Cognitive Barriers in the Scenario Development Process

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Abstract. The literature on scenario planning can be neatly divided into two broad categories: (a) anecdotal, practitioner oriented articles that describe how scenario planning has been undertaken in organizations, its espoused benefits, and experienced-based advice on how to construct scenarios and (b) articles that are more academic and analytical in that they attempt to provide a theoretical underpinning for scenarios based on a small body of empirical studies of related topics. It is this second category, the empirical studies of related topics that this article focuses on, in particular, research findings from the cognitive psychology domain in terms of how knowledge is organized and activated in the human mind, cognitive simplification processes, and inductive versus deductive thinking. A research project focusing on the scenario development process is described and the preliminary findings related to the impact of these cognitive phenomena in terms of learning barriers in the development process is discussed.

Keywords: *scenario planning; cognitive barriers; challenges in scenario planning*

Although scenario techniques have a long history, there appears to be no area in scenarios on which there is widespread consensus. The literature reveals a large number of different and at times conflicting definitions, characteristics, and methodological ideas. Even the term *scenario* itself is not a very precisely defined concept (Jungermann, 1985a; Jungermann & Thuring, 1987); it means different things to different people and, accordingly, is labeled and applied in widely divergent ways and the term elicits "all kinds of vague and loosely defined concepts" (Simpson, 1992, p. 13). The consequence according to Khakee (1991) is that "few techniques in futures studies have given rise to so much confusion as scenarios" (p. 52). This confusion may be explained by the fact that unlike other long-range forecasting methods there appears to be no

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solid theoretically based foundation underpinning scenario techniques. As a number of writers have noted, there is in fact "a paucity of systematic research" (Kuhn & Sniezek, 1995, p. 148), leading Chermack (2002) to conclude that "the status of theory development in the area of scenario planning is dismal" (p. 25). This is explained by the fact that the growth in popularity of scenarios has happened for practical reasons rather than theoretical ones, the consequence of which is that "theoretical research and sophisticated tools have been neglected in favour of multiple applications" (Godet, 1990, p. 88).

Bunn and Salo (1993) suggested that depending on their objectives, scenarios can fall within one of three theoretical frameworks: (a) strategic planning and decision analysis, (b) risk and sensitivity analysis, or (c) organizational learning. Increasingly, the literature on scenarios focuses on the utility of scenarios as a tool for learning, and they have been shown to meet all the stages of an effective organizational learning process identified by Senge (Georgantzas & Acar, 1995). In essence, scenarios force individuals to examine their perceptions, to stretch their mental models, and to develop a shared view of uncertainty, all of which lead to an increased confidence in decision making and move the organization toward becoming a learning organization (van der Heijden, 2005). Within the intuitive-logics scenario methodology (the most widely discussed scenario technique in the literature), the various tasks comprising the scenario development process are primarily creative, undertaken in facilitated groups, and rely heavily on the subjective judgments or disciplined intuition of the group members. However, there is a notable absence of discussion in the literature on the individual cognitive and group behavioral factors that have been shown to affect group process in other domains and can therefore reasonably be assumed to influence the scenario construction process.

Purpose of the Article

The objective of this article is to address this omission by identifying a number of cognitive barriers that appear to limit learning in the scenario development process. It begins with the proposition that although numerous scenario development models exist, most lack exacting description and provides no explicit supporting theoretical underpinning. The article then moves to an overview of empirical evidence from the cognitive psychology field revolving around mental models and thinking processes. This is followed by a description of a research project involving observations of groups engaged in scenario work, and posits that the cognitive processes observed in the groups accord with the evidence from the cognitive psychology literature and result in potential barriers limiting the purported learning inherent in scenario work. The article concludes with a discussion on the implications of these barriers in scenario development processes.

The Scenario Development Process

The first comprehensive model for the development of scenarios published in a journal was the one that was provided by Zentner in 1975 (Zentner, 1982). Since then numerous models have been published, and the literature is replete with descriptions of prototypical patterns or models for generating scenarios ranging from the simple to the elaborate and highly structured recipe-type techniques. Most of the models discussed are highly prescriptive, identifying a number of discrete steps varying from 5 (Foster, 1993) to 12 or more (Vanston, Parker, Frisbee, Cook Lopreato, & Poston, 1977), depending on the scenario approach used and what features of scenarios are highlighted or ignored. The detailed specifics of the construction process are generally vague, and more than 20 years ago, Jungermann (1985a) reported that most techniques discussed in the literature are only loosely defined procedures that are "neither theoretically derived nor based on empirical research" (p. 72). At the same time, he declared that "almost no documentation of actual construction processes from which one might learn something about the implementation of the various procedures" are offered in the literature (p. 322). Eight years later, Bunn and Salo (1993) suggested that protocols for scenario development are "ad hoc and not very defensible" (p. 293). Despite the significant number of publications on the subject of scenarios since then, the situation remains essentially unchanged.

Although much of the scenario literature suggests that scenario practice has endured so well because it is operationally simple relative to other techniques, the Shell "Guides to Planning" (Series No. 5; Shell, 1986) warn that developing scenarios is not an easy task as it requires a substantial investment in resources. At the same time, Wack (1985a) noted that the development process is of critical importance as the ultimate benefit of the scenarios to decision makers will be dependent on how the scenarios are constructed and presented. By taking a hypothetical example of an individual constructing a scenario and then tracing the cognitive activity required, Jungermann (1985a) described what constitutes a generic, four-stage scenario generation process model.

- Activation of problem knowledge within the world knowledge of the individual
- Constitution of the mental model in terms of the activated problem knowledge
- Stimulation of the mental model to draw inferences
- Selection of the inferences that appear appropriate for scenario construction

In reviewing the literature on cognitive psychology, three areas encompassing the above appear to affect this generic scenario development process: (a) cognitive processes in terms of how knowledge is organized and activated in the human mind, (b) cognitive simplification processes (heuristics and biases) that affect how individuals think about uncertain and complex events, and (c) the processes of inductive versus deductive thinking.

Organization and Activation of Knowledge

Although it is yet to be established with certainty how knowledge is stored in memory, one widely accepted theory is that knowledge is stored and organized in the brain in the form of a cognitive schema, which comprises the total of our past experiences (Minsky, 1975; Rumelhart, 1984; Schank & Abelson, 1977; Tversky & Khaneman, 1982c). When faced with disparate streams of facts and events, individuals attempt to understand the situation by automatically applying the schema according to the similarity between it and the situation facing them, relying in the process on cognitive simplification processes discussed in the next section of this article.

In addition to understanding of situations, schemata include expectations as to what should happen in a given situation and the sequence in which they should happen, what alternatives exist, and what information is required. The consequences are threefold. First, the schemata limit the solution space available to individuals in that they comprise deep-rooted, unquestioned assumptions as to the nature of a problem and a preconceived conceptualization of the available range of feasible options and solutions to the problem (Anderson & Johnson, 1966; Newell & Simon, 1972; Simon, 1973). Second, following from the above, once the problem set is established by the schemata the information search set is also then established, and as has been demonstrated in numerous experiments, individuals are insensitive as to the completeness of information in the search set, even when missing data that are crucial to the type of decision being taken (Fischoff, Slovic, & Lichtenstein, 1978). The third consequence is that where the existing schema cannot be readily applied because the individual is attempting to construct previously unexperienced patterns of events, the individual will generally force the situation to suit the existing schema using causal inferences from his or her schema to compensate for gaps.

Closely allied to the above is the theory espoused by a number of researchers in cognitive psychology (Anderson & Bower, 1973; Collins & Loftus, 1975; Collins & Quillian, 1969; Norman & Rumelhart, 1975) that information is stored in human memory in the form of an associative network in which various nodes representing concepts are connected by links representing relations between the concepts. Activation of one node in the network automatically activates other nodes in a search set according to the associative or causal links between nodes. It follows, therefore, that what instances or events are searched for and retrieved from memory is largely dependent on what search set within the individual's knowledge base is elicited. What set is elicited depends on the starting point, as the starting point (which is itself influenced by factors such as saliency) will, by activating nodes in an associative pathway, determine what information is subsequently generated. Consequently, activation of different search sets will generally result in different frequency and probability judgments being assigned to the same problem, because different search sets are unlikely to contain the identical availability of instances or events.

Cognitive Simplification Processes

In the early 1970s, a major line of research by cognitive scientists such as Kahneman, Tversky, Slovic, and their colleagues resulted in a set of findings that purportedly showed that as a consequence of cognitive limitations individuals tend to intuitively rely on a limited number of inferential judgmental rules, known as heuristics, to reduce the complex task of determining the likelihood of uncertain events. Although these cognitive simplification or heuristic principles are valid in some situations and can result in reasonable judgments, they lead to biases that result in "severe and systematic errors" (p. 241) in the intuitive judgment of probability (Kahneman & Tversky, 1973). The three most widely discussed heuristics are representativeness, availability, and anchoring and adjustment.

The Representativeness Heuristic

In a series of studies, Kahneman and Tversky established that individuals intuitively evaluate the probability of an event or a sample by the degree to which it is (a) similar in essential properties to its parent population and (b) reflects the salient features of the process by which it is generated (Kahneman & Tversky, 1972, 1973, 1982a, 1982b; Tversky & Kahneman, 1982a, 1982b). Thus, by extension, individuals assign probabilities to uncertain events according to how closely the events represent each individual's model of the world and an understanding of the processes that results in various outcomes; the greater the degree of representativeness, the higher the probability of occurrence assigned to the events and the higher the confidence associated with the resultant prediction.

Reliance on the representativeness heuristic leads to predictable and systematic errors of judgment because "representativeness has a logic of its own which differs from the logic of probability" (Tversky & Kahneman, 1982a, p. 98). Tversky and Kahneman supported this contention by identifying a list of biases that affect probability judgments and therefore should but do not appear to affect representativeness, including the base rate fallacy, insensitivity to sample size, misconceptions of random events, misconception of regression, and the conjunction fallacy. This suggests that as in schemata search sets the expected accuracy of judgments of individuals based on representativeness appear to be unaffected by the quality and reliability of the information that forms the basis of their predictions.

The Availability Heuristic

Tversky and Kahneman (1982a, 1982d) have also demonstrated that individuals intuitively judge the probability of an event by the ease with which they can remember or imagine instances of a similar nature. In general terms, this availability heuristic suggests that (a) instances or events that occur more frequently are more readily recalled from memory than those that occur less often, (b) instances or events that are more likely to occur are more easily imagined than those that are less likely to occur, and (c) instances of larger classes are more easily constructed in the mind than are instances of smaller classes (Tversky & Kahneman, 1982d). A cornerstone of availability is that the only two mental operations by which things can be brought to mind are recall (retrieval from memory) and construction (the process of imaging).

Both recall and construction are affected by a number of factors. In the case of recall, factors affecting retrieval from memory include the following.

- Salience—Research shows that vivid and concrete information is likely to be more memorable and has a greater impact on individuals and their theory development, even if it is contradictory and inferior to more abstract, pallid information (Anderson, 1983; Chapman & Chapman, 1969; Hamill, Wilson, & Nisbett , 1980; Nisbett & Ross, 1980; Watson, 1960).
- Recency—Incidents that have occurred recently are likely to occupy a more prominent position in the memory and therefore will be more readily retrieved; because they are more readily retrieved they are given greater weight than is warranted (Bower, Black, & Turner, 1979; Montgomery & Weinberg, 1973).
- Familiarity—Events or incidents with which an individual is familiar and can readily recall past incidents of a similar nature will be judged albeit erroneously, as occurring more frequently than incidents or events that occur with the same frequency, but with which the individual is not as familiar (Bower et al., 1979).

In the case of the process of imagining, instances or events that are not stored in memory need to be constructed or imagined according to established rules. In these situations, individuals tend to evaluate the frequency or probability of the instances or events according to how easy it was to imagine them. This leads to bias, in that the most easily imagined instances are not necessarily the most frequent or most probable events.

Anchoring and Adjustment

The third heuristic widely discussed in the research literature is anchoring and adjustment. When required to make an estimate, individuals generally begin with some initial value (the anchor) and then adjust the value up or down to reflect subsequent information to arrive at a final answer. The initial anchor value is either explicit, in that it is given, or implicit, in that it is derived from the way in which the problem is framed. Regardless of what the initial anchor value is or how it is obtained, the findings of researchers indicate that having established it people tend to make insufficient adjustments up or down in arriving at a final answer because they are usually biased toward the initial value (Tversky & Kahneman, 1982a). Examples of this phenomenon have been demonstrated by numerous researchers (Butler, 1986; Joyce & Biddle, 1981; Slovic & Lichtenstein, 1971; Smith & Kilda, 1991).

In addition to the three discussed above, several other well-documented heuristics and biases that are relevant to scenario processes are present.

Belief perseverance. As far back as the 1950s, researchers such as Hovland, Janis, Kelly, and Luchins had already established that individuals have a propensity to adhere to their initial opinions, attitudes, and theories about themselves and others and relationships between social variables, even when it is made clear that the initial data on which the beliefs are founded are fictitious. It appears that once created, beliefs tend to become independent of the data on which they are founded, subsequently demonstrating that the data are not true appears to have little if any effect on the beliefs. Additionally, the findings of Anderson (1983) indicated that although vivid and concrete albeit dubious data have the greatest impact on memory, it also has a similar effect on belief perseverance.

Confirmation bias. The confirmation bias, well documented by Watson (1960) and others (Levine, 1971; Pruitt, 1961), indicated that once formed initial beliefs are not only difficult to dislodge because of belief perseverance but also that they tend to structure the way in which subsequent evidence is interpreted; new evidence that supports initial beliefs is judged to be reliable whereas evidence that contradicts the beliefs is dismissed as unreliable or erroneous. Thus, individuals routinely overestimate evidence that confirms their theories, expectations, and beliefs and disregard or devalue evidence that falsifies their theories, or they maintain "blatant self-contradictions and develop elaborate rationalisations to defend their theories" (Steinbruner, 1974, p. 79; Jervis, 1976). Paradoxically, in searching for and being receptive only to supportive evidence, individuals unwittingly receive repeated reinforcement as to the correctness of their theories and become convinced that these theories are correct, even when presented with contradictory evidence.

The experience bias. This bias, also called selective perception in the literature, postulates that the training and experience of individuals, that is, their knowledge base, will bias how they interpret and then act on information, because they have a propensity to focus on those things that they already have an understanding of (Tversky & Kahneman, 1981). This experience bias gives rise to two interrelated problems. First, the knowledge base, goals and values of individuals will naturally determine how they conceptualize the problem, a process termed *framing* by Tversky and Kahneman (1981). Second, the framing of a problem in a certain way determines which elements of the decision maker's knowledge base are activated, effectively limiting the solution space available (Newell & Simon, 1972; Simon, 1973). At the same time, in viewing problems from their experience vantage points, individuals tend to ignore or dismiss other aspects of information (Dearborn & Simon, 1958).

Overconfidence. This phenomenon describes the fact that people appear to be systematically overconfident of their ability to predict (Lichtenstein, Fischhoff, & Phillips, 1982; Russo & Schoemaker, 1992; Schwenk, 1986; Slovic, Fischhoff, & Lichtenstein, 1977) because they fail to recognize "the tenuousness of the assumptions on which their judgments are based" (Lichtenstein et al., 1982, p. 311). Empirical evidence in this area comes from laboratory studies associated with calibration in which it has been repeatedly observed that there is an incongruity between the confidence individuals have in their judgments and the number of correct answers they then achieve in simple metaknowledge tests. The implication of this overconfidence is that people are not generally aware of how little they know and how much more they need to know to make correct judgments (Slovic, Fischhoff, & Lichtenstein, 1985).

Inductive Versus Deductive Developmental Processes

Jungermann (1985a, 1985b) has demonstrated that exploratory (deductive) scenario developmental models result in very different scenarios than those generated by anticipatory (inductive) developmental models. Deductive development approaches employ forward inference and causality. They start with present conditions and develop logical, causal explanations as to how the environmental drivers of change may play out in combinations to create plausible alternative future states. Inductive approaches are essentially the opposite process. They start with imagining plausible alternative future states, then work backwards to establish what must have happened in order for the imagined future states to have evolved from present conditions, relying on backward inference and diagnostic effectuality. At the same time, there is empirical evidence that first people make causal inferences with a greater degree of confidence than they do making diagnostic inferences, even when aware that the relationship between variables in the data is accidental rather than causal. Second, when presented with data that have both causal and diagnostic elements, causal data are generally accorded more weight in probability judgments than are diagnostic data, even where the cause and effect provide the same information about each other (Kahneman & Tversky, 1982a).

Backward inferences or diagnostic reasoning, which requires uphill thinking, is at odds with the temporal order of things and causal knowledge cannot be easily transferred in backwards reasoning. Therefore, constructing scenarios using this approach is more difficult. However, causal thinking is problematic given that there are no universally accepted rules for distinguishing between cause and effect; thus, individuals distinguish causes from effect by relying on probabilistically based cues to causality, which include the temporal order of events, degree to which two events occur simultaneously, number of competing variables or explanations, degree to which one variable can predict another, and the similarity between events and prior knowledge. All of these cues are related to numerous heuristics and biases, and as Einhorn and Hogarth (1982) observed, "one must guard against the way cues to causality quickly restrict our interpretation of the past" by "structuring and stabilising our perceptions of reality" (p. 32). In essence, the cues are apt to focus attention on the obvious and known at the expense of creative thinking.

Research Case Study

To examine elements of the scenario process in detail, a research project at the Centre for Scenario Planning and Future Studies in the University of Strathclyde Business School was undertaken using postgraduate students attending a Scenario Planning elective course in the MBA programme. The course, modeled on the intuitive-logics development process used by the Shell Group of Companies and the Global Business Network, as depicted in Figure 1, was designed by Professor Kees van der Heijden to give students a firsthand experience of undertaking a scenario planning exercise in as close to a real-world situation as possible. The course was run five times with different groups of students over a 5-month period.

As in a real-life scenario exercises, the students worked in small groups or syndicates consisting of five or six students each and attended a series of workshops. The task assigned to the groups was to develop a set of scenarios with a 10- to 15-year horizon for a designated client organization notionally represented by one of the group members. The syndicate composition was prearranged to ensure as diverse a team as possible (in terms of the age, qualifications, work experience, and nationality of the members) as the scenario literature suggests that this enhances the ability of the scenario team to contemplate a wider range of different futures. Syndicates were assigned a dedicated room for the duration of the elective workshops and provided with a series of detailed process guidelines for each stage of the scenario development process. Throughout the process, the syndicates were facilitated on an intermittent, roving basis by Professor van der Heijden.

Following a successful pilot study of a syndicate undertaking each step of the scenario development process, four other syndicates were then covertly observed and recorded on tape using a camouflaged peep-hole camera installed in the syndicate rooms. The resulting tape of more than100 hours was subsequently examined and analyzed in terms of language content and behavioral patterns. Additionally, on completion of the elective course, all syndicate members completed a questionnaire aimed at capturing their reflections

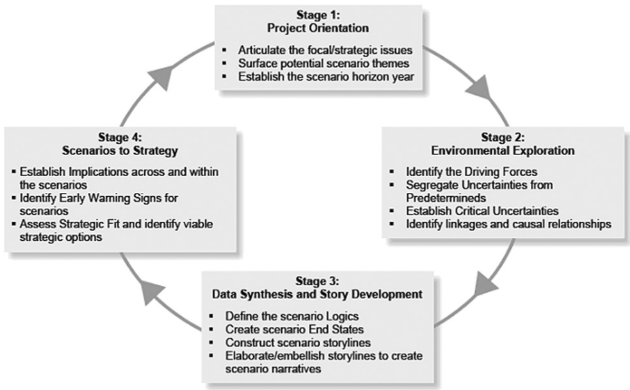

FIGURE 1: Typical Intuitive Logics Scenario Development Process Framework

on the scenario process, and a number of syndicate members were engaged in in-depth interviews.

Although all four stages of the scenario development process shown in Figure 1 were included in this research project, this article focuses specifically on Stage 2 of the process, namely, the environmental exploration stage, as the information searched for and developed in this phase of the scenario development process forms the foundation stone for all subsequent stages of the process.

Preliminary Case Study Findings

An overwhelming volume of data was generated in this research study and analysis and interpretation of the data is still ongoing; consequently, the findings discussed below represent preliminary findings. An overview of the process issues identified in the preliminary findings and which potentially affect learning is depicted in Figure 2.

As we know from the cognitive sciences, humans are not as rational as once believed, we interpret and make sense of what we see going on around us through unique and interacting ontological and epistemological lenses comprising our mental models. At the same time, empirical evidence suggests that individuals tend to be satisfied with a single interpretation of a situation and are predisposed at the outset of a decision process to focus on a single outcome and a single alternative for achieving that outcome, especially in highly uncertain and complex decision domains (Festinger, 1957; Steinbruner, 1974). Writers on the subject of scenarios contend that the power of scenarios is that they overcome this single interpretation/outcome predisposition by engaging participants in a wide-ranging exploration of exogenous variables in the

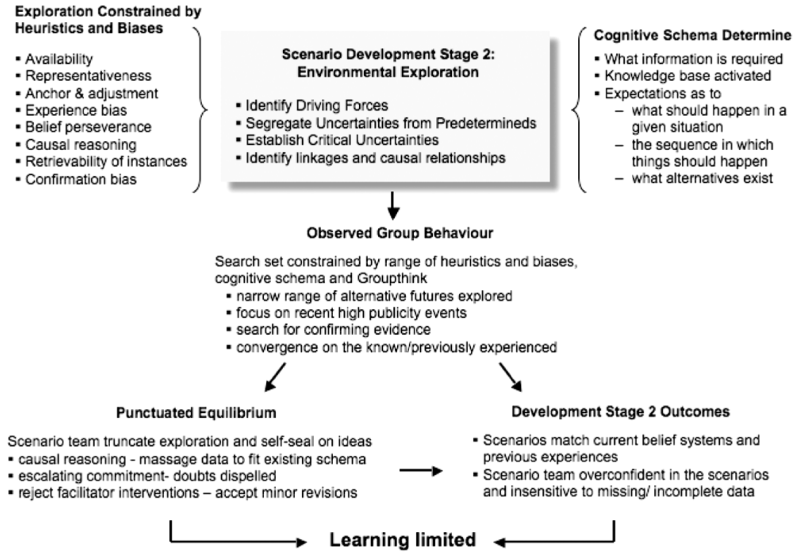

FIGURE 2: Process Issues in Scenario Development Stage 2

contextual environments and systematically contemplating how these may combine to evolve in a variety of ways in the future, bringing about a shifting of personal frames of reference and changes in the mental models of the scenario participants. However, in examining and comparing the behavior of the syndicates observed undertaking the scenario process, a number of outcomes were evident across all four syndicates.

Media-determined search set. What initial search set was triggered in the syndicates determined which variables the group subsequently explored, and the trigger essentially related to recent happenings highly publicized in the media. Thus, events such as AIDS and Bird Flu, the war in Afghanistan, Iraq and the Middle East tensions, the situation in North Korea, the question of the sustainability of the U.S. economy, and stem cell research were the initial issues raised in all syndicates in determining the list of potential drivers of change in the contextual environment. Numerous other issues were raised but accorded relatively minor attention. Even when provided with evidence, for example, that pneumonia, diarrheal diseases, and malaria are responsible for more childhood deaths in developing countries than AIDS/HIV, the syndicates dismissed this and continued to focus their discussions on AIDS/HIV.

Embedded cognitive script. In exploring these recent events, each of the syndicates tended to have a clear view as to how they would unfold in the future;

although there was much discussion around this and the syndicates engaged in freewheel thinking in terms of possible combinations and alternative developments, invariably they returned to contemplate combinations and alternatives that were already known. In reviewing these, it was apparent that developments envisaged by all syndicates essentially epitomized variations around a common, already well-articulated midpoint of events that were expected to occur and the order in which they were expected to occur, representing what might be called an embedded cognitive script. Although extreme developments were raised, they largely lay dormant and were eventually discarded as being unrealistic and implausible. For example, in discussing global economics, headline news at the time suggested that the U.S. economy might be slowing whereas the Chinese economy was overheating. In contemplating this, the combinations and outcomes discussed in the syndicates included the following: the U.S. and Chinese economies would continue to grow, and the U.S. economy would slow whereas the Chinese economy would manage a soft landing. A wholesale collapse of the economies precipitating a global depression was raised but summarily rejected by all syndicates as an implausible development.

Punctuated equilibrium induced coagulation. Although each of the groups engaged in diverse and distinctive behaviors, there was a common pattern in the exploration exercise in all groups—periods of inertia punctuated by concentrated, revolutionary periods of quantum changes, time being the stimulus for the transition in group behavior, a phenomenon described as "punctuated equilibrium" (Gersick, 1990, p 16). However, unlike the model depicted by Gersick, the transition point was not the midpoint in the time allotted for the exercise in all cases, it varied within each syndicate.

Clearly evident in all groups was the fact that once the punctuated equilibrium transition point was activated, the groups abandoned any further exploration, self-sealing on ideas already discussed and organizing and interpreting these in terms of cause-and-effect relationships. Once the group reached this coagulation point, interventions by the facilitator proved ineffective, even when it was demonstrated to the groups that their ideas and supporting data may have been outdated and incomplete or that the relationship between variables could have been accidental rather than causal. Although group members appeared to pay attention to the facilitator, on his departure from the room they continued to develop their existing ideas with an escalating commitment; some revisions were made based on the facilitator's comments but these tended to be minimal in scope.

The overall preliminary conclusion in this research project was that the scenarios subsequently developed by the syndicates largely matched the collective belief systems and previous experiences of the syndicate members, as was later confirmed in the questionnaire and interview data. Although the scenarios were well constructed, written and presented, there were no extreme or surprising developments in any of the scenarios, all evolved in largely predictable patterns.

In essence, there was no evidence of the so-called out of the box thinking in the scenarios and there were no strategic insights as to how the future might evolve in new and unprecedented ways, they largely represented what might be best described as described as "canonical variations around a midpoint" (Kahn & Wiener, 1967, p. 256).

Discussion and Conclusions

As already indicated, there has been little direct research in the area of scenario processes, most of the reported research is rooted in the discipline of cognitive psychology and relates primarily to examining the quality of intuitive human judgment of uncertain events. The bulk of this research was conducted more than 20 years ago, it has been criticized on a number of fronts, and there is still disagreement in the literature as to explanations for the findings and, as with such research, the findings raise more questions than answers.

Equally, the research described in this article is not without problems and can be criticized on a number of fronts, including the fact that although the research attempted to replicate a real-world setting, it was a laboratory setting using students, albeit mature postgraduate students. At the same time, the findings discussed above focus on one particular set of cognitive phenomena operating at the individual level; it does not address equally important group dynamics phenomena such as "groupthink" (Janis, 1982, p. 34).

The cognitive phenomena discussed are complex and interrelated rather than standalone phenomena; they interact and reinforce each other to varying degrees. What is clear from the research literature, however, is that they are likely to be most prevalent when there is a multitude of inherently uncertain and complex situations and issues to consider as is generally the case in scenario work. Inevitably, therefore, they affect the scenario development processes in terms of how and what information is searched for and what data are accepted or rejected. As was evident from the preliminary findings of the research project described in this article, saliency and primacy largely determined the starting point of the information search, which in turn determined what information was searched for as pathways of linked nodes in the neural network of the brain were presumably activated. The search for information was largely guided by what individuals already had an understanding of and was constrained by their cognitive anchors, experiences, and belief systems; information that did not accord with this was generally discarded. Once this search set was activated, individuals were generally insensitive to missing information, sample size, prior probabilities, and the concept of regression and correlation among other things. At the same time, events that were representative, easily imagined, and founded on recent highly publicized happenings, and which could be causality linked in a plausible manner so as to explain why an event had occurred, were accorded a high (but unwarranted) likelihood of occurrence.

In reading the literature on scenario planning it appears that the scenario development process is relatively straightforward. However, the overall conclusions from all of the forgoing is that first, it is not that simple, there is obviously substantially more going on in the process than is generally ascribed to in the literature. Second, the findings from the cognitive literature in terms of phenomena affecting information searching and processing have the potential to severely limit the learning in scenario processes. Practitioners at large, however, appear generally unaware of, or at best only vaguely aware of, these phenomena and their ramifications on the scenario developmental process. This is evidenced by the fact that few of the articles on scenarios in the anecdotal, experienced-based literature make references to these phenomena; and in advocating particular methodologies, only a small number cite supporting empirical evidence.

Although the flexibility of scenario techniques lend themselves to a wide range of purposes, increasingly as indicated at the start of this article, scenarios are promoted as a tool for learning. For those in the HRD/OD fields interested in positioning scenario planning as HRD's strategic learning tool, the implications in terms of learning and change in the scenario development process discussed above are significant but not limited to scenario interventions. It may be taken as axiomatic that the building of strategic capacity for comprehending and dealing with fast changing environments is essential for any organization to survive in the long term. In this context, Ashby's (1958) law of requisite variety states that to survive the variety of compensatory actions or responses the organization is able to execute must be at least as great as the variety of perturbations that might occur in the environment. Although by their very nature scenario techniques offer great potential here, there are "many aspects of effective scenario planning that are currently up for debate" (Chermack, 2002, p. 28). Foremost among these is the fact that there are numerous cognitive factors at work in determining how people think, and therefore, stretching mental models and moving people beyond their business-as-usual thinking to create new insights about the changing world is a complex and difficult task. Although this should not deter HRD professionals interested in scenarios, it should be recognized that overcoming the cognitive barriers discussed in this article requires a great deal of attention to the design of a scenario process, and the existing literature on scenarios provides little guidance of any substance in this area.

It has been said that scenarios are not science but practitioner art and craft based on intuition, insight, and vision. This may be true, but as Mintzberg (2004) has noted, in the context of management, effective managing happens where art, craft, and science meet, the same should be true in the province of scenario planning. Although engaging in scenario work may indeed facilitate organization learning as is commonly suggested, more science is required to gain a deeper understanding of the process involved and for the development and testing of techniques to eliminate (or at least mitigate) the effects of inherent cognitive phenomena that present potential barriers to learning in the scenario method.

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