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Scanning behavior and strategic uncertainty

Proposing a new relationship by adopting new measurement constructs

Won S. Suh
Florida International University, Miami, Florida, USA
Susan K. Key and George Munchus
School of Business, The University of Alabama at Birmingham, Birmingham, Alabama, USA

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Abstract *Studies which assess the relationship between scanning behavior (SB) and strategic uncertainty (SU) have shown mixed results. The lack of consistency in measurement constructs and differences in underlying assumptions for SU may explain these empirical inconsistencies. Earlier studies have adopted measurement constructs which ignore the interaction effect between the two dimensions of SU – variability and complexity. Our study suggests adopting new measurement constructs for SU that sort uncertainty into four distinct categories based on the interaction of the two environmental constructs, variability and complexity, as drawn from categorizations originally proposed by Duncan. This new measurement approach will provide a means to generate consistent results in research on the relationship between SB and SU. We provide a practical example using the strategic environment in the health care industry to illustrate for managers a more precise way to assess their external environment.*

Introduction

Efforts by executives to assess uncertainty and identify opportunities in their environment are called "scanning (behavior)". Henry Ford noted the societal change from agrarian to industrial and envisioned a car in the garage of every worker; Bill Gates observed rapid changes in technology and envisioned a computer in every home. While visionary leaders such as those have always engaged in scanning activity, academics first identified its importance to managers at about the time strategy was emerging as a critical and distinct field (Aguilar, 1967).

As environmental changes have increased in their rapidity, scanning has become one of the most important duties for executives (Ginter *et al.*, 1998; Raymond, 2003). As documented by academics, scanning is used for a variety of strategic purposes: to reduce uncertainty in the environment (Elenkov, 1997; Kumar and Strandholm, 2002), to achieve competitive advantage through superior information gathering (Strandholm and Kumar, 2003), to gain knowledge about stakeholder priorities and demands that can be used to develop effective response strategies (Kumar and Subramanian, 1998), to develop strategies that improve financial performance (Kumar and Subramanian, 1997/1998; Kumar *et al.*, 2001), to generate strategic change (Muralidharan, 2003; Pett and Wolff, 2003), and in general to increase the usefulness of the strategic management process (Fahey and Narayanan, 1986; Subramanian *et al.*, 1993).

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The process of scanning includes three phases: scanning, interpretation, and choice/action (Bluedorn *et al.*, 1994). Research into this process can also be categorized into these three phases. Research in the first phase of the scanning process, where we will also focus our inquiry, has attempted to assess the relationship between scanning behavior (SB) (i.e. scanning frequency) and strategic uncertainty (SU) (Hambrick, 1981a, b, 1982; May *et al.*, 2000). While theory would suggest that managers of firms would scan the environment more frequently as the level of uncertainty increases, empirical studies have not clearly established this relationship (Auster and Choo, 1993; Daft *et al.*, 1988; Elenkov, 1997; May *et al.*, 2000; Sawyer, 1993).

Assumptions in earlier studies about the level of SU, also referred to as environmental uncertainty, may have played a role in generating the mixed results. Studies have tested a continuum-embedded hypothesis, i.e. the higher the degree of SU, the higher the frequency of scanning (Sawyer, 1993). These studies have had inconsistent results which we argue may be partly explained by the insufficiency of the measurement constructs used for SU.

In 1972, Duncan proposed a categorization of uncertainty based on the interaction of two aspects of the environment – variability and complexity. We argue that the main flaw of the measurement constructs currently used is that they ignore the interaction effect between the variability and complexity dimensions of SU as originally proposed by Duncan (1972). Since these two dimensions are inherent in the environment, we argue that it is necessary to consider an interaction effect between these two dimensions in order to provide a more effective measurement approach. In order to do this, we suggest that environmental uncertainty be classified into distinct ranges or levels which include both the variability and complexity dimensions of SU along with the interaction effect between the two variables (Suh and Key, 2002).

No one has as yet proposed or developed a metric to measure this interaction effect, and thus no research has been done to find the relationship between SU and SB through the classification method originally suggested by Duncan (1972). Clustering SU into different levels and using a reliable measurement approach to assess these categories may generate more consistent results in the study of SB in relation to SU (Suh and Key, 2002). Figure 1 shows a simple view of the interactive relationship between these constructs: the variability and complexity dimensions of SU interact to influence SB.

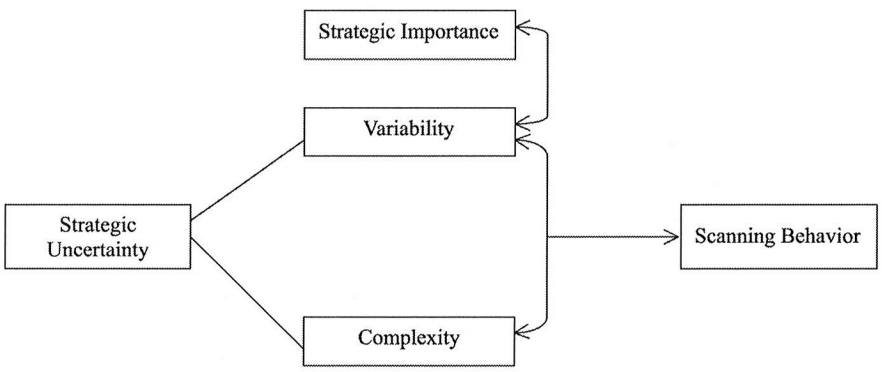


Figure 1.
Conceptual model of SB

First, we review existing literature on the relationship between SB and SU in order to establish the basis for proposing new measurement constructs that we believe will provide a more precise categorization of SU. Then, we present hypotheses regarding the relationship between SB and the constructs of SU – complexity and variability, and their interaction. Finally, we provide our conclusions regarding the contribution that this work will make to research in strategic SB, and suggest practical applications for managers to employ in their SB.

Literature review

While the purpose of the strategic management process is to effectively align or match the organization with its environment (Subramanian *et al.*, 1993), the role of scanning in this process is to identify information that may provide an opportunity or present a threat to an organization (Muralidharan, 2003). In performing environmental scanning, managers identify the environmental uncertainty that their organizations face, and assess how this identified uncertainty fits into their organizational strategy (Elenkov, 1997). Many studies on environmental scanning have tried to assess the relationship between SB and environmental uncertainty. The strategic concept that has been identified in most studies is "strategic uncertainty", which has been defined as "perceived uncertainty in strategically important sectors" (Boyd and Fulk, 1996, p. 1). As noted earlier Duncan (1972) has defined uncertainty as variability and complexity in the environment, thus an integrated definition of SU is "perceived variability and complexity in relevant environmental sectors".

Since measurement constructs had not been developed, early studies of the relationship between SB and SU had to determine which dimensions of SB should be measured (Aguilar, 1967; Duncan, 1972; Kefalas and Schoderbek, 1973). The methodological archetype in measuring SB was established by Hambrick (1981a, b, 1982). He identified three behavioral dimensions of scanning: frequency of scanning, managerial/organizational interest in the scanning, and time devoted to the scanning activity. Researchers after Hambrick (1982) have tried to empirically identify the differences among these behavioral dimensions in relation to the degree of SU perceived by managers (Bluedorn *et al.*, 1994; Daft *et al.*, 1988; Sawyer, 1993).

Scanning frequency is the number of times the managers received information about the environment in a given time period (Hambrick, 1981a), and it has been the most popular dimension of SB used in earlier studies (Elenkov, 1997; May *et al.*, 2000; Sawyer, 1993). It is generally believed that managers scan more frequently when they perceive higher SU in the environment. Therefore, studies in this area have tried to empirically test the hypothesis, "strategic uncertainty will be positively related to the frequency of scanning across the environmental sectors" (Elenkov, 1997; May *et al.*, 2000; Sawyer, 1993). However, the results of earlier studies have shown mixed results. Daft *et al.* (1988) and Auster and Choo (1993) found a positive relationship between the frequency of scanning and SU. Studies that replicated this research (Elenkov, 1997; May *et al.*, 2000; Sawyer, 1993) were not consistent with the earlier studies by Auster and Choo (1993) and Daft *et al.* (1988).

For example, Sawyer (1993) found a positive relationship between frequency of scanning and higher uncertainty using a sample of Nigerian firms, but this relationship was not consistent across the environmental sectors (general vs task environments). Elenkov (1997) and May *et al.* (2000) also did not find support for the positive relationship between frequency of scanning and higher environmental uncertainty in

their later studies. Another difference in these studies that may be relevant is that the two studies which supported the greater scanning/higher SU hypothesis, and analyzed the data of firms within North America (Auster and Choo, 1993; Daft *et al.*, 1988) while the three studies which did not consistently support the greater scanning/higher SU hypothesis analyzed the data of firms outside of North America (Elenkov, 1997; May *et al.*, 2000; Sawyer, 1993). This difference provides evidence that the location of study may be a latent variable in assessing the relationship between scanning frequency and SU.

Defining components of SU: variability and complexity

One study of the scanning and SU is of particular interest because of its unique measurement constructs (Boyd and Fulk, 1996). Most earlier studies adopted a composite measure for perceived uncertainty, but Boyd and Fulk (1996) decomposed the SU variable into the two dimensions that were suggested by Duncan (1972) – complexity and variability. According to Child (1972), the environment is said to be complex when the sectors of the environment, a firm has to scan, are large in number and when the interdependence and the heterogeneity of the organization's environmental sectors are low in degree. Thus the complexity component consists of the size, interdependence and heterogeneity of environmental sectors. The concept of complexity as it relates to SU has been studied using different labels (Kumar and Strandholm, 2002): "analyzability" was the term used by Daft and Weick (1984), "effect uncertainty" was the label employed by Milliken (1987), and "predictability" was the descriptor chosen by Boyd and Fulk (1996).

The second dimension, variability, is about the confidence interval of the perceived uncertainty in the environment (Duncan, 1972). If a manager's perceived environment was highly variable, i.e. the rate and frequency of change in the environment was high, his or her predictions about uncertainty would have a broader confidence interval. In contrast, in a static environment, where the rate of change is minimal or constant over time, a manager would have a narrower confidence interval in predicting uncertainty in the environment. Thus, the variability component consists of the rate and frequency of change in an organization's environment. The concept of variability as it relates to SU has also been studied using different labels (Kumar and Strandholm, 2002): Duncan (1972) called it dynamism, Tung (1979) labeled it turbulence, and Bourgeois (1980) identified it as volatile.

Using the decomposing method of the SU variable into the components of complexity and variability, Boyd and Fulk (1996) found that the variability dimension was positively related to scanning frequency and managerial interest, but the complexity dimension was negatively related to scanning frequency and managerial interest. They did not however consider the interaction variable that we are proposing to include. The relevance of Boyd and Fulk's work is that it may help to explain why inconsistencies were found in earlier studies, i.e. we cannot really understand the relationship between scanning frequency and SU unless we look at the components of SU, and additionally – as we propose – the interaction of these two components (Suh and Key, 2002).

New approach to measuring SU

The earlier section presents evidence that earlier studies of the relationship of SB and SU have provided mixed results. We argue that these mixed results can be explained

by the inadequate measurement constructs used for SU. In this section, we attempt to develop new measurement constructs to assess the relationship between SB and SU. To do so, we will first challenge an underlying assumption that is present in earlier studies which have measured SU.

Four levels of SU

An assumption underlying research on SU in earlier empirical studies was the conceptualization of SU as an unbroken continuum, that is, it was assumed that it was a solid line, not a dotted one. For example, researchers assumed that SU was linear rather than existing on different levels with gaps between one level of SU and another level of SU. Therefore, the studies tested a continuum-embedded hypothesis, i.e. the higher the degree of SU, the higher the frequency of scanning (Sawyer, 1993).

However, the assumption that SU is linear in nature could result in unreliable findings about the relationship between SB and SU (Duncan, 1972; Suh and Key, 2002). In measuring SU, researchers usually ask managers about their perceptions of uncertainty in the environment and the importance of the environmental events. Given that perception about the uncertainty almost is likely to be very subjective for each manager, it is hard to attain reliable scores regarding SU from managers. Classifying SU into different levels as originally proposed by Duncan (1972) will result in mean scores with confidence intervals. This approach may generate more reliable scores for the construct of SU. This reliability will be further enhanced by adding the interaction variable to each of these levels as we are proposing (Suh and Key, 2002).

There have only been three studies which have tried to classify environmental (strategic) uncertainty into different stages as we advocate (Aldrich *et al.*, 1984; Courtney *et al.*, 1999; Duncan, 1972). Table I provides a detailed description of these studies. Although these studies were rooted in different theoretical backgrounds, they all classified the uncertainty into four different stages based on the concept of "residual uncertainty", which is "the uncertainty that remains after the best possible analysis has been done" (Courtney *et al.*, 1999, p. 5).

In addition, the characteristics of each uncertainty stage are almost identical across the three studies. Aldrich *et al.* (1984) characterized the attribute state as one in which many specific characteristics of the environments are known, while Duncan (1972) characterized the simple-static stage as one where factors and components in the environment remain basically the same. These are almost identical to level 1, labeled "clear enough future" in the study by Courtney *et al.* (1999) (Table I).

We have chosen to adopt the two dimensions of SU, complexity and variability, that were identified by Duncan (1972) for two reasons. First, his conceptualization was initially developed for study in the field of environmental scanning, our proposed area of study. Secondly, Duncan (1972) provided an acceptable rationale for his classification which has been acknowledged as the representative dimensions of SU by other scholars both historically (Dill, 1958; Thompson, 1968), and subsequently (Boyd and Fulk, 1996).

Based on these two dimensions of SU, Duncan (1972) distinguished four levels of SU in the environment: low (simple-static), moderately low (complex-static), moderately high (simple-dynamic), and high SU (complex-dynamic). Table II details these four different levels.

Table I.
Three study comparison of the construct of strategic (environmental) uncertainty

	Duncan (1972)		Aldrich *et al.* (1984)		Courtney *et al.* (1999)	
Purpose	To identify the dimensions of SU		To design organizational structure for different environmental states		To develop strategies for different levels of uncertainty in the environment	
Criteria for classification	*Level of remaining uncertainty*		*Level of remaining uncertainty*		*Level of remaining uncertainty*	
Level 1	Simple-static	Similar in sectors of environment (low perceived uncertainty)	Attribute state	Many specific characteristics of the environments are known	Clear enough future	A single forecast precise enough for strategy
Level 2	Complex-static	Dissimilar in sectors of environment (moderately low perceived uncertainty)	Population state	General resource pools have been identified	Alternate future	A few discrete outcomes that define the future
Level 3	Simple-dynamic	The rate of change in the environment is high, but similar in sectors (moderately high perceived uncertainty)	Domain state	Environments contain identifiable populations	A range of future	A range of possible outcomes, but no natural scenarios
Level 4	Complex-dynamic	The rate of change in the environment is high, and dissimilar in sectors (high perceived uncertainty)	Uncertainty state	Environments are characterized by gross uncertainty	True ambiguity	No basis to forecast the future

Level 1: low SU (simple-static state). We first consider the environment that is definite enough for clear strategy development by the organization. In this stage, an organization will easily narrow the domain of strategic direction for its entities. Duncan (1972) argued that little uncertainty was expected to exist in this stage. The number of factors and components in the environment that a manager must consider in this stage are relatively smaller and similar compared to the other, higher levels of environmental uncertainty.

For example, as an executive of a large hospital chain, you try to assess the effect on your environment of the market entry by one small hospital, a known competitor in other markets. The organization has been faced with a similar situation on several occasions with other new entrants, and information about this particular new competitor is already known. In this case, SU due to the new market entry is low and the organization will easily narrow the domain of strategic direction for the entity. We can identify the complexity aspect of environmental uncertainty here as the market size and the interdependence and heterogeneity of the market competitors – this environment is relatively simple, thus the complexity is low. The variability aspect involves the rate and frequency of change in the environment – again both of these are known, change is slow, predictable and infrequent, thus the variability is low. The interaction of these two processes can be described in this way: a simple, slowly infrequently changing environment where both the lack of complexity and slow rate of change reduces the SU.

Level 2: moderately low SU (complex-static state). At level 2, the uncertainty can be described as one with a few alternate outcomes, and an analysis of the environment does not allow an executive to identify which outcome will occur (Courtney *et al.*, 1999). In this situation, the executives of an organization will try to increase the probability that a favored industry scenario will occur. However, Duncan (1972) argued that, like level 1 uncertainty, the rate of change in sectors of the environment is very slow, therefore the factors and the components in the environment remain basically the same in short-term.

Some industries faced with major regulatory changes are at this level of SU (Courtney *et al.*, 1999). For example, in the healthcare industry, hospital executives have also been faced with major regulatory changes. One of the most remarkable changes was the introduction of Medicare's prospective payment system (PPS) in 1983. Unlike the fee-for-service payment system, the PPS set-up the fixed payment level for hospital services, and hospitals are responsible for any cost above the price limit (Lee and Alexander, 1999).

Variability dimension	Complexity dimension: Simple	Complexity dimension: Complex
Static	Level 1 SU Simple-static Low perceived uncertainty	Level 2 SU Complex-static Moderately low perceived uncertainty
Dynamic	Level 3 SU Simple-dynamic Moderately high perceived uncertainty	Level 4 SU Complex-dynamic High perceived uncertainty

Source: Duncan (1972)

Table II.
Four levels of SU as defined by Duncan (1972)

Before the legislation, hospital executives acknowledged the possible outcomes of the PPS, however, they were not sure which outcome would occur as a result of the legislation. In addition, there was no clear indication whether or not the PPS was going to be passed and how quickly it would be implemented if it were passed. Therefore, executives were not able to implement any courses of actions – i.e. the reduction of hospital beds.

We can identify the complexity aspect of environmental uncertainty here as the complicated regulatory changes which – as with all new regulation – have both known, predictable effects and unknown, unpredictable effects in a heterogeneous market. This environment is very complex due to the intricacy of the new regulation and the unpredictability of how it will affect the industry, thus complexity is high. The variability aspect involves the rate and frequency of change in the environment. In this case, the timing of the regulation is known and occurs infrequently. In this case, change is slow, predictable and infrequent, thus variability is low. The interaction of these two processes can be described in this way: a complex change where the effects are not known but the uncertainty is reduced somewhat because the timing of the change is known. Thus, what the interaction creates in this case is an opportunity for executives to use the known timing of the complex changes to reduce their uncertainty.

Level 3: moderately high SU (simple-dynamic state). At level 3, according to Courtney *et al.*'s (1999) theory, a range of potential futures can be identified. Predicting the market penetration rate range, i.e. from 10 to 50 percent, is a good example of level 3 SU. Duncan (1972) argued that this state is almost identical to level 1 because it is simple in its complexity dimension. However, its dynamic nature leads to high rate of changes in the sectors of the environment, therefore, components and factors in this environment are in a continual process of change and is thus complex in its variability dimension.

Healthcare organizations entering new markets often face level 3 SU. For example, after the Balanced Budget Act (BBA) in 1997, the federal government allowed Medicare beneficiaries to buy commercial health insurance coverage called medicare + choice program (M+C). Many private managed care organizations (MCOs) decided to enter this new market despite the unpredictability in the changes of reimbursement rate set by the government. We can identify the complexity aspect of environmental uncertainty here as the market size and the interdependence and heterogeneity of the market competitors – this environment is relatively simple – that is the players are not changing, thus complexity is low. The variability aspect involves the rate and frequency of change in the environment – with the unpredictability in the rate changes by the government and the timing of the changes, variability is high. The interaction of these two processes can be described in this way: a simple environment that is changing in unpredictable ways – the players are known but their market moves are unknown, thus increasing SU.

Level 4: high SU (complex-dynamic state). The uncertainty at level 4 is virtually impossible to predict (Courtney *et al.*, 1999). It is difficult to predict all the relevant variables that will define SU in different sectors of the environment. Duncan (1972) argued that this true ambiguity was from the dynamic and complex dimensions of SU in the environment.

In the healthcare industry, the emergence of telemedicine business provides an example of level 4 uncertainty. Healthcare organizations are confronting multiple

uncertainties concerning technology, demand, and the relationship between hardware and software content providers. Healthcare managers are confronting difficult decisions regarding where and how to compete in the emerging consumer telemedicine market because the future is so unpredictable that no plausible range of scenarios can be identified (dynamic environment).

We can identify the complexity aspect of environmental uncertainty here as the complicated market changes which – as with all new technologies – have unknown, unpredictable effects in a heterogeneous market. This environment is very complex due to the new opportunities and the new threats that telemedicine brings to the industry, thus complexity is high. The variability aspect involves the rate and frequency of change in the environment – with unpredictability in the rate of technological change and timing in terms of how this technology will be brought to market and by whom, variability is high. The interaction of these two processes can be described in this way: a complex change where the effects are not known where the uncertainty is increased because the timing and rate of change is unknown. Thus, what the interaction creates in this case is an opportunity for executives to use timing to take advantage of complex technological changes.

Measurement constructs

Two types of measurement constructs have been adopted in earlier studies: multiplicative (composing) and decomposing methods (Boyd and Fulk, 1996; Elenkov, 1997). The multiplicative type of measurement constructs defines SU as the multiplication of perceived environmental uncertainty (PEU) and strategic importance (I). Most studies have adopted this type of measurement, and reported conflicting findings on the effectiveness of scanning (Daft *et al.*, 1988; Elenkov, 1997; Sawyer, 1993). Milliken (1987) cautioned that the multiplicative approach should not be used to measure SU. Instead, he suggested that decomposing the constructs would be a more effective way to concisely reflect the difference of each individual's perception on each dimension of uncertainty. Boyd and Fulk's (1996) study discussed earlier is the only study that has adopted the decomposing process. The main flaw of both composing and decomposing processes is that they do not consider an interaction effect between the two dimensions of SU. Figure 2 expands the current measurement construct for SU by including the interaction effect as explained in detail in the next section.

First, as previously described, managerial SB is affected by SU. Therefore, SB can be expressed as a function of the SU:

$$\mathrm{SB} = F(\mathrm{SU}). \tag{1}$$

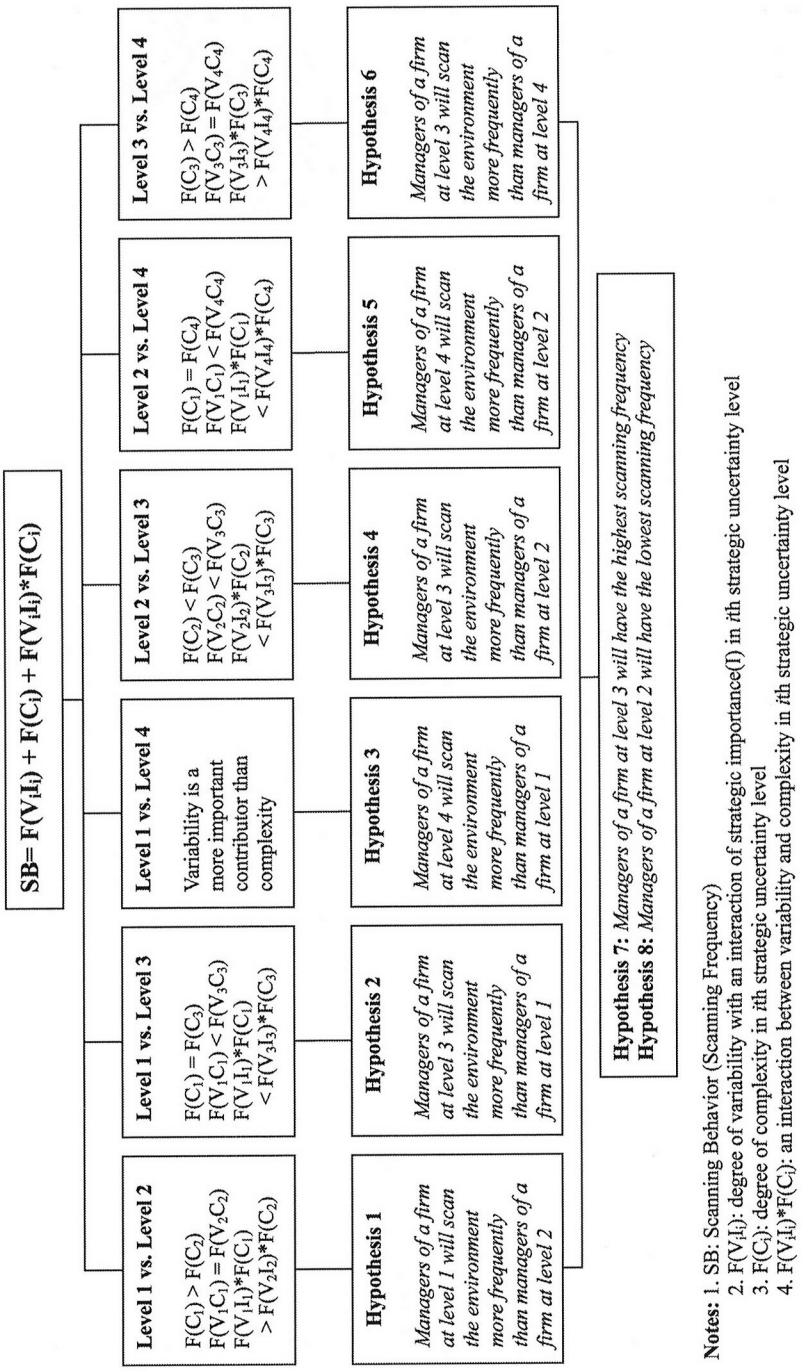
Most earlier studies defined SU as the multiplication of PEU and strategic importance (I) (Daft *et al.*, 1988; Elenkov, 1997; Sawyer, 1993):

$$\mathrm{SU} = (\mathrm{PEU} * I). \tag{2}$$

By decomposing the PEU constructs by the complexity (C) and variability (V) dimensions, we find:

$$\mathrm{SU} = (\mathrm{PEU} * I) = (V + C) * I\} = (VI) + (CI). \tag{3}$$

Boyd and Fulk (1996) suggested that there should be no interaction between complexity and strategic importance. They reasoned that external environment is of



Notes: 1. SB: Scanning Behavior (Scanning Frequency)
2. $F(V_iI_i)$: degree of variability with an interaction of strategic importance(I) in *i*th strategic uncertainty level
3. $F(C_i)$: degree of complexity in *i*th strategic uncertainty level
4. $F(V_iI_i)*F(C_i)$: an interaction between variability and complexity in *i*th strategic uncertainty level

Figure 2.
A summary of hypotheses

limited use in responding to complexity, regardless of the strategic importance. Therefore, the function of SB suggested by Boyd and Fulk (1996) can be expressed as follows:

$$\begin{aligned} \text{SB} &= F(VI) \\ \text{SB} &= F(C). \end{aligned} \tag{4}$$

The decomposing process, however, is not able to assess an interaction effect; therefore, composing the decomposed constructs is needed to analyze an interaction effect between the two dimensions. By incorporating this revision into the equation, SU can be defined as follows:

$$\text{SU} = (VI) + (C) + (VI) * (C). \tag{5}$$

The equation is composed again after the decomposing process to add an interaction term in the equation (5). Therefore, the SB for this study can be defined in general form as follows:

$$\text{SB}_i = F(V_iI_i) + F(C_i) + F(V_iI_i) * F(C_i). \tag{6}$$

where SB_i is the SB (scanning frequency) at ith SU level, $F(V_iI_i)$ the degree of variability with an interaction of strategic importance (I) at ith SU level, $F(C_i)$ the degree of complexity at ith SU level, and $F(V_iI_i) * F(C_i)$ the degree of an interaction term between variability and complexity at ith SU level.

Research hypothesis

The frequency of scanning is operationalized for this study to measure the SB of managers because of its acceptance in earlier research. As previously described, since the level of SU for this study was classified into four different stages, we are able to generate at least six comparisons to analyze the difference between scanning frequencies of managers in the different conditions of SU. They are:

(1) the difference of the scanning frequency between SU level 1 and level 2;

(2) level 1 and level 3;

(3) level 1 and level 4;

(4) level 2 and level 3;

(5) level 2 and level 4; and

(6) level 3 and level 4.

Strategic uncertainty level 1 vs level 2. According to Duncan (1972), the SU at level 2 is more complex than the uncertainty at level 1 (illustrated earlier in Table II). Because complexity was found to be negatively related to SB (Boyd and Fulk, 1996), SU perceived by managers on the complexity dimension [$F(C)$] should be higher at level 1 (a simple state) than at level 2 (a complex state) $\{F(C_1) > F(C_2)\}$. The SU on the variability dimension [$F(VI)$] should be the same between two levels [$F(VI_1) = F(VI_2)$] because both levels 1 and 2 uncertainties are said to be static in the variability dimension (Duncan, 1972). The SU of an interaction term [$F(VI) * F(C)$] should also be

higher at level 1 than level 2 because of higher complexity at level 1 $\{F(VI_1) * F(C_1) > F(VI_2) * F(C_2)\}$. Therefore:

H1. Managers of a firm at SU level 1 will scan the environment more frequently than managers of a firm at SU level 2.

Strategic uncertainty level 1 vs level 3. The SU at level 3 is more dynamic than the SU at level 1 (Table II). Because variability was found to be positively related to SB (Boyd and Fulk, 1996), the SU on the variability dimension $[F(VI)]$ should be higher at level 3 (a dynamic state) than at level 1 (a static state) $\{F(VI_1) < F(VI_3)\}$. The SU on the complexity dimension $[F(C)]$ should be the same between two levels $[F(C_1) = F(C_3)]$ because both levels 1 and 3 uncertainties are said to be simple in the complexity dimension. The SU of an interaction term $[F(VI) * F(C)]$ should also be higher at level 3 than at level 1 because of higher variability at level 3 $\{F(VI_1) * F(C_1) < F(VI_3) * F(C_3)\}$. Therefore:

H2. Managers of a firm at SU level 3 will scan the environment more frequently than managers of a firm at SU level 1.

Strategic uncertainty level 1 vs level 4. Hypothesizing the difference in the scanning frequency between levels 1 and 4 is somewhat difficult. First, SU at level 4 is more dynamic than at level 1 (Table I). Because variability was found to be positively related to SB (Boyd and Fulk, 1996), SU on the variability dimension $[F(VI)]$ should be higher at level 4 than at level 1 $\{F(VI_1) < F(VI_4)\}$. However, SU on the complexity dimension $[F(C)]$ should be higher at level 1 than at level 4 $[F(C_1) > F(C_4)]$ because the complexity dimension was found to be negatively related to SB (Boyd and Fulk, 1996). The opposite results led to a problem ranking an order for an interaction term $[F(VI) * F(C)]$. Therefore, it is not appropriate to hypothesize the relationship between the two SU levels using the arguments from the study by Boyd and Fulk (1996).

However, Duncan (1972) provided interesting results in his study. He found that the variability dimension was a more important contributor than the complexity dimension in explaining SU. According to him, the range of variation in the variability dimension should be larger than in the complexity dimension. For example, when we ask managers of a firm at the same level of SU to rate their perceptions of environmental uncertainty, the highest scores on the variability dimension would always be higher than the highest scores on the complexity dimension. The scores on the variability dimension cannot be lower than the scores on the complexity dimension at the same level of the SU. Although it is still problematic, we may be able to infer the difference of the scanning frequency between levels 1 and 4 based on Duncan's (1972) argument:

H3. Managers of a firm at SU level 4 will scan the environment more frequently than managers of a firm at SU level 1.

Strategic uncertainty level 2 vs level 3. The SU at level 3 is more dynamic than at level 2, but level 3 is less complex than level 2. Therefore, the SU on both the variability $[F(VI)]$ and the complexity dimensions $[F(C)]$ should be higher at level 3

$\{F(VI_2)<F(VI_3), F(C_2)<F(C_3)\}$. The SU of an interaction term should also be higher at level 3 than at level 2 $\{F(VI_2)*F(C_2)<F(VI_3)*F(C_3)\}$. In addition, Duncan (1972) showed that the variability dimension was more important than the dimension of complexity to explain SU. Therefore:

H4. Managers of a firm at SU level 3 will scan the environment more frequently than managers of a firm at SU level 2.

Strategic uncertainty level 2 vs level 4. The SU at level 4 is more dynamic than SU at level 2. Because variability was positively related to SB (Boyd and Fulk, 1996), SU on the variability dimension $[F(VI)]$ should be higher at level 4 than at level 2 $\{F(V_4)>F(V_2)\}$. The SU of an interaction term $[F(VI)*F(C)]$ should also be higher at level 4 than level 2 because of higher variability at level 4 $\{F(VI_4)*F(C_4)>F(VI_2)*F(C_2)\}$. Strategic uncertainty on the complexity dimension $[F(C)]$ should be the same between the two levels $[F(C_2) = F(C_4)]$ because both levels 1 and 2 are said to be complex in the complexity dimension. Therefore:

H5. Managers of a firm at SU level 4 will scan the environment more frequently than managers of a firm at SU level 2.

Strategic uncertainty level 3 vs level 4. The reasoning process adopted in generating hypothesis for SU at levels 1 and 2 is also applicable in generating the hypothesis for levels 3 and 4. Because the complexity dimension was found to be negatively related to SB (Boyd and Fulk, 1996), SU perceived by managers on the complexity dimension $[F(C)]$ should be higher at level 3 (a simple state) than at level 4 (a complex state) $\{F(C_3)>F(C_4)\}$. Strategic uncertainty on the variability dimension $[F(VI)]$ should be the same because both levels 3 and 4 uncertainties are said to be dynamic in the variability dimension $\{F(VI_3) = F(VI_4)\}$ (Duncan, 1972). The SU of an interaction term $[F(VI)*F(C)]$ should also be higher at level 3 than at level 4 because of higher complexity at level 3 $\{F(VI_3)*F(C_3)>F(VI_4)*F(C_4)\}$. Therefore:

H6. Managers of a firm at SU level 3 will scan the environment more frequently than managers of a firm at SU level 4.

Finally, by combining the hypotheses provided above, we are able to generate two additional hypotheses (refer Figure 2 for a summary of the hypotheses).

H7. Managers of a firm at SU level 3 will have the highest scanning frequency.

H8. Managers of a firm at SU level 2 will have the lowest scanning frequency.

Conclusion and future research

We hope that the new measurement constructs developed here provide more reasonable explanations for the relationship between SB and SU. The measurement constructs adopted in earlier studies ignored an interaction effect between two dimensions of SU. Adding an interaction term in measurement constructs allows researchers to more concisely assess the characteristics of SU.

We also challenged another assumption underlying the study of SU regarding the continuum of the SU level. Researchers have assumed that there is a no gap between one level of SU and other levels of SU. In contrast, in this study we assumed that there is a gap between different levels of SU, and classified the SU into four different levels based on two dimensions of SU – variability and complexity as identified by Duncan (1972).

Recognizing that there are several different levels of SU provides potentially useful new insights for future studies in assessing the relationship between SB and SU. The hypotheses proposed here reveal that the level of SU faced by managers is dependent on the variability and complexity of environmental sectors and their interaction.

Finally, although attempts made in this paper offered more systematic reasoning process to analyze the relationship between SB and SU than studies done earlier, empirical studies are needed to verify the specific hypotheses presented here. To do so, first and foremost, a methodologically sophisticated scheme to classify the SU into the different levels as theorized here must be developed.

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Application questions

1. At which level of strategic uncertainty would you place your industry currently?
2. How would you assess the environment that your organization faces in terms of complexity and variability?
3. How does the interaction of complexity and variability affect the environment within which your organization operates?