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Studying scenario planning: Theory, research suggestions, and hypotheses

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Abstract

The scenario planning literature reveals a gap regarding its research and theory development. This article addresses these gaps by beginning the development of a theory of scenario planning and by providing suggestions for research. To do so, this research uses Dubin's (R. Dubin, Theory Building, revised ed., Free Press/MacMillan, New York, 1978) technique for theory building in applied disciplines and then provides suggestions for verifying each aspect of the proposed theory. While this research is preliminary in nature, its intent is to work toward a theoretical understanding and validation of scenario planning practices through sound research. Thus, the core purpose of this article is to provide an approach to studying scenario planning that is based on research, theory, and practice.

Keywords: Scenario planning; Theory; Research

1. Introduction

Organizational leaders have long sought to understand the environments in which they operate. Several methods, including strategic planning, open systems planning, integrated strategic change, and transorganizational development, have surfaced to help organizational leaders achieve such alignment [1]. Scenario planning is another tool that has gained increased attention during the last 20 years as an effective method for examining future uncertainties and investigating assumptions in organizations [2].

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2. Problem statement

Scenario planning appears to have utility in planning for the future [2–4]. In a world that changes too rapidly for prediction to be accurate, scenarios are gaining credibility as effective tools to prepare for an uncertain future, alter mental models, test decisions, and improve performance in a dynamic environment [5]. The demand for tools like scenario planning has exploded, and therefore practitioners have been charged with answering difficult questions about how organizational leaders might best consider the future. With the practice of scenario planning set firmly in place and continuing to develop rapidly, a body of research and theory that describes and explains the phenomenon does not exist.

The problem is that there has been inadequate research and theory development to support the fast growing practice of scenario planning.

Theory building research will therefore be a valuable contribution to the scenario planning literature. Dubin's [6] specific eight-step theory building research method (Fig. 1) is one way to construct a theory of scenario planning and to fill the research and theory void. Other methods include Lynham's [7] general method and Van de Ven's [8] diamond model.

3. Methodology

Dubin's [6] eight-step theory building methodology consists of (1) developing the units of the theory, (2) specifying the laws of interaction describing the relationships among the units, (3) determining the boundaries within which the theory is expected to function, (4) identifying the system states in which the theory is expected to function, (5) specifying the propositions or truth statements about how the theory is

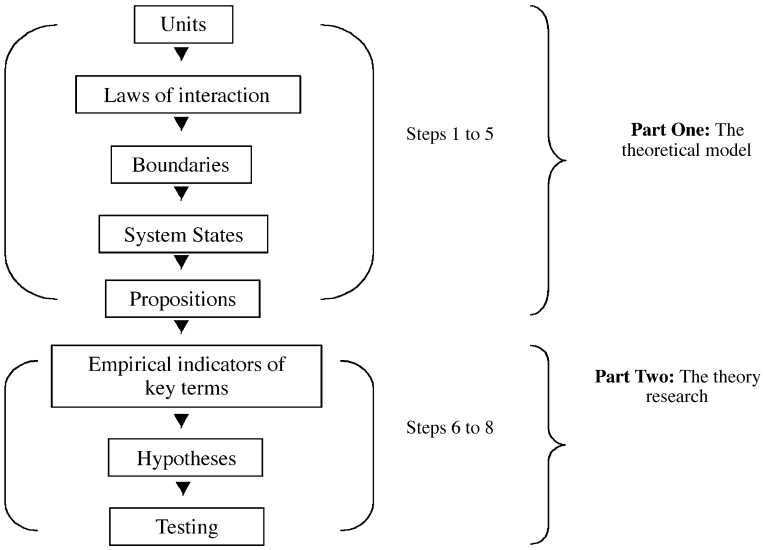


Fig. 1. Dubin's [6] eight-step theory building research methodology.

expected to operate, (6) identifying the empirical indicators used to make the propositions testable, (7) constructing hypotheses used to predict values and relationships among the units, and (8) conducting research to test the predicted values and relationships.

Dubin's [6] theory building method is judged the most appropriate research method because (1) it is the most comprehensive method of theory building available, (2) it requires that the researcher/theorist construct a theoretical model based on conceptual and logically connected ideas, (3) it requires the translation of that theoretical model into testable hypothesis about how the theory works in practice, (4) it requires that the theoretical model be tested in order to claim that a theory exists and finally, and (5) through the identification of hypothesis, it provides a demand for empirical research.

4. Units of a theory of scenario planning

"The theorist has unlimited opportunities to employ units of his [or her] choice" Ref. [6, p. 78]. The units of the theory are the building blocks of the theory and are selected based on the scenario planning literature. The units of a theory of scenario planning are thus (1) scenario stories, (2) learning, (3) mental models, (4) decisions, and (5) performance. Each unit warrants further discussion.

4.1. Unit 1: Scenarios

Scenarios are "tools for ordering one's perceptions about alternative future environments in which one's decisions might be played out" Ref. [2, p. 4]. Alternatively, scenarios are a set of organized ways to dream effectively about our own future [2]. Scenarios can be thought of as stories. van der Heijden [4] identified that well-written scenarios (1) are internally consistent, (2) link historical and present events with hypothetical events in the future, (3) carry storylines that can be expressed in simple diagrams, (4) are internally consistent and plausible, (5) reflect predetermined elements or "those events that have already occurred. . .but whose consequences have not yet unfolded" Ref. [9, p. 4], and (6) identify signposts or indicators that a given story is occurring.

4.1.1. Research suggestions

Varying case studies attempt to document instances of scenario planning in practice; however, general descriptive data about the number of companies implementing scenario projects in different countries and how often are unavailable. Studies that document the increasing use of scenario planning are needed, as well as cases that document project failure. Phelps et al. [10] have provided some descriptive data about scenario planning in the water and IT industries in Europe that may serve as a template for further research applied in different industries in different countries.

4.2. Unit 2: Learning

Schwartz [2], van der Heijden [4], and de Geus [11] are key authors who have suggested that learning is a key component of scenario planning. The usefulness of learning in a system of scenario planning is embedded in the assumption that a core goal of any planning system is to reperceive [12] the organization and its environment. The ability to reperceive requires that individuals and groups learn

something new about the organization and its environment as well as to raise up the present and past perceptions of the organization [13,14].

4.2.1. Research suggestions

While the conceptual case linking learning and scenario planning has been made, there are no empirical studies that support or refute this relationship. Studies that assess this link in empirical terms are needed. For example, learning inventories might be used to assess participants before and after a scenario project and clarify whether a correlation exists. Further, learning can be assessed on three levels: (1) individuals, (2) groups, and (3) the organization itself [15].

4.3. Unit 3: Mental models

Learning in scenario planning often means challenging the assumptions that are taken for granted about the organization and its environment [16]. Mental models encompass those assumptions. Reperceiving the organization and its environment is thought to occur with learning as a driver that forces participants to reexamine their assumptions and alter their mental models [9]. Accurate mental models are also verified and shared during the dialogue required in scenario planning. Senge Ref. [16, p. 8] defined mental models as "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action. Very often, we are not consciously aware of our mental models or the effects they have on our behavior."

4.3.1. Research suggestions

Carely and Palmquist [17] have developed a quantitative method of analyzing mental models. Their method consists of transcribing interviews into text, and then using a software program with parameters set by the researcher to analyze the content of the interviews. The software then produces a concept map of the transcribed interview along with a statistical assessment of the map. Warren [18] provided another, more qualitative approach to developing and analyzing cognitive maps. Such tools could be used pre- and postscenario planning project implementations to assess the relationship between mental models and scenario planning.

4.4. Unit 4: Decisions

To decide, as an action, is to select a course of action or to come to a choice—to choose one among many. Plainly, a decision is "an act or process of reaching a conclusion or making up one's mind" [19]. The challenge in strategic situations becomes providing the decision maker with an adequate amount of the right information at the right time. Scenarios are advocated as one means of doing so. A key assumption with regard to decisions in this context is that decision making is conceived of as a process requiring multiple decisions rather than a single decision [20,21].

4.4.1. Research suggestions

Harries [22] provided a clear call for a more aggressive evaluation of the relationship between scenario planning and decision making. Additionally, Harries [22] introduced the question of what makes for good decision making in strategic contexts for scenario planning professionals to consider. Computer simulations and microworlds have been used in the cognitive sciences to assess individual

decision-maker performance [23]. Such simulations could be used pre- and postscenario planning projects to assess the relationship between decision-maker capability and performance.

4.5. Unit 5: Performance

Performance improvement is seen as the primary outcome of the planning system in this research. The other units of the theory of scenario planning are seen as performance drivers [24]. To clarify, scenarios, learning, mental models, and decisions are things that affect performance but do not embody performance themselves. Performance in the context of planning can be focused or general. For example, such performance outcomes might include increased shareholder value or a more general outcome such as better or ongoing fit with and assessment of the business environment [1,25].

4.5.1. Research suggestions

Phelps et al. [10] have provided the only study that examines the effects of scenario planning on firm performance. More studies like theirs are needed to establish the ultimate effectiveness of scenario planning. Given the high costs of designing and implementing a scenario project, the ability to suggest there will be a return on investment can only serve to advance both the theory and practice of scenario planning. Longitudinal studies that track corporations using scenario planning over time could provide valuable insights into the long-term benefits and pitfalls of using scenarios. Additionally, case studies of scenario use over time (such as the famed Royal Dutch/Shell examples) will also aid in developing a better understanding of scenario planning.

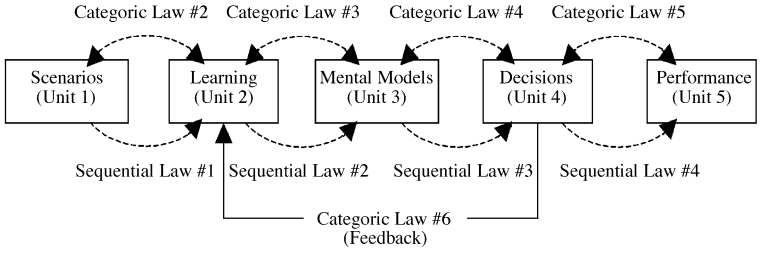
4.6. Summary

This section has introduced the units of a theory of scenario planning. Further, this section has provided justification for these particular units and has outlined some research that would further support the development of the theory or provide the data for altering and refining it.

5. Laws of interaction

The laws of interaction describe how the units relate to each other. In this research, the theory of scenario planning includes five categoric laws and four sequential laws (where "a categoric law of interaction is one that states that values of a unit are associated with values of another unit" Ref. [6, p. 98], and a sequential law of interaction is defined as a law that is "always employing a time dimension). The time dimension is used to order the relationship among two or more units" Ref. [6, p. 101].

All units are linked with categoric laws, as a change in any unit will provoke a change in at least one other unit. All units are also linked with sequential laws to stress the importance of the time element in scenario planning. The model does not include any determinant laws and designates scenario stories as catalyst units. The lack of determinant laws is based on the preliminary nature of this research. To clarify, not enough is known about the correlation among these units to warrant determinant laws; however, determinant laws may be developed as this research proceeds. Catalyst units are independent units



Categoric Laws
Law #1 -- All units are required for the theory to function.
There is a greater-than-chance probability that:
Law #2 -- Scenarios are assoiciated with learning.
Law #3 -- Learning is associated with mental models.
Law #4 -- Mental models are associatee with decisions.
Law #5 -- Decisions are associated with performance.
Law #6 -- Decisions are associated with learning.

Sequential Laws
There is a greater-than-chance probability that:
Law #1 -- Scenarios precede learning.
Law #2 -- Learning precedes the alteration of mental models.
Law #3 -- The alteration of mental models precedes improved decision-making.
Law #4 -- Improved decision-making precedes improved performance.

Fig. 2. The laws of interaction in the theory of scenario planning.

whose presence is required for other interaction in the theoretical model. A graphic depiction of the laws of interaction is displayed in Fig. 2.

6. Boundaries

The boundaries locate the theory in its environment. The determination of the boundaries requires the identification of the domains in which the theory operates [6]. In identifying the boundaries, the theorist must also make the logic used to determine those boundaries explicit. There are four potential boundaries concerning the practice and theory of scenario planning: (1) a process boundary, (2) a planning system boundary, (3) a performance system boundary, and (4) an organizational and contextual environment boundary. The boundaries of a theoretical model of scenario planning are provided graphically in Fig. 3.

All boundaries in the theory are open boundaries (as depicted by the dashed lines in Fig. 3), indicating that the system constantly exchanges information and resources among all domains. Planning in the organizational context will generally be thought of as a system [1]. This means that organizations consist of the general components that constitute a system, namely, inputs, processes, and outputs. Following the logic of general system theory and earlier work on scenarios as part of a larger planning system, scenario building is positioned as a process within the planning system [27].

7. System states

Dubin Ref. [6, p. 144] stated "a state of a system may be defined by three features: (1) all units of the system have characteristic values, (2) the characteristic values of all units are

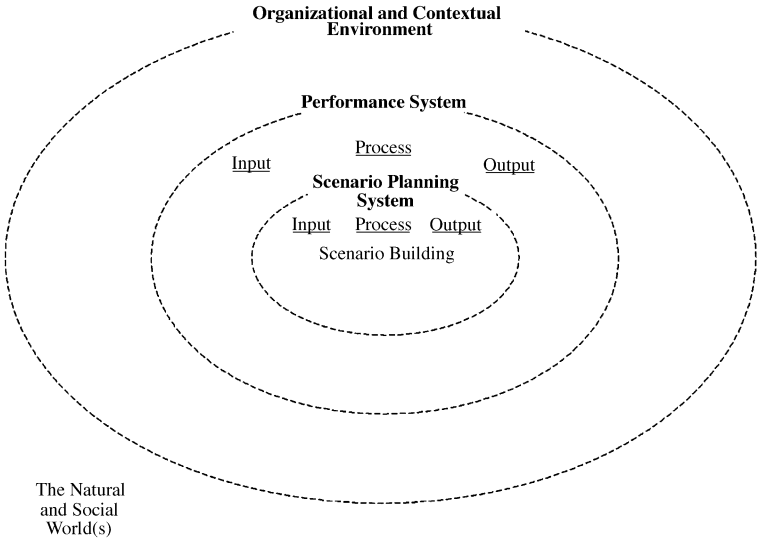


Fig. 3. The boundaries of a theory of scenario planning.

determinant, and (3) this constellation of unit values persists through time." It is necessary for the values of all units to be known in order to determine the system state.

Scenario planning is conceptualized as a system itself. Naturally then, the scenario planning system will vary and transition among several states. In order to illustrate the differing states of the system, the theory proposed will adopt (0,1) coding. By this, it is intended that 0 indicates none of the thing or characteristic under examination (for example, if the unit "scenarios" were coded 0, this would be taken to indicate that the scenarios have not been developed). The laws of interaction suggest that the theory of scenario planning occurs along a time sequence. That is, actions with regard to specific units precede actions with regard to others. As the system transitions from state to state, the unit values shift from 0 to 1.

There are six system states in the theory of scenario planning: (1) system state 1—nonoperation, (2) system state 2—scenario generation, (3) system state 3—reflection and learning, (4) system state 4—revealing and altering mental models, (5) system state 5—improving decision making, and (6) system state 6—assessing implications and performance.

Fig. 4 shows the theory of scenario planning in a state of nonoperation or prior to the development of scenarios. This is system state 1. In it, the values of each unit are known to be

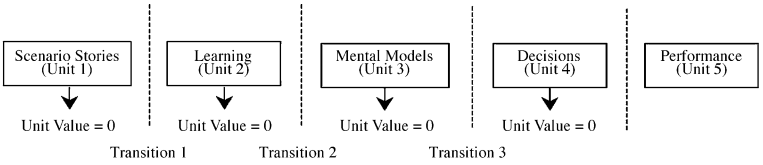


Fig. 4. System state 1 in a theory of scenario planning—nonoperation.

zero. System state 1 is also defined by the fact that its values persist over some course of time. This course of time, also known as its state life [6], is undefined as the time allotted to generate scenarios varies, as does the approach and preparation for scenario planning.

System state 1 can be defined using Dubin's [6] logic by the following statement:

> If all unit values in a theoretical model of scenario planning are equal to zero, then the model is in a state of nonoperation under the conditions that no scenarios have been developed.

The theory of scenario planning is set in motion through the generation of scenarios with relevance to a particular situation or issue [2]. As each unit is incorporated and affected, the theoretical model transitions through six system states as depicted in Fig. 4, with each corresponding system state value transitioning from 0 to 1.

7.1. System state 2: Scenario generation

System state 2 denotes that scenarios have been created and incorporated into the next state of the planning system. In this state, the unit value for scenarios is 1 and all remaining units are 0 (referring to Fig. 4, the unit value for "scenarios" becomes 1 and the others remain 0). This state is characterized by the use of scenarios to provoke learning in the organization context.

System state 2 can be defined using Dubin's [6] logic by the following statement:

> If scenarios are used in the planning system then, the value of the unit (scenarios) transitions from 0 to 1 under the conditions that a process of scenario building has been completed by the planning team.

7.2. System state 3: Learning and reflection

System state 3 indicates that the scenarios have been used to trigger learning among the participants in the planning system (referring to Fig. 4, the unit value for "scenarios" and "learning" are 1 and the others remain 0). System state 3 can be defined using Dubin's [6] logic by the following statement:

> If learning occurs in the scenario planning system, then the value of the unit (learning) transitions from 0 to 1 under the conditions that the scenarios are used to provoke dialogue, interaction, and thoughtful reflection by the planning team.

7.3. System state 4: Revealing and altering mental models

The unit value shift in mental models indicates that scenarios have triggered learning among the planning participants and that learning has altered the experiences, learning, assumptions, biases, and beliefs of the participants (referring to Fig. 4, the unit value for "scenarios," "learning," and "mental models" are 1 and the others remain 0).

System state 4 can be defined using Dubin's [6] logic by the following statement:

If mental models are altered in the scenario planning system, then the value of the unit (mental models) transitions from 0 to 1 under the conditions that learning has provoked new insight, revealed assumptions, and allowed participants to re-view their thinking about the organization and its positioning.

7.4. System state 5: Improving decision making

System state 5 presents the theoretical model of scenario planning in a state characterized by decision making. In this state, scenarios have been used to provoke learning, mental models have been altered, and the decisions have been pushed against multiple hypothetical situations (referring to Fig. 4, the unit value for "scenarios," "learning," "mental models," and "decisions" are 1 and the others remain 0).

System state 5 can be defined using Dubin's [6] logic by the following statement:

If decision making is improved in the scenario planning system, then the value of the unit (decisions) transitions from 0 to 1 under the conditions that changed mental models have provided increased, more diverse, more robust, and more challenging decision options.

7.5. System state 6: Examining implications and performance

At the state in which the value of the decision unit transitions from 0 to 1, there are two potential paths of feedback that may result from the next transition. In the first, the decisions directly impact organization performance. This state occurs when the focal issue that prompted engagement in scenario planning is one of explicitly improving organization performance. In this case, engagement in scenario planning has been focused on a specific issue of uncertainty and assessments of increased performance and preparation around that focal issue can be made. This state is characterized using Dubin's [6] logic in the following way:

If firm performance is improved in the scenario planning system, then the value of the unit (performance) transitions from 0 to 1, under the conditions that improved decision making has resulted in better organizational fit with the environment, and has exposed organizational decision makers to hypothetical but plausible future states that have fostered the development of signposts and anticipatory memory.

The second state is characterized by outcomes from the decisions unit being fed back into the learning unit. In this sense, the original reasoning for engaging in scenario planning may simply be one of ongoing monitoring or assessment of plausibilities. In this case, scenario planning is not targeted specifically at improving performance; rather, it is targeted at continuous learning about strategic options. However, it is inherent that firm performance is affected by such learning. When the theoretical model has reached a state in which all units have moved from 0 to 1, feedback from decisions becomes an input to the learning or scenario units and begins the process again from either point.

8. Propositions

Dubin stated, "A proposition may be defined as a truth statement about a model when the model is fully specified in its units, laws of interaction, boundary, and system states" Ref. [6, p. 160]. To clarify, propositions are predictive statements that follow logically from the previous steps of the theory building method. Propositions usually take the form of if–then statements and are also referred to as logical consequences. Thus, propositions can be thought of as the logical consequences or conclusions given the units, laws, boundaries, and system states that have provided structure for the theory. The logical consequences for a theory of scenario planning given the previous steps are as follows:

Proposition 1: *If scenarios are positively associated with learning, then learning will increase as a result of participation in scenario planning.*

Proposition 2: *If learning is positively associated with the alteration of mental models, then mental models change as a result of learning.*

Proposition 3: *If a change in mental models alters decision structure, then a change in mental model implies a change in the approach to decision making.*

Proposition 4: *If changes in decision making are positively associated with firm performance, then firm performance will increase as a result of altered decision-making strategies.*

Proposition 5: *If scenarios are positively associated with learning, learning is positively associated with altered mental models, altered mental models are positively associated with change in decision making, and change in decision making is positively associated with firm performance, then scenarios can be positively associated with firm performance.*

9. Empirical indicators of a theory of scenario planning

An empirical indicator is "an operation employed by a researcher to secure measurements of values on a unit" Ref. [6, p. 182]. Empirical indicators must produce reliable results or results that do not differ from observer to observer. Dubin [6] suggested the use of the phrase "as measured by" (for example, the value of unit A as measured by) to describe the empirical indicator used to produce the unit values. Dubin stated, "empirical indicators are valid if all members of a sample studied have the possibility of securing any of the scores measured by the indicator" Ref. [6, p. 204].

Scenarios constitute the catalyst unit of the theory [6]. Therefore, there is no empirical indicator required to provide a measurement of scenarios utilized in the planning system. By simply verifying that scenarios are used as the basis of the planning system, the researcher or theorist can confirm their presence. Thus, the empirical indicators begin with measurements of learning. The theory proposed specifies the operation of measurement in terms of multiple measurement devices. The reasoning behind this is simply that instruments must be developed to measure changes with specific regard to scenario planning. Perhaps the most intriguing aspect of this research as it unfolds in future studies will be the determination of

precisely how each of the units will be measured as it is the nuances and subtle differences that may account for large variance. The general empirical indicators of the proposed theory are as follows:

1. Empirical indicator 1: The value of unit (learning) will increase as a result of participation in scenario planning as measured by any instrument that measures learning about the strategy and strategic context of the organization.
2. Empirical indicator 2: The value of unit (mental models) will increase as a result of participation in scenario planning as measured by any instrument that measures the adjustment and alteration of mental models pertaining to the strategy and strategic context of the organization.
3. Empirical indicator 3: The value of unit (decisions) will increase as a result of participation in scenario planning as measured by any instrument that measures the improvement of decision making pertaining to the strategy and strategic context of the organization.
4. Empirical indicator 4: The value of unit (performance) will increase as a result of participation in scenario planning as measured by any instrument that measures firm performance.

10. Hypotheses of a theory of scenario planning

Hypotheses are "the predictions about values of units of a theory in which empirical indicators are employed for the named units in each proposition" Ref. [6, p. 206]. Hypotheses establish the link between the empirical world and the theoretical model that has been under construction. Each proposition must have at least one hypothesis that represents it. It is common, however, for each proposition to reveal several testable hypotheses. "The general rule is that a new hypothesis is established each time a different empirical indicator is employed for any one of the units designated in a proposition" Ref. [6, p. 209]. Thus, as the number of propositions increases, so does the number of possible hypotheses. Ultimately, however, the number of hypotheses investigated is a question of research preferences and energy available in a discipline and its researchers.

The hypotheses for the proposed theory are depicted in Figs. 5 and 6.

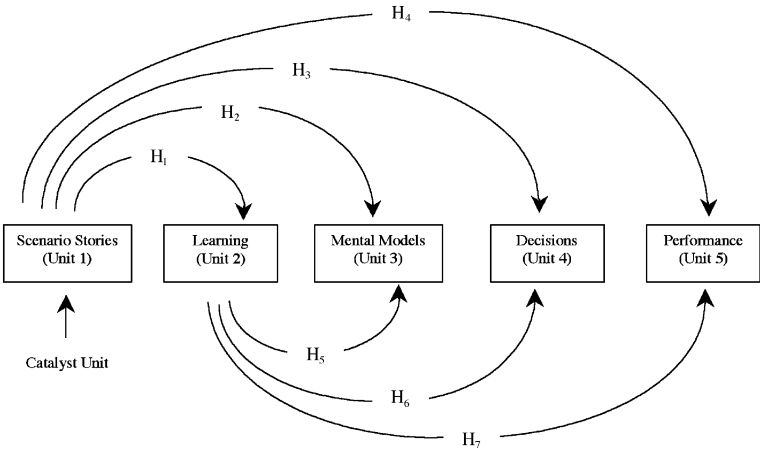


Fig. 5. 1 Hypotheses 2 Hypotheses 3 Hypotheses 4 Hypotheses 5 Hypotheses 6 Hypotheses 7 in a theory of scenario planning.

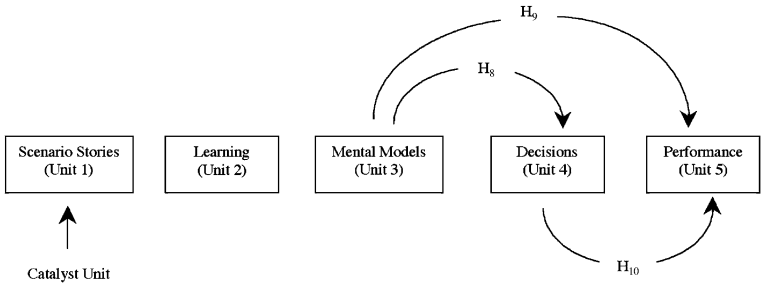


Fig. 6. 8 Hypotheses 9 Hypotheses 10 in a theory of scenario planning.

10.1. Participation in scenario planning

The following hypotheses pertain to participation in scenario planning. Generally, each hypothesis states the anticipation of a correlation between scenario planning and each other unit of the theory.

Hypothesis 1: There will be a positive relationship between participation in scenario planning and learning.

Hypothesis 2: There will be a positive relationship between participation in scenario planning and altered mental models.

Hypothesis 3: There will be a positive relationship between participation in scenario planning and improved decision making.

Hypothesis 4: There will be a positive relationship between participation in scenario planning and firm performance.

10.2. Learning

The following hypotheses pertain to learning in the strategic context brought about by engaging in scenario planning.

Hypothesis 5: There will be a positive relationship between learning and altered mental models.

Hypothesis 6: There will be a positive relationship between learning and improved decision making.

Hypothesis 7: There will be a positive relationship between learning and firm performance.

10.3. Mental models

The following hypotheses pertain to altered mental models in the scenario planning system.

Hypothesis 8: There will be a positive relationship between altered mental models and decision making.

Hypothesis 9: There will be a positive relationship between altered mental models and firm performance.

10.4. Decision making

The following hypothesis represents the anticipated relationship between improved decision making and firm performance.

Hypothesis 10: There will be a positive relationship between improved decision making and firm performance.

10.4.1. Research suggestions

The 10 hypotheses that have been presented intend to verify whether the units of the theory of are indeed correlated with scenario planning practice. At best, these hypotheses (if tested and the statistics found significant) could establish only that a relationship exits between these units and scenario planning practice. While correlations are helpful in the early phases of research, they will not allow statements of causality to be made.

10.5. Additional hypotheses

In addition to the first 10 hypotheses that verify or refute a relationship between the units of the theory, there are several additional hypotheses that are implied by the logic of the theory and they provide the basis for several further empirical studies to validate and confirm the theory. Such further hypotheses are as follows:

Hypothesis 11: Collective variance in use of scenarios and learning accounts for variance in firm performance.

Hypothesis 12: Collective variance in use of scenarios, learning, and altered mental models accounts for variance in firm performance.

Hypothesis 13: Collective variance in use of scenarios, learning, altered mental models, and decision-making accounts for variance in firm performance.

Hypothesis 14: Differing levels of participation in scenario planning account for variance in firm performance.

10.5.1. Research suggestions

Hypotheses 11–14 are specifically aimed at studies more complex than simple correlations. These hypotheses indicate the use of multiple regression and one-way ANOVA designs to test the proposed theory. It is however inappropriate to engage in such studies without first establishing that the units are indeed correlated. Thus, these more complex studies are needed only if the previous hypotheses are supported.

11. Conclusions for studying scenario planning

This article has proposed (1) a theory of scenario planning according to Dubin [6] and (2) a body of research to support or refute it. Included in this theory and research are multiple hypotheses and suggestions for studying scenario planning. While Dubin's [6] quantitative theory building method has been used in this case, the phenomenon of scenario planning lends itself to any and all of the methods detailed by Lynham et al. [28] or Van de Ven [8] among others.

This research has specified several hypotheses that once tested could confirm or disconfirm aspects of the theory proposed. In turn, this leads to further refinement and adjustment to the theory. Clearly, next steps include conducting more research in applied scenario planning projects by collecting and analyzing data to determine whether the assumptions made in the theory are valid. The theory proposed may also provoke alternative or counter theories that can only lead to rich discussions about the theory base of scenario planning and futures studies itself.

An important note about practicality can also be made at the conclusion of this article. That is, at first glance, there is little of immediate utility to managers and executives. However, as Cristensen and Raynor [29] have recently argued, good theories are valuable to managers for two key reasons: (1) they help us make predictions and (2) they help us understand what is happening in practice and why. The authors go on to argue that good theory is constructed in three phases, namely, (1) a description of some phenomenon is presented, (2) the phenomenon is classified into categories, and (3) hypotheses are formulated about what happens as a result of the phenomenon and why [29].

While this article offers a description of the scenario planning phenomenon, classifies it into categories, and presents hypotheses about the effects of scenario planning and the reasons for them, these elements conclude on a correlational level. That is, in order to make statements about the effects of scenario planning, it will be necessary for practitioners and researchers to examine scenario planning in companies and reveal the core "causal mechanisms" Ref. [29, p. 4] and "describe the circumstances under which it does and does not work" Ref. [29, p. 4]. In simpler terms, large statistical studies that correlate the elements presented and discussed in this article are helpful. To apply Cristensen and Raynor's [29] argument to this specific problem means that the true effects of scenario planning will not be known and will not become predictable until the phenomenon is examined rigorously in applied settings in which the circumstances of success and failure can be noted. As a potential basis for such investigation, this research has provided an emerging theory of scenario planning, hypotheses about how scenario planning works, and research suggestions to assess its accuracy.

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