals, ethics, knowledge, history and memory may all serve as the sources of 'social friction,' by which gross motions are damped, impetuous ones slowed and historical ones absorbed. Such friction is essential to prevent the persistence and multiplication of social and political movements once their driving force is removed" [20, p. 132]. Friction can be described as the nuances and double-checks that occur in the social interactions among humans in work processes, such as those found in the operation of an aircraft carrier flight deck [19,21,35]. Such double-checks only exist as a result of social interaction among multiple individuals. This friction would not exist if computer automation were to take over the launching and landing procedures aboard aircraft carriers. Authors such as Rochlin [20], Dreyfus and Dreyfus [7], and Von Hippel [31] argued that as technology threatens to replace many such human

processes, decision failure will increase because the loss of friction will allow many errors to continue that were previously prevented during the course of normal social interaction among the humans involved in the process.

Frictionless knowledge [7] would initially be more efficient, but would also allow for a drastic increase in decision errors. Dreyfus and Dreyfus [7] argued that their own model of novice, advanced beginner, competence, proficiency, and expertise provides the experiential elements required to reach the potential of true human intelligence. Frictionless knowledge would be knowledge that develops a "set of rules and principles that produce expert-quality performance in an entire domain of skill" [7, p. 284]. In this view, frictionless knowledge could be easily transferred to or among countless individuals, and it would not be sticky as there would be no cost in transferring the knowledge. However, Dreyfus and Dreyfus [7] argued for the necessity of the experience and thus, the build up of friction required for true expertise.

3.3.3. Expertise and necessary friction

Expertise *requires* friction. Rochlin [20] formulated the argument that with a push to replace many human workplace roles with automation, the reduction in friction will likely cause even more errors. Rochlin [20] was also referring to human expertise and the error prevention that occurs as a product of human socialization within the process. Rochlin [20] also differentiated between inertia and friction: "The distinction is critical: Inertia is a measure of the force that must be applied to get a bureau or other organization to initiate movement or change its direction, whereas friction is a measure of the energy required to keep the bureau moving, or inversely, the rate at which movement will decay once the energy for motion is removed" [20, p. 133]. Ultimately the argument presented by Rochlin [20] was that the social processes that managers deem inefficient and seek to eliminate create the very essential friction that give people the experience required to identify errors early on. With automation threatening to reduce friction to minimal levels, to roles of expertise and necessary friction show that friction serves a very important purpose. While at times friction can impede, or slow the decision process, faster decisions with increased instances of failure and error would not be a step in a productive, beneficial direction.

3.4. Mental models, cognitive maps, policies and decision premises

Mental models and cognitive maps are both extremely important to the decision process. For the purposes of this article, mental models and cognitive maps will be considered to mean generally the same thing, as they are highly conceptually related. While some have debated the nuances between these two concepts, they are both concepts that attempt to explain the way we frame our experiences in the world and from which we draw our assumptions about situations and alternatives [22,34]. Individuals include and exclude information based on their mental models and cognitive maps. Often, people make decisions based on nothing else [34]. Many have speculated that the key to improving decision-making lies in changing or altering current mental models and cognitive maps [6,23,34].

3.4.1. Mental models and cognitive maps

Mental models are more specifically the lenses through which we see the world. Mental models incorporate our biases, values, and beliefs about how the world works. Senge [23] defined mental models as "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action. Very often, we are not consciously aware of our mental models or the effects they have on our behavior" [23, p. 8].

Cognitive maps are highly related to mental models and emphasize spatial relatedness, classification, time, and are "a sketch to communicate a sense of place, some sense of here in relation to there" [36, p. 7]. Cognitive maps give people a means for identifying difference within their environments. Weick [34] argued that in a socially constructed world, (such as the manager's) maps *become* the territory. Thus cognitive maps in the managerial sense are ideas and conceptions about where we are, what we are doing, what is in our immediate path, and likely something about where we are headed in the long term.

3.4.2. Policies and decision premises

In this context, a policy is defined as "a formal statement giving the relationship between information inputs and resulting decision flows" [10, p. 58]. Policies, decision premises and decision rules are all terms that describe this same pheno menon. "Informal policy results from habit, conformity, social pressures, ingrained concepts of goals, awareness of power centers within the organization, and personal interest" [10, p. 58]. Decision policies, premises, or rules can be thought of as the guiding norms within the context that help individuals make decisions when they are uncertain about the information at hand, or the "best practices" that offer guidance. It is argued here that such policies, premises, or rules are developed according to the mental model in use as mental models house our biases, values, and beliefs about how the world works. Thus, to change or expand the decision rules, one must change the mental model.

3.5. Summary

Having reviewed these four core causes of unexpected decision failure, namely 1) bounded rationality 2) an emphasis on exogenous variables 3) stickiness and friction of information and knowledge and 4) mental models and cognitive maps with their corresponding decision premises or rules, we may now turn to the consideration that these contributions to decision failure can manifest themselves in their individual presence or in any number of combinations. A particularly disturbing domain of failure that often incorporates all four of these core causes of unexpected decision failure can be seen in folly.

4. Folly

Folly represents the ultimate in decision failure for groups of organizational leaders and often incorporates all four of the core causes of decision failure described

herein. Tuchman [28] described folly in the context of government and policy. She defined folly as a form of misgovernment as the pursuit by government of policies that are contrary to their own self-interests. For the purposes of this paper, the concept of folly is considered in organizational contexts (as if the executive team were a "government" of the organization pursuing policies that run contrary to organizational interests).

Tuchman [28] described three criteria for the presence of folly: 1) the policy must have been perceived as counter-productive in its own time, 2) a feasible alternative course of action must have been available, and 3) the appearance of folly is independent of era or locality. Some sources of folly include the assessment of a situation using fixed notions while rejecting any contrary signals, efforts to reinstate failed structures, cultural ignorance, and greed. Ultimately, folly lies in persisting with decisions and policies *after the negative consequences are revealed*, and folly is perhaps most commonly the result of a relentless pursuit of power [28]. Thus, the key and disturbing feature of folly is that decision-makers are aware of the negative impacts brought about by their decisions, yet they persist in erroneous decision-making.

Preventing folly is much more considerable task that it at first appears. Situations involving large numbers of constituents with excessively diverse problems across multiple arenas can lead to "protective stupidity" [28, p. 17] or the tendency to persist in erroneous courses of action and decisions. This is often because making decisions that do not satisfy the desires of certain groups within the constituency lead to unpopular favor and political struggles around positioning and popularity. Tuchman's [28] suggestion for preventing folly includes a concentration on individual leader character and integrity. While individual leadership development efforts may be one effective method for addressing folly, another is proposed here in scenario planning.

5. Scenarios and scenario planning

Scenarios have been defined as "a tool for ordering one's perceptions about alternative future environments in which one's decisions might be played out. Alternatively: a set of organized ways for us to dream effectively about our own future" [22, p. 4]. Scenario planning has been defined as "a process of positing several informed, plausible and imagined alternative future environments in which decisions about the future may be played out, for the purpose of changing current thinking, improving decision making, enhancing human and organization learning and improving performance" [5, p. 16]. Some key outputs of the scenario planning process are plausible alternative stories about the future, or scenarios, which are used as building blocks for designing *strategic conversations*—dialogue within the organization that leads to continuous organizational learning about key decisions and priorities [22].

Of importance is the distinction between *scenario planning* and *scenario building*. For the purposes of this paper, *scenario planning* is taken to indicate the over-

arching process of positing plausible alternative future environments and using these environments for learning, changing thinking or for testing or "wind-tunneling" [30, p. 57] executive decisions. *Scenario building* is taken to mean the process of constructing the stories themselves, as a component of the larger scenario planning process. In this section, scenario planning will be posited as a tool for 1) limiting bounded rationality 2) considering endogenous as well exogenous variables 3) reducing stickiness and making the best use of friction and 4) revealing, examining and altering mental models and their decision premises.

5.1. Scenarios and bounded rationality

Scenarios appear to have utility in reducing bounded rationality. Scenarios communicate a vast amount of information in a story. Research has shown that scenarios are effective because they are highly memorable, conversational, and narrative in nature [22,27,30]. "Cognitive science research tells us that *memorable* information is more likely to be acted upon than is information that remains unconscious and not retrieved from memory. Therefore, anything that tends to make information more memorable will have a greater likelihood of assuming significance" [27, p. 103]. This point explains the emphasis and importance placed on the selection of titles for developed scenarios. Schwartz [22] stated that: "if the names are vivid and memorable, the scenarios will have a much better chance of making their way into the decision-making and decision-implementing process across the company" (p. 248). Important information about the future is often too imprecise and complex for display in tables and graphs [22], and thus, stories have several advantages: 1) they provoke an openness to multiple perspectives 2) they aid in coping with complexity, and 3) they give meaning to events [11].

In an experiment testing consumer preferences, Stanford MBA students were asked to assess the persuasiveness of an advertisement from a California Winery [14]. Given a choice among numerical data from the winery's sales division, a policy statement about the winery's strict quality standards and a story about the founder of the winery and his procedures for delivering a quality product, results showed an overwhelming preference for the story precisely because it contained the same, or very similar data in a form that was easy to remember. While the use of stories in this context varies slightly from the use of scenarios in a planning context, some parallels can be drawn. For example, this research demonstrates the availability heuristic [29] that suggests an event made more available from memory will be more easily acted upon. In this sense, events made more available from memory through inclusion in a scenario can reduce the time required for managers or individuals to react to signals in the environment.

Scenarios might be helpful to decision-makers in coping with their own bounded rationality by providing a vast amount of information in a detailed story exhibiting features that are easily remembered. While scenarios can be helpful in addressing this core cause of decision failure, it should be acknowledged that bounded rationality, as a feature of being human, can never be completely solved. What is further required is a series of case studies, or research regarding the specific impact of

scenario planning on individual habits of information gathering, synthesis, and decision-making.

5.2. Scenarios and exogenous variables

There are a variety of scenario planning methods, and each of them differ slightly. However, all approaches advocate a systems view of the organization. The important link between scenario planning and systems theory has been outlined in detail [4,33]; the implications of which include the examination of internal and external elements of the system. van der Heijden's [30] approach to scenario planning begins with mapping the organization as a system in what he terms the business idea. Further, van der Heijden [30] suggested the use of interviews, internal analysis, teams, and remarkable people as methods for avoiding a focus solely on external forces.

Senge [23] has developed systems archetypes that are essentially common combinations of feedback loops that inhibit systems. The use of these archetypes as diagnosis tools forces scenario planners to consider system outputs that become system inputs—exogenous variables that become endogenous variables, addresses Forrester's [9] concern. The systems view incorporates the consideration of internal and external variables and focuses on how they interact to change the system.

5.3. Scenarios, stickiness, and friction

Scenario planning is posited as a tool for reducing the cost of information transfer and increasing the friction among knowledgeable organizational decision makers. By reducing the cost of information transfer, in theory, decisions can be made more effectively and efficiently. By increasing the friction among decision makers, small errors may be caught and perspectives can be added that might have otherwise been overlooked.

5.3.1. Scenarios and stickiness

Scenarios and scenario planning seem to address information stickiness by providing a forum for multiple individuals to develop similar expertise about the potentials of the organization. The strategic conversation [30] is one example of how developing a shared mental model, and thus a shared language, can reduce the stickiness of information within the organization. The process of creating a shared mental model facilitates the process of information transfer. By requiring frequent and intense interaction, scenario planning reduces the cost of information transfer, making information less sticky.

5.3.2. Scenarios and friction

Scenarios might further help decision-makers take full advantage of the necessary friction required for expertise in organizational decision-making. The process of scenario building requires intense interaction for extended periods of time among managers and executives involved in the decision-making process. Through this interaction and friction, important forces in the environment are often detected

that would not have been if a single decision-maker were attempting to construct scenarios individually.

In scenario planning, van der Heijden [30] makes use of "remarkable people" to provide yet even more friction. Remarkable people are "those experts who are not in regular contact with the client organization, such that an original contribution can be expected" (p. 185). Remarkable people often provide insight, prevent groupthink, help with information gathering and processing, increase the friction and interaction among planning team members and expand the rationality of the group [22].

5.4. Scenarios, mental models, cognitive maps, policies and decision premises

A core espoused aim of scenario planning is to reveal and alter the mental models of managers and decision makers in organizations [5,23,32]. Because of the link between mental models and decision premises, it is inevitable that altering mental models means altering decision premises, however, often this link is overlooked. In changing mental models, the scenario planning process intends to provide a more complete view of the world reveal the assumptions made by the decision maker. By providing a wider view of the world, decision premises can be altered to incorporate a longer time frame, and the consideration of more factors in more plausible future situations.

5.4.1. Scenarios and mental models

After becoming masters at designing technically magnificent scenarios planners at Royal Dutch/Shell realized that by focusing on the scenarios themselves, they were overlooking the core purpose of their work—to alter the mental models of the management teams for whom they were developing plans [24]. Thus, it can be argued that scenario projects that fail, may fail because client organizations do not have the mental model that allows them to comprehend uncertainty, or a serious threat to their organization. Therefore a core aim of scenario planning is to alter the mental models of managers.

van der Heijden developed a model of what he termed a strategic conversation: "An effective strategic conversation must incorporate a wide range of initially unstructured thoughts and views, and out of this create shared interpretations of the world in which the majority of the individual insights can find a logical place" [30, p. 42]. The strategic conversation creates the organizational dialogue through which individuals can reveal, analyze, share, and reconstruct their mental models, thus opening their minds to consider new possibilities. "If action is based on planning on the basis of a mental model, then institutional action must be based on a shared mental model. Only through a process of conversation can elements of observation and thought be structured and embedded in the accepted and shared organizational theories-in-use" [30, p. 41]. (see Fig. 2 for a model of the strategic conversation).
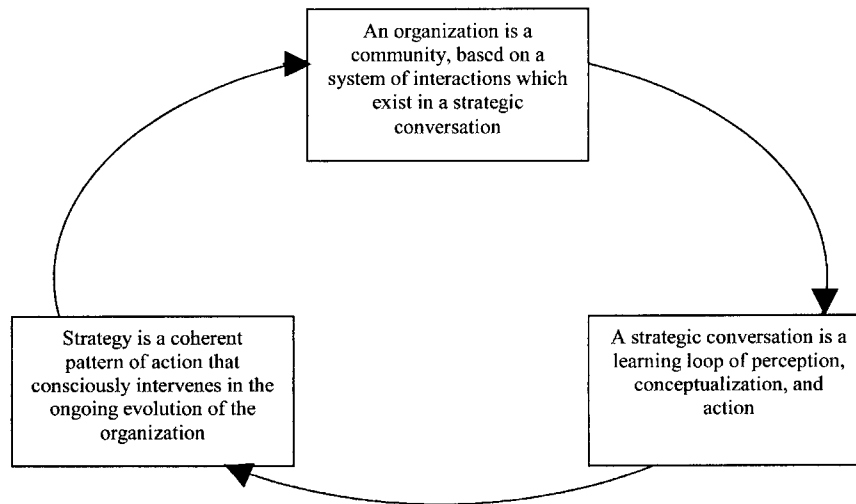
Fig. 2. The art of strategic conversation ([30] p. 274)

5.4.2. Scenarios and decision premises

Decision premises and policies are linked to mental models. Because premises and policies "result from habit, conformity, social pressures, ingrained concepts of goals, awareness of power centers within the organization, and personal interest" [10, p. 58], they can be changed through the alteration of mental models. The key idea with regard to decision premises is that through the expansion of mental models, guiding decision policies are revised to accommodate a more adequate view of the world and the system within which the individual is operating.

Scenarios may also provide a venue for testing new decision policies by manipulating forces and potential responses to them in an experimental environment. Decision-makers can play out the possibilities of given decision policies and examine their long term effects. Further, by creating shared mental models and a strategic conversation within the organization, policies undergo constant scrutiny, modification and adjustment to assure that they provide decision makers with an informed perspective when confronted with an uncertain situation.

6. Conclusions

Some key points and arguments presented in this paper are that scenarios and scenario planning have the potential to address four core causes of unexpected decision failure, namely, 1) bounded rationality, 2) the consideration of exogenous and endogenous variables, 3) information stickiness and knowledge friction, and 4) mental models and decision premises. Each of these components of decision failure has been examined a summarized for consideration by managers. These

contributors to decision failure have been examined in detail, and scenario planning has been explored as a potential means for limiting the impact of each.

By providing relevant information in a format that is easily accessible from memory, scenario planning addresses the issue of individual bounded rationality. The extent to which this issue is addressed by scenario planning is a difficult additional issue because bounded rationality can never be completely extinguished, however, research has shown that scenarios and stories are an effective means to provide information in a format that is easily recalled from memory.

Scenario planning requires a thorough examination of the forces an organization is dealing with and also those that the organization might potentially deal with. These forces and variables can be both internal and external. With an emphasis on system structure and the patterns that underlie events, scenario planning forces decision-makers to consider both exogenous and endogenous variables. Additionally, system theory and systems thinking are highly integrated in the scenario planning process [3] thus; internal variables that become inputs to organizational processes are often prioritized and highlighted in environmental analyses.

Scenario projects that fail, fail because client organizations do not have the mental model that allows them to comprehend uncertainty, or a serious threat to their organization, or they are busy applying mental models to problems that they do not fit. Therefore a core aim of the scenario planning process is to alter the mental models of managers. In doing so, scenario planning provides an increased capacity for individuals and groups in organizations to comprehend their environment.

The process of scenario building requires intense interaction for extended periods of time. The challenge becomes convincing management to invest the time and energy and not to rely solely on their instincts. Because of such lengthy and intense interaction, scenario planning addresses the issues of stickiness and friction of information and knowledge. Scenario planning decreases the stickiness of information by providing a forum for several individuals to engage in learning that can culminate in shared understandings. Scenario planning also increases friction by relying on social and group interactions to consider problems and potential solutions from multiple perspectives and mental models. An example of this can be seen in the use of "remarkable people" [30, p. 41].

This article has advocated for scenario planning in the context of decision-making processes with an aim of reducing decision failure. By preventing or reducing the impact of four core causes of unexpected decision failure, scenarios and scenario planning might further prevent folly and contribute to more effective decision-making capabilities. Long-term, thoughtful thinking in organizations is not an event and the concept of an ongoing strategic conversation and constantly evolving perspectives are essential to managing today's organizations.

A key acknowledgement considering the arguments in this paper is that, thus far, they are unsupported by evidence. There are numerous examples providing *anecdotal* evidence about the effectiveness of scenario planning, and the arguments presented in this paper rest on such conceptual cases and often, samples of one. Thus, this paper serves two important purposes, (1) as a case for the *conceptual* link between scenario planning and decision-making, and (2) as a call for a variety

of research, be it in the form of case studies, correlations, interviews or other, the point is that efforts to validate and understand scenario planning practices are needed and they must be based on sound research.

Acknowledgements

References

[1] B. Brehmer, Strategies in real-time, dynamic decision making, in: R. Hogarth (Ed.), University of Chicago Press, Chicago, IL, 1990, pp. 262–291.
[2] B. Brehmer, Dynamic decision making: Human control of complex systems, Acta Psychological 81 (1992) 211–241.
[3] T.J. Chermack, The mandate for theory in scenario planning, Futures Research Quarterly 18 (2) (2002) 25–28.
[4] T.J. Chermack, The role of systems theory in scenario planning, Human Resource Development Review. (submitted for publication).
[5] T.J. Chermack, S.A. Lynham, S. A., Definitions and outcome variables of scenario planning, Human Resource Development Review 1 (3) (2002) 366–383.
[6] D. Dorner, The Logic of Failure: Recognizing and Avoiding Error in Complex Situations, Addison-Wesley, Reading, MA, 1996.
[7] H.L. Dreyfus, S.E. Dreyfus, Frictionless forecasting is a fiction, in: N. Akerman (Ed.), Westview Press, Boulder, CO, 1998, pp. 267–284.
[8] D.N. Ford, J.D. Sterman, Expert knowledge elicitation to improve formal and mental models, Systems Dynamics Review 14 (4) (1998) 309–340.
[9] J.W. Forrester, Industrial dynamics, Productivity Press, Portland, OR, 1961.
[10] J.W. Forrester, Policies, decisions, and information sources for modeling, in: J. Morecroft, J. Sterman (Eds.), Productivity Press, Portland, OR, 1994, pp. 51–84.
[11] N.C. Georgantzas, W. Acar, Scenario-Driven Planning: Learning to Manage Strategic Uncertainty, Quorum, Westport, CT, 1995.
[12] E.F. Holton III, Performance domains and their boundaries, in: R.J. Torraco (Ed.), Advances in Developing Human Resources, Vol. 1 Berrett-Koehler, San Francisco, 1999, pp. 26–46.
[13] P. Johnson, (2002). Personal communication.
[14] J. Martin, Stories and scripts in organizational settings, in: A. Hastorf, A. Isen (Eds.), Elsevier, New York, 1982, pp. 255–305.
[15] J.D.W. Morecroft, System dynamics: Portraying bounded rationality, OMEGA: The International Journal of Management Science 11 (2) (1983) 131–142.
[16] J.D.W. Morecroft, Rationality in the analysis of behavioral simulation models, Management Science 31 (7) (1985) 900–916.
[17] R. Phelps, C. Chan, S.C. Kapsalis, Does scenario planning affect performance? Two exploratory studies, Journal of Business Research 5 (1) (2001) 223–232.
[18] G.P. Richardson, Two feedback threads, in: Feedback Thought in Social Science and Systems Theory, University of Pennsylvania Press, Philadelphia, PA, 1991, pp. 92–168.
[19] G.I. Rochlin, Informal organizational networking as a crisis avoidance strategy: US naval flight operations as a case study, Industrial Crisis Quarterly 3 (1989) 159–176.
[20] G.I. Rochlin, Essential friction : Error-control in organizational behavior, in: N. Akerman (Ed.), Westview Press, Boulder, CO, 1998.

[21] G.I. Rochlin, T.R. La Porte, K.H. Roberts, The self designing high-reliability organization: Aircraft carrier flight operations at sea, Naval War College Review 40 (4) (1987) 76–90.

[22] P. Schwartz, The art of the long view, Doubleday, New York, 1991.

[23] P. Senge, The Fifth Discipline, Doubleday, New York, 1990.

[24] P. Senge, Learning to alter mental models, Executive Excellence 11 (3) (1994) 16–17.

[25] H.A. Simon, Administrative behavior, McMillan, New York, 1957.

[26] R.A. Swanson, The foundations of performance improvement and implications for practice, in: R.J. Torraco (Ed.), Advances in Developing Human Resources, Vol. 1Berrett-Koehler, San Francisco, 1999, pp. 1–25.

[27] W. Swap, D. Leonard, M. Shields, L. Abrams, Using mentoring and storytelling to transfer knowledge in the workplace, Journal of Management Information Systems 18 (1) (2001) 95–114.

[28] B.W. Tuchman, The March of Folly: From Troy to Vietnam, Ballantine Books, New York. NY, 1984.

[29] A. Tversky, D. Kahneman, Judgment under uncertainty: Heuristics and biases, Science 185 (1974) 1124–1131.

[30] K. van der Heijden, Scenarios: The Art of Strategic Conversation, John Wiley, New York, 1997.

[31] E. Von Hippel, Economics of product development by users: The impact of sticky local information, Management Science 44 (5) (1998) 629–644.

[32] P. Wack, Scenarios: Shooting the rapids, Harvard Business Review 63 (6) (1985) 139–150.

[33] E. Ward, A.E. Schriefer, Dynamic scenarios: Systems thinking meets scenario planning, in: L. Randall, R. Randall (Eds.), John Wiley & Sons, Inc., New York, 1998.

[34] K.E. Weick, Introduction: Cartographic myths in organizations, in: A. Sigismund Huff (Ed.), John Wiley & Sons, New York, NY, 1990, pp. 1–10.

[35] K.E. Weick, K.H. Roberts, Collective mind in organizations: Heedful interrelating on flight decks, Administrative Science Quarterly 38 (3) (1993) 357–381.

[36] J.N. Wilford, The Mapmakers, Knopf, New York, 1981.