



Effects of scenario planning on participant mental models

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Abstract

Purpose – The purpose of this paper is to assess the effects of scenario planning on participant mental model styles.

Design/methodology/approach – The scenario planning literature is consistent with claims that scenario planning can change individual mental models. These claims are supported by anecdotal evidence and stories from the practical application of scenario planning. This research study documents the responses of 129 participants from 10 organizations using the mental model style survey as a pretest and posttest, with scenario planning as the intervention. Paired samples *t*-tests were performed between participant pretest and posttest, to test hypotheses on all five factors of the mental model style survey.

Findings – Results provide evidence that scenario planning can change individual mental model styles. More specifically, results show that scenario planning promotes efficiency, social, and systems mental model styles, with moderate effect sizes.

Research limitations/implications – The implications of this research include contribution to the growing body of quantitative studies attempting to document the impact scenario planning has on participants. Implications for future research include the use of control groups to isolate effects of the scenario planning intervention.

Originality/value – The study documents one of the largest sample sizes to date in scenario planning research and makes a clear contribution in clarifying significant changes in mental model styles from pretest to posttest.

Keywords Scenario planning, Mental models, Mental model styles, Changing mental models, Research on scenario planning, Mental model style survey, Modelling, Strategic planning

Paper type Research paper



Mental models are defined as cognitive representations or constructs of situations that may be real, imagined, or hypothetical (Al-Diban and Ifenthaler, 2011; Gentner and Stevens, 1983). Mental models have also been described as filters that influence the way individuals see the world (Bolman and Deal, 2008; Chermack, 2003; Senge, 1990, 2006). Craik (1957) described the mind's ability to construct small-scale models of

reality that are used to anticipate events, to reason, and to explain. These models of the world are based on what is real or imagined, and can be influenced by an individual's perception of their surroundings (Bolman and Deal, 2008; Chermack, 2003; Senge, 1990, 2006). Furthermore, "mental models embody how individuals see the world, how individuals know and think about the world, and how individuals act in the world" (Chermack, 2003, p. 410).

Mental models make up the biases, beliefs, experiences, and values of the individual impacting all parts of their lives, including their performance at work (Ford and Sterman, 1998). Simulation-based research indicates that consistently strong organizational performance requires an accurate understanding "of the causal relationships in the business environment" (Gary and Wood, 2011, p. 586). Accurate understandings improve the accuracy of mental models held by business managers (Denrell *et al.*, 2004; Gary and Wood, 2011; Gavetti and Levinthal, 2000). An individual's mental model of the organization they work for may have significant influence over their ability to perform and function within that organization. Individual performance impacts organizational performance, an important focus of Human Resource Development (HRD) (Cummins and Worley, 1997; Swanson, 1994; Swanson and Holton, 2009).

Due to the turbulent nature of the business environment today, organizations and individuals must be flexible and adaptable to changing conditions, yet it is commonly believed that mental models are difficult to change (Chermack, 2003). The ability of individuals to change their mental models can impact organizational performance because "in order to do different things, at least on a consistent, systematic basis over a sustained time period, companies and their people actually must begin to think differently" (Pfeffer, 2005, p. 124). Research focused on changing mental models has important implications for HRD in terms of the ability of scholars and practitioners to improve organizational performance.

There are several proposed methods for examining and changing mental models. These include Carley and Palmquist's method for extracting mental models, Swanson's (1994) knowledge task analysis, cognitive mapping (Warren, 1995), mind mapping (Warren, 1995) and scenario planning (van der Heijden, 2005; Shoemaker, 1992). Research focused on understanding and developing additional strategies toward behavioral change must include the impact these methods have on changing mental models. In other words, traditional approaches to behavioral change such as stimulus – response psychology (Skinner, 1953), or reward and compensation approaches (Pavlov, 1957) may not be the only way to change individual perceptions about an organization.

Large-scale learning opportunities such as leadership development and strategic planning represent possible intervention points for changing how individuals understand their organizations and environments (Mintzberg *et al.*, 1998, 2005). Individuals share information or common experiences while developing a group memory system to facilitate group learning for future application (Ford and Sterman, 1998). It is thought that as expertise evolves the individual's mental model also becomes more elaborate and complex (Al-Diban and Ifenthaler, 2011).

To achieve shared mental models, changes in knowledge and/or behaviors of team members must occur. Therefore, group learning plays a significant role in developing, modifying and reinforcing team mental models (Johnson-Laird, 1983; Michael, 1995;

Mohammed and Dumville, 2001). "Because of this requirement for learning, changing mental models can be viewed as a developmental process" (Chermack, 2003, p. 409). Based on this argument, any improvement intervention drawing on transformational learning principles may have the potential to shift mental models. Proposed strategies for changing mental models might include leadership development, team building, and scenario planning to name a few.

The purpose of this research is to assess the effects of scenario planning interventions on participant mental model styles. This article begins with the problem statement, research question, and a description of five mental model styles that were the basis for the survey instrument. The research hypotheses that were the focus of the study and a description of scenario planning as the theoretical framework for the study is presented. Finally, the research design and methodology are described and the conclusions and implications for future research and practice are provided.

Problem and research question

This article addresses a core problem in scenario planning literature. Many authors claim that scenario planning is a tool for shifting mental models and assumptions inside the organization (Chermack, 2011; Schwartz, 1991; van der Merwe, 2008; van der Heijden, 2005). These claims are based on anecdotal evidence, which can be helpful but does not constitute the rigorous inquiry required to support gross generalizations frequently made. In other words, there are no empirical research studies to demonstrate that participation in scenario planning changes mental models. There is a lack of documented knowledge of the successes and failures of scenario planning in practice (Chermack and Lynham, 2004), thus studying scenario planning's impact on mental model styles becomes a worthy research project. The specific research question that is the basis of this research is:

RQ1. Does scenario planning affect individual mental model styles as measured by the Mental Model Style Survey?

To answer this research question it is important to understand the evolution of an instrument designed to measure five mental model styles individuals might employ when operating in their organizations. Five mental model styles have been identified including political, financial, efficient, social, and systems (Chermack *et al.*, 2011b). These styles are described in the following section, and research hypotheses are defined.

Mental models

Allee (1997) stated that mental models are "important cornerstones for building knowledge and defining some of the cognitive processes that support change and learning" (p. 11). Introduced by Forrester (1961), mental models are the lenses through which we see the world. Mental models incorporate our preferences, experiences, and beliefs about how the world works. Senge (1990, 2006) called mental models "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" (p. 8).

Doyle and Ford (1998) defined mental models in detail: "Mental models are thus the stock in trade of research and practice in system dynamics: they are the 'product' that

modelers take from students and clients, disassemble, and reconfigure, add to, subtract from, and return with value added” (p. 4). Resulting from a comprehensive literature review of the terms “mental models” from both the systems dynamics and cognitive psychological perspectives, and some discussion in *Systems Dynamics Review*, Doyle and Ford (1999) eventually offered the following revised definition: “A mental model of a dynamic system is a relatively enduring and accessible, but limited, internal conceptual representation of an external system (historical, existing or projected) whose structure is analogous to the perceived structure of that system” (p. 414). Further, Weick (1979, 1985, 1990; Weick and Roberts, 1993) has argued consistently that mental models guide, shape, and provide the basis on which individuals interpret and make sense of organizational life.

Using mental models as decision heuristics (which people frequently do) is based on several assumptions about the utility of mental models in that domain. These assumptions include:

- Mental models exist for the purpose of taking action (Weick, 1990; Wack, 1985).
- Mental models provide us with decision premises in situations where we don't know what to do (Simon, 1957).
- We are not confronted with the components (or the possibility of examining the components or premises) of our mental models until we take some action. Usually this action is in the form of a decision.
- Decisions occur in dynamic contexts (Brehmer, 1990, 1992).

Mental model styles

Because mental models are inherently difficult to study, this research takes a cue from Scott and Bruce's (1995) development of an instrument to measure decision-making styles. Because individual decisions in the organizational context were so difficult to study, Scott and Bruce hypothesized there were overall categorical patterns to the way people made decisions. That is, they could study people's decision-making preferences by asking them to rate their own decision-making performance. We argue we have a similar situation when it comes to mental models, and the assumption underlying this research is that people also have patterns to the ways in which they perceive their organizations.

In an organizational context “mental model” is a title for the cryptic, fuzzy, ill-defined mental schema by which individuals make decisions (Al-Diban and Ifenthaler, 2011; Ford and Sterman, 1998; Senge, 1990, 2006). Studying mental models is no easy task, and several methods have been developed that essentially document a mental model in the form of a mind map or concept diagram (Dudzinska-Przesmitski and Grenier, 2009). These various methods of assessing individual mental models have increased power for understanding decision-making when considering the concept of shared, or group mental models (Sweeney and Sterman, 2000). Scenario planning has been theorized as a means for building shared mental models of the organization, team building, and creating a space for shared exploration and dialogue about the future (Bradfield, 2008; Bradfield *et al.*, 2005; Burt and van der Heijden, 2003; Chermack, 2003; Kleiner, 2008).

One model of team learning presents meta-cognition as an important role of group learning. Groups identify information pertinent to the problem at hand and then

information exchange takes place from individuals to the group or at the group level (McCarthy and Garavan, 2008). As groups experience greater awareness, behaviors and practices for sharing information evolve into new processes, routines, behaviors, and structures. Finally, groups take action as a result of the new learning and awareness (McCarthy and Garavan, 2008).

Since Senge's *The Fifth Discipline* (1990, 2006), the term "mental models" has become common in organizational literature when referring to individual perceptions, beliefs, values, and experiences shaping individual behavior. Measuring mental models is multifaceted, generally eluding empirical measurement across a group on a particular topic (Dudzinska-Przesmitski and Grenier, 2009; Ford and Serman, 1998; Senge, 1990, 2006). Previous research focused on choosing an approach suited to the nature of the group's task (Dudzinska-Przesmitski and Grenier, 2009; Kitaygorodskaya, 2006).

The Mental Model Style Survey

The Mental Model Style Survey (MMSS) was developed specifically to assess peoples' views of how their organization generally operates (Chermack *et al.*, 2011b). The majority of approaches to studying mental models include qualitative, mind-mapping, and intuitive techniques that highlight the individualistic nature of mental models (Carley and Palmquist, 1992; Dudzinska-Przesmitski and Grenier, 2009). This survey instrument was developed to address some organizational research aims to gather less dense information from large numbers of people.

The MMSS was developed through the use of a group of subject matter experts to generate categories and items. An initial study examined the validity and reliability of scores with a sample of managers in Korean organizations, so the instrument was translated forward and backward. Data were collected from 701 participants in various firms in the IT industry (Chermack *et al.*, 2011b). Results of both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were all within the acceptable range, indicating that for that population, the instrument was producing accurate and consistent results.

A second study was conducted to assess the validity and reliability of scores using a United States based sample (Chermack *et al.*, 2011a). Results showed strong evidence for the proposed factor structure and the results confirmed instrument validity and reliability. Cronbach's alpha is the accepted test of reliability and exceeded 0.70 for all components with the exception of the efficiency (posttest) items. Alpha should be 0.70 or higher to provide support for internal consistency reliability (Morgan *et al.*, 2011). Cronbach's alpha by component ranged between 0.61 and 0.95, indicating an overall internally consistent instrument. While the Mental Model Style Survey has a short track record of results and is considered a new instrument, it seems promising as a measure of individual perceptions of mental model styles. This study positions participation in scenario planning as the intervention. All participants received the intervention. The research strategy is simply to compare pretest and posttest results from the MMSS.

Both previous validity studies for the MMSS scores confirmed an instrument with five factors:

- (1) Political mental model style.
- (2) Financial mental model style.

- (3) Efficiency mental model style.
- (4) Social mental model style.
- (5) Systems mental model style.

While not a definitive list of mental model styles of organizations, the categories or factors were distilled through a modified Delphi process with subject matter experts (Chermack *et al.*, 2011b). While it is possible for individuals to hold more than one mental model style when viewing their organization, the utility of the MMSS is maximized when aggregating results for larger samples. In other words, research methods focused on small sample sizes and individual experiences will find the existing tools for accessing and assessing mental models more useful (Dudzinska-Przesmitski and Grenier, 2009). Each of the five mental model styles is briefly summarized in the following section.

Political mental model style. Organizations as systems of political activity focus on “relations between interests, conflict, and power” (Morgan, 1997, p. 160). Political activities may arise “when people think differently and want to act differently” (Morgan, 1997, p. 160). Four approaches to how work is accomplished may take place in political organizations. These four approaches include decision-making that is autocratic (do it this way), bureaucratic (it should be done this way), technocratic (this is the best way to do it), or democratic (how should we do it?). How decisions are ultimately made depends on the power relations existing between the employees (Morgan, 1997).

An individual with a political mental model style will view their organization as a system for political posturing and maneuvering. While not necessarily driven by politics themselves, holders of this style will view others in the organization as politically motivated with hidden agendas. This view can impede broader trust building within organizations, especially when the political style of management is autocratic, or a do it my way style. A political mental model style may be difficult to change because of the perception that someone else is in or has control.

Because of the emphasis on group dialogue, open and honest communication, and inclusion of a variety of views and opinions, scenario planning is expected to mitigate, or reduce the use of hidden agendas and political orientations in organizations.

H1. Individuals who engage in scenario planning will tend to reduce their reliance on a political mental model style.

Financial mental model style. An individual with a financial mental model style may view the organization’s locus of control within the accounting department because this is where decisions about using resources (cash) are made (Morgan, 1997). This department has influence over information systems, budgeting systems, policy, and daily operations. An individual with a financial mental model style may view financial performance as the most important goal and the organization as the means to financial stability. The organization is assessed only in terms of financial performance. A financial mental model style may limit an individual’s ability to fully understand other processes that are important to the organization as a system. Furthermore, decision-making styles based strictly on financial performance may reflect short-term thinking that may harm the organization in the long run.

Scenarios are learning-driven, rather than financially driven. In other words, scenarios lay out a variety of events and dynamics that could affect the organization, rather than focusing on a single variable. Scenario planning is expected to reframe planning to a learning orientation and reduce a purely budgetary approach to planning.

H2. Individuals who engage in scenario planning will tend to reduce their reliance on a financial mental model style.

Efficiency mental model style. An organization focused on efficiency was the basis of classical management theory, including the work of Frederick Taylor. An efficiency organization tends to be a top-down, management by objective, and a mechanistic system made up of goals and objectives (Morgan, 1997). The emphasis is on the organization as a rational system, operating as efficiently as possible. There is a tendency to view employees as cogs in the wheels of production and not as resources with potentially valuable contributions beyond their daily output. It is common for employees to feel they must do but not necessarily think. Thinking and decision-making are left to managers in efficient organizations, sometimes with devastating results (Mintzberg, 2009). Often quality is sacrificed for the sake of efficiency, a model that will not usually work in the long-term.

Because scenarios seek to promote a coherent view of the organization as a system, the challenges and opportunities can be understood more simply in the context of the industry and its dynamic forces. Scenario planning is expected to foster efficiency of views based on creating a shared mental model of the organization.

H3. Individuals who engage in scenario planning will tend to increase their reliance on an efficiency mental model style.

Social mental model style. An individual with a social mental model style views the organization in terms of its culture (Morgan, 1997). Within a social mental model style “the organization is viewed as a collectivity to which employees belong rather than just a workplace comprising separate individuals [...] there is considerable emphasis on interdependence, shared concerns, and mutual help” (Morgan, 1997, p. 122). Group culture can be described as “a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems” (Schein, 2004, p. 17). Culture is made up of artifacts, including “all the phenomena that one sees, hears and feels when one encounters a new group with an unfamiliar culture” (Schein, 2004, p. 25). Culture includes espoused beliefs and values and underlying assumptions about the organization.

An individual with a social mental model style views their organization as a hub of social activity. Relationships, team building, and other group activities are core to the social style along with corporate culture, power and politics, group dynamics, intergroup communication, and how these systems change (Cummings and Worley, 1997). A sense of belonging and connectedness is extremely important to an individual with a social mental model style. The process of scenario planning may be very exciting for someone with this style because scenario planning provides the opportunity to engage others in conversation and debate. This openness to exploring

new ideas in a *socially* engaging manner may make these mental model styles more adaptable to change.

Scenario planning is a social process and a social activity, based on group interaction and group decision-making. Scenario planning participants are often uncomfortable with group decision-making at first, but quickly adjust to its social nature.

H4. Individuals who engage in scenario planning will tend to increase their reliance on a social mental model style.

Systems mental model style. Individuals with systems-based mental-model styles view organizations as a series of inputs, processes, and outputs. This framework includes a feedback loop that allows adjustments to the system (Swanson and Holton, 2009). Basic to HRD theory and practice, systems thinking can be defined as “a conceptual framework, a body of knowledge and tools that have been developed over the past 50 years, to make full patterns clearer, and to help us see how to change them effectively”. The ability to think about an organization as a system provides a unique perspective on the impact of changes to the system, both from internal and external sources. Systems thinkers understand the parts that make up the whole and the relationship between the two. This is believed to enable them to process change more easily.

Within a systems-based organization the ability to learn and change may be based on the idea of double-loop learning. This learning depends on an individual’s ability to frame and then reframe, or to change the way in which a new concept or idea is perceived (Senge, 1990, 2006). This learning requires the ability of employees to understand “the paradigms, metaphors, mind-sets, or mental models that underpin how the organization operates” (Morgan, 1997, p. 92). Understanding how organizations operate may help individuals to implement change more easily. Most critical is the ability to change ones’ own mental model in order to view the future of an organization through a new lens (Morgan, 1997). A mental model style which views an organization as a system may be more readily changed by scenario planning.

Again, because scenario planning emphasizes understanding the organization as a system in its environment, scenarios are expected to promote a systems view. To clarify, participants begin to understand their organization as a system in a dynamic context, and this understanding is often powerful and transformational.

H5. Individuals who engage in scenario planning will tend to increase their reliance on a systems mental model style.

Theoretical framework – scenario planning

A key proposed tool for changing mental models is scenario planning, particularly in teams as scenario planning lends itself to group dialogue, conversation, and decision making (Bradfield, 2008; Bradfield *et al.*, 2005; Burt and van der Heijden, 2003; Chermack, 2003; Kleiner, 2008). Scenario planning can be described as an “alternative to traditional strategic planning with recognition of the unpredictable nature of the future” (Chermack, 2011, p. 7). Within scenario planning the uncertainty of the future becomes part of the organization’s plan (Schoemaker, 1992, 1995). Expanding the view beyond the financial plan or the capital budget allows employees freedom to explore future possibilities without limiting the boundaries (Mintzberg *et al.*, 1998, 2005). The process of participating in scenario planning is believed to have multiple benefits for

the organization and its participants (Chermack, 2011; van der Heijden, 1997; Schwartz, 1991). It is generally theorized that participation in scenario planning will contribute to employee learning and increased capacity to think in innovative and challenging ways (van der Heijden, 1997; Schwartz, 1991). Learning in this case is not just learning the answer, but learning as a continuous process (Michael, 1995). This continuous process involves:

- learning to re-perceive or reinterpret a situation;
- learning how to apply that re-perception to the formulation of policy and the specification of action (including evaluation of policy and action);
- learning how to implement those policies and intended actions; and
- learning how to keep these three earlier requirements alive and open to continual revision (Michael, 1995, p. 461).

Scenario planning theory is argued as a strong potential approach to revealing, analyzing and reconstructing mental models. Theorizing is based on the assumption that organizations are systems of feedback loops that spread the dominant mental model and cultural artifacts through interaction (Weick, 1990); and considerable other theoretical work positions scenario planning as such a mechanism (Bradfield, 2008; Bradfield *et al.*, 2005; Burt and van der Heijden, 2003; Chermack, 2003).

Scenario planning is 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” (Chermack and Lynham, 2002, p. 16). Key outputs of scenario planning are plausible alternative stories about the future, dialogue within the organization leading to organizational learning about key decisions and priorities, changed decision making patterns, and performance improvements (Chermack, 2011; van der Heijden, 1997; Schwartz, 1991).

Scenario building can help decision makers reconsider their long-term strategy in light of uncertainty and a fast changing environment. It can help organizational leaders reframe their company’s identity, their operating assumptions, their values, and their vision for the future” (Allee, 1997, p. 179). Senge (1994) theorized three stages of organizational learning:

- (1) mapping mental models;
- (2) challenging mental models; and
- (3) improving mental models.

Scenario planning has been conceptually, logically, and theoretically argued as a tool for meeting all three of these stages (Georgantzias and Acar, 1995; Shoemaker, 1992), although research is lacking to ground the theoretical argument in observed data. Perhaps most influential was Wack’s (1985) comment after 30 years of facilitating scenario planning in a variety of contexts. If his scenarios did not address the mental models of their users, the scenarios “would be like water on stone” (p. 34).

It is well argued in a variety of scenario planning sources that one key outcome is to change the way users think about a certain issue or problem, and thus to change the users mental model about it. The purpose of this section has been to acknowledge the

theoretical and conceptual connection between scenario planning and changed mental models rather than to provide a full review (for a full review, see Bradfield, 2008; Chermack, 2011; Schwartz, 1991; van der Heijden, 1997, 2005). The other purpose of this section was to highlight that a connection between scenario planning and changed mental models has been conceptual, theoretical and anecdotal at best, and that no rigorous research has been undertaken to investigate the relationship. One key barrier is the lack of an appropriate measure of mental models that would facilitate data collection with a large sample. Given the emergence of the Mental Model Style Survey, it seemed logical that the next step was to use the measure in the context of scenario planning, ultimately to confirm or disconfirm the espoused relationship of scenario planning to mental models. The question of whether participation in scenario planning can influence learning enough to change an individual's mental model style is the focus of this research and the method for inquiry provided in the following section.

Method

This section describes the sample, instrument, data collection, and analysis procedures, including research limitations. It then presents the hypotheses that were the basis of this study along with the results of the survey of mental model styles.

Sample

The sample for this study was comprised of participants in scenario planning projects from ten organizations. Participant job titles ranged from line workers to executive managers. Following receipt of Institutional Review Board (IRB) approval employees were asked to complete survey pretests one week before and survey posttests two weeks after the scenario planning workshops were conducted. On average the length of time between pretest and posttest was 14 weeks. Control groups were not used in this study, a common limitation in social science intervention-based research.

Lack of a control group may severely limit the ability to say with confidence that the intervention caused the results (Gliner *et al.*, 2009). As interest in scenario planning and its outcomes increase, more rigorous studies need to use control groups to establish the true ability of scenario planning to cause certain changes in participant perceptions and behaviors (Gliner *et al.*, 2009).

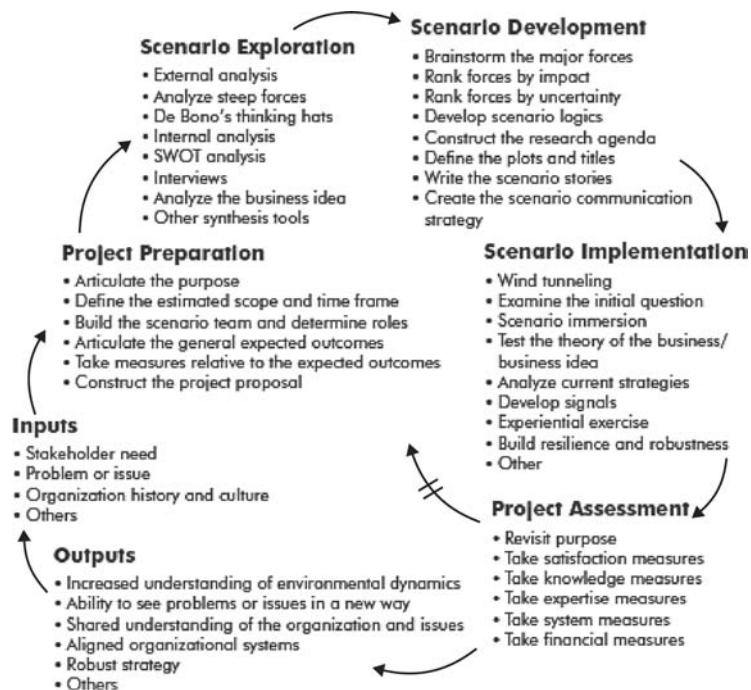
Scenario planning projects were conducted over a two-year time period. Each project lasted an average of 12 to 14 weeks and 129 participants took part in the research study. Each scenario planning participant was offered the opportunity to participate in the research, thus the participants were self-selected. Participant job titles ranged from line workers to executive managers. Following receipt of Institutional Review Board (IRB) approval participants were asked to complete surveys one week before and two weeks after the scenario planning workshops were conducted. On average the length of time between pretest and posttest was 14 weeks.

The influence of seeing the test before the scenario planning workshops is unknown. While a minimum of nine weeks passed from pretest to posttest, it is possible that some participants may have been influenced by or recalled some of their pretest responses. Some participants may have retained information from the pretest enabling them to recall previous answers (Gliner *et al.*, 2009). This sensitization can affect posttest responses.

Brief description of the intervention. The approach to the scenario planning intervention for this research study followed the model in Figure 1 (Chermack, 2011). Facilitators were given the same scenario planning materials and were trained by the same individual. Each team had the creative freedom to customize the workshops according to organization, context, and industry nuances (as scenario planning practices demand). Thus, while there was some variation in the specific project details, all projects followed the same general framework (as in Figure 1) and were advised by a single project leader who oversaw ten scenario projects.

While leaders in each organization sought scenario planning with different strategic issues, and with different specific purposes in mind, all were generally interested in addressing the uncertainty inherent in their operating environments. The major workshops that all ten organizations followed were:

- (1) A pre-work introduction, distribution of pretests, description of the project and informed consent to participate in our research.
- (2) Interviews with six and ten individuals from the organization to surface the strategic agenda.
- (3) A workshop to clarify the strategic issue, and brainstorm the forces affecting that issue.
- (4) A workshop to rank the brainstormed issues from 3, first on impact on the strategic issue, then on uncertainty.



Source: Chermack (2011)

Figure 1.
Performance-based
scenario planning

- (5) Experimentation with high impact – high uncertainty items to create the 2×2 scenario matrix.
- (6) Construction/presentation of the scenario narratives.
- (7) Windtunneling workshop 1.
- (8) Windtunneling workshop 2.
- (9) Project summary, debrief, and posttest data collection.

Instrument

The instrument used in this survey was the Mental Model Style Survey (MMSS). Utilizing five mental model styles this instrument asks employees to rate their organization using a five-point Likert scale of never (1) to always (5). The instrument describes five mental models for considering organizations including: political, financial, efficiency, social, and systems. It is believed that pre-determined mental models may inhibit creative thinking in organizations (Shoemaker, 1992). It is suggested that one way to change pre-determined models is through scenario planning (Chermack, 2003).

The instrument required self-reported measures of mental model styles. Even with evidence of the validity and reliability of the data, the participants were self-selected and the data are self-reported perceptions as opposed to objective or observed behavior (Gliner *et al.*, 2009). Given the content of the survey it may be difficult to obtain anything but subjective data. This makes it difficult to assess the congruence between what people may claim, how they chose to act, and how they actually perceive the organization they work for (Argyris and Schön, 1996).

Data collection

The purpose of this pretest posttest methodology was to explore the impact of scenario planning on mental model styles used by participants to view the organizations they work for. In other words, the goal was to measure whether or not participant mental models shifted over the course of the scenario project. Data were collected in the same manner for both the pre- and posttest. Prior to beginning the scenario planning work sessions, participants were asked to complete a survey to assess the mental model style they used when considering their organization. At the end of the scenario planning sessions the individuals were asked to complete the same survey. Data from the surveys were entered manually into IBM SPSS software for statistical analysis.

Data analysis strategy

The data analysis strategy was to perform *t*-tests on each factor of the Mental Model Style Survey to determine whether or not data supported or refuted the five hypotheses proposed as the core of this research. Thus, five *t*-tests were performed between participant pretest scores, and posttest scores on:

- (1) political mental model style;
- (2) financial mental model style;
- (3) efficiency mental model style;
- (4) social mental model style; and
- (5) systems mental model style.

Results

This section presents the results of a reliability analysis for each factor, and the five *t*-tests with effect sizes. Table I presents the summary data, followed by descriptions of the hypotheses tested and the corresponding results.

Hypothesis One – Political Mental Model Style

A paired samples *t*-test indicated that after participating in scenario planning sessions participants exhibiting political mental models reported a change in their mental model style, $t(128) = 4.317, p < 0.001, d = 0.38$. The change is statistically significant with a small to medium effect size, according to Cohen (1988). The mean score decreased from the pretest to the posttest, an indication that the individuals' mental model shifted to a less politically oriented style following the scenario planning workshops.

Hypothesis Two – Financial Mental Model Style

A paired or correlated samples *t* test indicated that individuals with financial mental model styles did not show a significant change after participating in scenario planning sessions, $t(128) = -0.309, p = 0.758, d = -0.027$. These results indicate that individuals with financial mental model styles may be more difficult to influence with scenario planning. A common stereotype of individuals with financial training is that they tend to be inflexible thinkers. While not significant the mean score increased slightly from pre- to posttest.

Hypothesis Three – Efficiency Mental Model Style

A paired or correlated samples *t*-test indicated that after participating in scenario planning employees with efficiency mental model styles showed statistically significant changes in their mental model styles, $t(128) = -2.347, p = 0.020, d = -0.21$. While the change is statistically significant, the effect size was small according to Cohen (1988). In addition, the mean scores increased from pre- to posttest indicating that participation in scenario planning enforces or encourages individuals to consider their organizations using an efficiency mental model style.

Hypothesis Four – Social Mental Model Style

A paired or correlated samples *t* test indicated that after participating in scenario planning sessions employees with social mental model styles exhibited statistically significant changes, $t(128) = -2.267, p = 0.025, d = -0.20$. While the change is statistically significant, the effect size is small according to Cohen (1988). The mean

Table I.
T-test results with effect sizes for five mental model styles, with scenario planning as the intervention

Mental model style	<i>M</i> pre	<i>M</i> post	<i>M</i>	SD	Std error mean	<i>t</i>	df	Sig. (2-tailed)	<i>d</i>
Political	2.41	2.12	0.29	0.76	0.07	4.32	128	0.00**	0.38
Financial	3.05	3.07	-0.02	0.86	0.08	-0.31	128	0.76	-0.03
Efficiency	3.26	3.41	-0.14	0.70	0.06	-2.35	128	0.02*	-0.21
Social	2.82	3.03	-0.21	1.05	0.09	-2.27	128	0.03*	-0.20
System	3.53	3.96	-0.43	0.86	0.08	-5.73	128	0.00**	-0.50

Notes: *Significant at $\alpha < 0.05$; **Significant at $\alpha < 0.01$

scores increased for the social mental models, establishing evidence that scenario planning may reinforce a participant's use of a social mental model style when considering their organization.

Hypothesis Five – Systems Mental Model Style

A paired samples *t* test indicated that after participating in scenario planning sessions participants with systems mental model styles showed statistically significant changes in their mental models, $t(128) = -5.729, p < 0.001, d = -0.50$. The effect size is medium according to Cohen (1988) indicating a general change in the overall sample. The mean scores increased from pre- to posttest, indicating that scenario planning is indeed a mechanism for promoting and teaching systems thinking.

Implications for human resource development

There is value in understanding tools to promote changed mental models within HRD. HRD is based on foundational theories supporting performance improvement in organizations. In order for performance improvement to take place learning and change must occur on one or many levels. These levels of performance include individual, group, systems, and organizational (Swanson and Holton, 2009). While it is believed that mental models are difficult to change (Chermack, 2003) individuals often must begin to think differently in order to perform at different and more desirable levels (Pfeffer, 2005).

One solution proposed for changing individual thinking or mental models is scenario planning. Until now there has been a lack of empirical evidence supporting the theory that scenario planning helps to change or shift mental models. This research has shown that scenario planning holds promise as a tool for shifting mental models. The practical work of performance improvement requires a basis in foundational theory (Swanson and Holton, 2009). Theory building requires constant testing and refinement (Lynham, 2002) and this research contributes to Chermack's theory of scenario planning, thus contributing to the growing body of theory supporting HRD.

HRD practice

This research provides valuable evidence for HRD practitioners who may promote scenario planning as a way to engage and change the way individuals think about their organization. The ability to shift mental models may lead to more innovative and creative thinking which can drive many performance improvement initiatives. Many HRD interventions are focused on individual performance yet traditional training and development interventions often fall short of organizational needs (Swanson and Holton, 2009). Scenario planning offers a unique way to help individuals learn and thus change and improve their mental models.

Because scenario planning is typically a group interaction it seems that participation in scenario planning may also encourage the development of shared mental models, resulting in teams with a more cohesive, congruent view of the organization and its potential futures. The global business environment is more complex and tumultuous than ever. Organizations are in a continuous state of change, often due to mergers, acquisitions, and other significant interruptions. These changes may cause organizations to struggle for performance while integration of employees and business units take place. As businesses strive for a more global presence scenario

planning with its ability to influence team mental models may play a vital role in shifting corporate culture from what it was to what it is and needs to be for continued innovation and success.

Conclusions and implications for future research

We can conclude that participation in scenario planning may influence or change an individual's mental model used when thinking about their organization. This study provides evidence of a shift in political, efficiency, social, and system mental models styles following participation in scenario planning projects. This study does not provide evidence that participation in scenario planning projects result in a change to a financial mental model style. Specifically, this study provides evidence of a strong association between scenario planning and changes in four of five participant mental model styles. In other words, the data show that participants altered their mental model styles throughout the course of this research, but the study does not establish causation.

This research also provides evidence supporting Chermack's theory of scenario planning. Study participants indicated changes in their mental model styles following participation in scenario planning workshops. This study provides promising evidence that scenario planning may contribute to employee learning while increasing an employee's capacity to think in innovative and challenging ways by shifting mental models (van der Heijden, 1997; Schwartz, 1991). From a practical perspective this research provides support for the use of scenario planning in organizations as an effective tool for helping employees think differently. A shift in thinking may lead to higher levels of innovation and creativity, thus improving individual and organizational performance (Waples and Friedrich, 2011). This research focused on changing mental models has important implications for HRD in terms of the ability of scholars and practitioners to improve organizational performance using scenario planning as an intervention.

The results of this research contribute to the growing body of quantitative studies that attempt to document the results of scenario planning. This was the first research project making use of the Mental Model Style Survey in intervention research. Results clearly call for continued studies to further substantiate these findings. Future studies should include a control group, if possible, to isolate effects of the scenario planning intervention and establish causation. Future research might also use a follow-up posttest occurring at least six months after the scenario planning exercise. This additional posttest would give indications of the long-term effects of scenario planning.

While there are some limitations to this research, the study documents one of the largest sample sizes to date in scenario planning research and makes a clear contribution in clarifying significant changes in mental model styles from pretest to posttest. The greatest improvement to make in future studies will be the addition of a control group, however, the data in this study show strong evidence that participation in scenario planning interventions leads to changes in mental model styles.

References

Al-Diban, S. and Ifenthaler, D. (2011), "Comparison of two analysis approaches for measuring externalized mental models", *Educational Technology and Society*, Vol. 14 No. 2, pp. 16-30.

-
- Allee, V. (1997), *The Knowledge Evolution: Expanding Organizational Intelligence*, Focal Press, Newton, MA.
- Argyris, C. and Schön, D.A. (1996), *Organizational Learning II: Theory, Method, and Practice*, Addison-Wesley, Reading, MA.
- Bolman, L.G. and Deal, T.E. (2008), *Reframing Organizations: Artistry, Choice and Leadership*, Jossey-Bass, San Francisco, CA.
- Bradfield, R.M. (2008), "Cognitive barriers in the scenario development process", *Advances in Developing Human Resources*, Vol. 10 No. 2, pp. 198-215.
- Bradfield, R., Wright, G., Burt, G., Cairns, G. and van der Heijden, K. (2005), "The origin and evolution of scenario techniques in long range business planning", *Futures*, Vol. 37 No. 2, pp. 795-812.
- Brehmer, B. (1990), "Strategies in real-time, dynamic decision making", in Hogarth, R. (Ed.), *Insights in Decision Making*, University of Chicago Press, Chicago, IL, pp. 262-91.
- Brehmer, B. (1992), "Dynamic decision making: human control of complex systems", *Acta Psychologica*, Vol. 81, pp. 211-41.
- Burt, G. and van der Heijden, K. (2003), "First steps: towards purposeful activities in scenario thinking and future studies", *Futures*, Vol. 35 No. 10, pp. 1011-26.
- Carley, K. and Palmquist, M. (1992), "Extracting, representing, and analyzing mental models", *Social Forces*, Vol. 70 No. 3, pp. 601-36.
- Chermack, T.J. (2003), "Mental models in decision making and implications for human resource development", *Advances in Developing Human Resources*, Vol. 5 No. 4, pp. 408-22.
- Chermack, T.J. (2011), *Scenario Planning in Organizations: How to Create, Use, and Assess Scenarios*, Berrett-Koehler, San Francisco, CA.
- Chermack, T.J. and Lynham, S.A. (2002), "Definitions and outcome variables of scenario planning", *Human Resource Development Review*, Vol. 1 No. 3, pp. 366-83.
- Chermack, T.J. and Lynham, S.A. (2004), "Scenario planning in critical science research", *Futures Research Quarterly*, Vol. 20 No. 2, pp. 41-60.
- Chermack, T.J., Glick, M.B., Cummins, J. and Veliquette, A. (2011a), "The development and validation of an instrument for measuring mental model styles", *International Journal of Technology Intelligence and Planning*, Vol. 7 No. 3, pp. 250-68.
- Chermack, T.J., Song, J.H., Nimon, K., Choi, M. and Korte, R.F. (2011b), "The development and assessment of an instrument for measuring mental model styles", in Graham, C., Dirani, K. and Wang, J. (Eds), *Academy of Human Resource Development Conference Proceedings*, Academy of Human Resource Development, Bowling Green, OH.
- Cohen, J. (1988), *Statistical Power Analysis for the Behavioral Sciences*, L. Erlbaum Associates, Hillside, NJ.
- Craik, K.J.W. (1957), *The Nature of Explanation*, Cambridge University Press, Cambridge.
- Cummings, T.G. and Worley, C.G. (1997), *Organization Development and Change*, South-Western Cengage Learning, Mason, OH.
- Denrell, J., Fang, C. and Levinthal, D.A. (2004), "From T-mazes to labyrinths: learning from model-based feedback", *Management Science*, Vol. 50 No. 10, pp. 1366-78.
- Doyle, J.K. and Ford, D.N. (1998), "Mental models concepts for system dynamics research", *Systems Dynamics Review*, Vol. 14 No. 1, pp. 3-29.
- Doyle, J.K. and Ford, D.N. (1999), "Mental models concepts revisited: some clarifications and a reply to Lane", *Systems Dynamics Review*, Vol. 15 No. 4, pp. 411-5.

- Dudzinska-Przesmitski, D. and Grenier, R.S. (2009), "Gone fishin': a review of approaches to eliciting mental models", in Graham, C., Dirani, K. and Wang, J. (Eds), *Academy of Human Resource Development Conference Proceedings*, Academy of Human Resource Development, Bowling Green, OH.
- Ford, D.N. and Serman, J.D. (1998), "Expert knowledge elicitation to improve formal and mental models", *Systems Dynamics Review*, Vol. 14 No. 4, pp. 309-40.
- Forrester, J.W. (1961), *Industrial Dynamics*, MIT Press, Cambridge, MA.
- Gary, M.S. and Wood, R.E. (2011), "Mental models, decision rules, and performance heterogeneity", *Strategic Management Journal*, Vol. 32 No. 6, pp. 569-94.
- Gavetti, G. and Levinthal, D. (2000), "Looking forward and looking backward: cognitive and experiential search", *Administrative Science Quarterly*, Vol. 45 No. 1, pp. 113-37.
- Gentner, D. and Stevens, A.L. (1983), *Mental Models*, Lawrence Erlbaum Associates, Hillsdale, NJ.
- Georgantzias, N.C. and Acar, W. (1995), *Scenario-Driven Planning: Learning to Manage Strategic Uncertainty*, Quorum, Westport, CT.
- Gliner, J.A., Morgan, G.A. and Leech, N.L. (2009), *Research Methods in Applied Settings: An Integrated Approach to Design and Analysis*, 2nd ed., Taylor and Francis Group, LLC, New York, NY.
- Johnson-Laird, P. (1983), *Mental Models*, Cambridge University Press, Cambridge.
- Kitaygorodskaya, N. (2006), "Measurement of team knowledge: transactive memory system and team mental models", in Maula, M. (Ed.), *Proceedings of the Research Forum to Understand Business in Knowledge Society*, ICEB+eBRF, Tampere, pp. 1-6.
- Kleiner, A. (2008), *The Age of Heretics*, 2nd ed., Jossey-Bass, San Francisco, CA.
- Lynham, S.A. (2002), "The general method of theory-building research in applied disciplines", *Advances in Developing Human Resources*, Vol. 4 No. 3, pp. 221-41.
- McCarthy, A. and Garavan, T.N. (2008), "Team learning and metacognition: a neglected area of HRD research and practice", *Advances in Developing Human Resources*, Vol. 10 No. 4, pp. 509-24.
- Michael, D.N. (1995), "Barriers and bridges to learning in a turbulent human economy", in Gunderson, L., Holling, C. and Light, S. (Eds), *Barriers and Bridges to the Renewal of Ecosystems and Institutions*, Columbia University Press, New York, NY, pp. 461-85.
- Mintzberg, H. (2009), *Managing*, Berrett-Koehler Publishers, San Francisco, CA.
- Mintzberg, H., Ahlstrand, B. and Lampel, J. (1998, 2005), *Strategy Safari: A Guided Tour Through the Wilds of Strategic Management*, Free Press, New York, NY.
- Mohammed, S. and Dumville, B.C. (2001), "Team mental models in a team knowledge framework: expanding theory and measurements across disciplinary boundaries", *Journal of Organizational Behavior*, Vol. 22 No. 2, pp. 89-106.
- Morgan, G. (1997), *Images of Organization*, 2nd ed., Sage Publications, Thousand Oaks, CA.
- Morgan, G.A., Leech, N.L., Gloeckner, G.W. and Barrett, K.C. (2011), *SPSS for Introductory Statistics Use and Interpretation*, 4th ed., Routledge, New York, NY.
- Pavlov, I.P. (1957), *Experimental Psychology, and Other Essays*, Philosophical Libraries, New York, NY.
- Pfeffer, J. (2005), "Changing mental models: HR's most important task", *Human Resource Management*, Vol. 44 No. 2, pp. 123-8.
- Schein, E.H. (2004), *Organizational Culture and Leadership*, 3rd ed., Jossey-Bass, San Francisco, CA, pp. 1-37.

-
- Schwartz, P. (1991), *The Art of the Long View*, Doubleday, New York, NY.
- Scott, S.G. and Bruce, R.A. (1995), "Decision-making style: the development and assessment of a new measure", *Educational and Psychological Measurement*, Vol. 55 No. 5, pp. 818-31.
- Senge, P. (1990, 2006), *The Fifth Discipline*, Doubleday, New York, NY.
- Senge, P. (1994), "Learning to alter mental models", *Executive Excellence*, Vol. 11 No. 3, pp. 16-17.
- Shoemaker, P.J.H. (1992), "How to link strategic vision to core capabilities", *Sloan Management Review*, Fall, pp. 67-80.
- Shoemaker, P.J.H. (1995), "Scenario planning: a tool for strategic thinking", *Sloan Management Review*, Vol. 37 No. 2, pp. 25-40.
- Simon, H.A. (1957), *Administrative Behavior*, Macmillan, New York, NY.
- Skinner, B.F. (1953), *Science and Human Behavior*, Macmillan, New York, NY.
- Swanson, R.A. (1994), *Analysis for Improving Performance: Tools for Diagnosing and Documenting Workplace Expertise*, Berrett-Koehler Publishers, San Francisco, CA.
- Swanson, R.A. and Holton, E.F. (2009), *Foundations of Human Resource Development*, 2nd ed., Berrett-Koehler Publishers, San Francisco, CA.
- Sweeney, L.B. and Serman, J.D. (2000), "Bathtub dynamics: initial results of a systems thinking inventory", *Systems Dynamics Review*, Vol. 16 No. 4, pp. 249-86.
- van der Heijden, K. (1997), *Scenarios: The Art of Strategic Conversation*, John Wiley and Sons, Chichester.
- van der Heijden, K. (2005), *Scenarios: The Art of Strategic Conversation*, 2nd ed., John Wiley and Sons, Chichester.
- van der Merwe, L. (2008), "Scenario-based strategy in practice: a framework", *Advances in Developing Human Resources*, Vol. 10 No. 2, pp. 216-39.
- Wack, P. (1985), "Scenarios: the gentle art of re-perceiving", Harvard Business School, Boston, MA, unpublished manuscript.
- Waples, E.P. and Friedrich, T.L. (2011), "Managing creative performance: important strategies for leaders of creative efforts", *Advances in Developing Human Resources*, Vol. 13 No. 3, pp. 366-85.
- Warren, K. (1995), "Exploring competitive futures using cognitive mapping", *Long Range Planning*, Vol. 28 No. 5, pp. 1-9.
- Weick, K.E. (1979), *The Social Psychology of Organizing*, Addison Wesley, Reading, MA.
- Weick, K.E. (1985), "Sources of order in underorganized systems: themes in recent organizational theory", in Lincoln, Y.S. (Ed.), *Organizational Theory and Inquiry*, Sage Publications, Beverly Hills, CA, pp. 106-36.
- Weick, K.E. (1990), "Introduction: cartographic myths in organizations", in Sigismund Huff, A. (Ed.), *Mapping Strategic Thought*, John Wiley & Sons, New York, NY, pp. 1-10.
- Weick, K.E. and Roberts, K.H. (1993), "Collective mind in organizations: heedful interrelating on flight decks", *Administrative Science Quarterly*, Vol. 38 No. 3, pp. 357-81.

Further reading

- Dillman, D.A., Smyth, J.D. and Christian, L.M. (2009), *Internet, Mail and Mixed-Mode Surveys: The Tailored Design Method*, 3rd ed., John Wiley and Sons, Hoboken, NJ.
- Fernández-Berrocal, P. and Santamaria, C. (2006), "Mental models in social interaction", *Journal of Experimental Education*, Vol. 74 No. 3, pp. 229-48.

Appendix

Use the checklist which follows to assess your own mental model style in the context of your organization and work responsibilities (see Figure A1).

MENTAL MODEL STYLE

Use the check list below to assess your own mental model style in the context of your organization and work responsibilities.

Name _____

Complete the following statements by indicating how you view the organization in which you work.

When considering my organization...

Never	Sometimes	Often	Usually	Always
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MENTAL MODEL STYLE

1) Organizations are primarily forums for political maneuvering.	1	2	3	4	5
2) Managers should do what is necessary to meet and exceed the expectations of senior managers.	1	2	3	4	5
3) Negotiating a personal agenda is my core purpose in my organization.	1	2	3	4	5
4) The most important metric of organizational health depends on the views of the CEO.	1	2	3	4	5
5) People are often used for leverage in a political game in organizations.	1	2	3	4	5
6) The most important metric of organizational health is the balance sheet.	1	2	3	4	5
7) The main goal of organizations is to provide financial return on investment to shareholders.	1	2	3	4	5
8) Organizations primarily economic entities.	1	2	3	4	5
9) The most important responsibility that managers have is to ensure high returns on all investments.	1	2	3	4	5
10) People are a resource that can be quantified in organizations.	1	2	3	4	5
11) Providing the highest quality output with the most efficient process should be the main goal of any organization.	1	2	3	4	5
12) Organizations are primarily productive, efficient entities.	1	2	3	4	5
13) The most important managerial goals is to ensure that processes run as smoothly and efficiently as possible.	1	2	3	4	5
14) The most important metric of organizational health is its productive output.	1	2	3	4	5
15) Human expertise is the critical element that makes productive output possible in organizations.	1	2	3	4	5
16) I think that a high quality of work life should be the main goal of any organization.	1	2	3	4	5
17) I view organizations primarily as social entities in which people can connect with other people.	1	2	3	4	5
18) The key goal of managers is to establish a harmonious workplace.	1	2	3	4	5
19) The most important metric of organizational health is the level of satisfaction reported by employees.	1	2	3	4	5
20) People and their social connections are what make organizations possible.	1	2	3	4	5
21) Organizations are best viewed as complex networks of interrelated components.	1	2	3	4	5
22) Organizations are complex entities.	1	2	3	4	5
23) Managers should view their key task as recognizing the implications of making changes in the organizational system.	1	2	3	4	5
24) Assessing organizational health is a complex task involving multiple measures.	1	2	3	4	5
25) People are critical components in the complex organizational system.	1	2	3	4	5

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Figure A1.
Mental model style

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