Journal of Management OnlineFirst, published on February 27, 2009 as doi:10.1177/0149206308329968

Measuring State, Effect, and Response Uncertainty: Theoretical Construct Development and Empirical Validation

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An important contribution to the literature on perceived environmental uncertainty (PEU) is Milliken's distinction between state uncertainty, effect uncertainty, and response uncertainty. However, despite its appealing logic in capturing the types of uncertainty managers may experience as they seek to understand and respond to changes in an organization's environment, there has been no full and rigorous psychometric development and testing of scales to measure the three constructs. Using a two-phase empirical study, this research seeks to develop and test such scales in terms of dimensionality, reliability, and validity (including nomological validity). The results suggest that managers do make a meaningful distinction between different types of uncertainty, that it is worthwhile measuring all three constructs (as they have differential impacts on outcome variables), and that there are linkages between them. Managerial contributions and implications for future research are also discussed.

Keywords: *Perceived Environmental Uncertainty (PEU); scale development; information seeking behavior*

Perceived environmental uncertainty (PEU) is cited as an important determinant of managerial behavior in both psychological decision theories and theories of human

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Journal of Management, Vol. XX No. X, Month XXXX x-xx
DOI: 10.1177/0149206308329968

information processing (Duncan, 1972; Tushman & Nadler, 1978). The concept has been applied as a contingency variable in a wide range of business-related fields, including organizational behavior (Gerloff, Muir, & Bodensteiner,1991; Li, Bingham, & Umphress, 2007), strategic management (Hough & White, 2004; Sawyerr, McGee, & Peterson, 2003), information systems (Karimi, Somers, & Gupta, 2004; Mangaliso, 1995), marketing (Achrol & Stern, 1988; Bstieler & Gross, 2003), and accounting (Lal & Hassel, 1998; Linn, Casey, Johnson, & Ellis, 2001).

Duncan (1972) stressed the importance of perceptions when studying environmental uncertainty, as perceptions play a significant role in determining how managers react to the environment (Doty, Glick, & Huber, 1993; Huber & Daft, 1987). Environmental uncertainty is viewed as a perceptual phenomenon and a property of the individual faced with a decision in an environment. However, Milliken (1987) noted that research on the construct of environmental uncertainty had yielded inconsistent and often difficult-to-interpret results. Furthermore, she suggested that one reason for this was that researchers failed to distinguish between three types of uncertainty relating to the environment. She argued that managers could experience state uncertainty, effect uncertainty, and response uncertainty as they seek to understand and respond to changes in an organization's environment. The nature of these three kinds of uncertainty is very different, and failure to distinguish between them has led to a myriad of conflicting research findings (Boyd & Fulk, 1996; Doty, Bhattacharya, Wheatley, & Sutcliffe, 2006; Milliken, 1990).

State uncertainty is defined as the situation that occurs when managers do not feel confident that they understand what the major events or trends in an environment are or feel unable to accurately assign probabilities to the likelihood that particular events or changes will occur (Milliken, 1987, 1990). Milliken recognized state uncertainty to be equivalent to PEU because both relate to a lack of understanding about how components of the environment might be changing. The second type of uncertainty advocated by Milliken (1987) is known as effect uncertainty and refers to the inability to predict the nature of the effect of a future state of the environment on the organization (i.e., an understanding of cause–effect relationships). Response uncertainty is the third type of uncertainty and characterizes an inability to predict the likely consequences of a response choice. This type of uncertainty is very similar to the uncertainty decision theorists have discussed (Conrath, 1967; Taylor, 1984) and is experienced when decision makers attempt to understand the range of strategic responses open to them and evaluate the relative utility of possible options.

The potential introduction of a new product by a competitor can serve as an illustration of how the three constructs might apply in an organizational setting. A manager may perceive state uncertainty about whether a competitor will introduce a new product. Effect uncertainty may be perceived about how such an introduction will affect sales of his or her organization's products. Finally, response uncertainty may occur if the manager feels unsure about how to respond should the rival product be launched.

Surprisingly, given the importance of state, effect, and response uncertainty in researching managers' understanding of, interpretation of, and response to the external environment, there has been no full and rigorous psychometric development and testing of scales to measure the three constructs. The closest attempt was by Gerloff et al. (1991), who

examined the ability of Duncan's (1972) items to measure the three constructs. They encountered problems with the wording of several items and a low reliability (alpha = .25) for the effect uncertainty scale. Their study was exploratory and therefore lacked tests for convergent and discriminant validity provided by confirmatory factor analysis. Finally, their sample was taken from one organization (the U.S. navy), limiting the generalization of their findings.

Given the importance of uncertainty on managerial decision making, the first objective of this study is to develop valid and reliable scales for measuring state, effect, and response uncertainty. The aim is to provide researchers with a set of items to measure these constructs and therefore provide them with opportunities to better measure their antecedents and organizational consequences.

With the exception of Milliken (1990), Gerloff et al. (1991), and Doty et al. (2006), researchers of perceived uncertainty about the environment have focused on a single perceptual measure of uncertainty or have measured individual subcomponents of the environment and have not attempted to measure further the process of understanding, interpreting, and responding to change in the external environment as separate phenomena. Consequently, the second objective of our research is to establish the worth of measuring all three constructs by examining if they have differential impacts on other organizational variables. Specifically, we develop and test hypotheses relating each construct to two outcome variables (perceptions of the usefulness of two types of marketing information).

The final research objective relates to the existence and direction of linkages between state, effect, and response uncertainty. Our study, therefore, is designed to throw light on the process of environmental interpretation. Gerloff et al. (1991) asserted that managers respond to the environment sequentially, first asking about the state of the environment and then asking how the environment affects the organization before deciding how to respond. Conceptually, then, the linkage should be from state to effect to response. We recognize that perception of uncertainty may not always begin with state uncertainty. Managers may not perceive uncertainty until they experience the effect of, for example, a competitor on their sales revenues, meaning that effect uncertainty would be the primary impetus for change. However, the logic of Gerloff et al.'s (1991) argument, which may apply in many instances, motivates us to test this hypothesis using path analysis.

We begin by conducting a literature review of empirical research into environmental uncertainty designed to classify existing approaches, outline the shortcomings of existing practices, and demonstrate how our study might contribute to future research. Then, we report on an exploratory study designed to identify the environmental uncertainty perceptions of senior marketing executives (SMEs). Next, we describe the data collection procedures for the main study and highlight issues related to item generation, instrument pretesting, and sample selection. We follow this with a description of the measure development procedures, addressing questions of dimensionality, reliability, and validity using Partial Least Squares (PLS) analysis. Specifically, we link different types of environmental uncertainty perceptions to the information-seeking perceptions of SMEs. We conclude with a discussion of how the findings relate to study objectives and provide some suggestions for how future research might benefit from using reliable and valid scales to measure the three constructs.

Research Into Environmental Uncertainty

A literature review of research into environmental uncertainty revealed a number of different approaches to its measurement. These are classified in Table 1. The taxonomy describes three broad generic approaches: objective measures, perceptual measures, and studies that have used both objective and perceptual measures. Within the first two groups, researchers have employed one composite measure of environmental uncertainty, a measure of individual environmental characteristics (e.g., environmental complexity, technological or competitive uncertainty), or have measured state, effect, and response uncertainty.

Objective measures use statistical analysis to infer environmental uncertainty. For example, Anderson and Schmittlein (1984) produced an overall measure of environmental uncertainty by measuring the expected deviation between forecast and actual sales in the next year, expressed as a percentage. Simerly and Li (2000) developed a measure of an environmental characteristic (dynamism) based on regression analysis of industry values of shipments against time where environmental dynamism was calculated as the standard error of the regression coefficient divided by the average value of industry shipments. Finally, a single study by Miller and Shamsie (1999) developed objective measures of state, effect, and response uncertainty. In their study of product line simplicity at Hollywood film studios, state uncertainty was based on the level of demand that the studios enjoyed for their films and the absolute values of the annual changes in market share of the seven major studios. Effect uncertainty was measured by the percentage of Academy Awards that were won annually by each studio and the number of domestic theatres owned or under lease for each studio. Response uncertainty was measured by the average production budgets per film and the length of tenure of heads of production for each studio. Full justification for these measures was given in the article.

When the research focus is managerial decision making, perceptions of the environment are more important than the actual environment (Bourgeois, 1980; Duncan, 1972; Swamidass & Newell, 1987). This is because managers' decision making is based on how they view the environment rather than objective reality. Consequently, there are numerous studies that have attempted to measure perceptions of environmental uncertainty. For example, Li and Atuahene-Gima (2002) used a composite measure based on four items reflecting perceptions of the degree of price, product, technological, and competitive change. Fink, James, and Hatten (2008) developed a perceptual measure for an environmental characteristic (technological uncertainty) based on two items. Finally, Gerloff et al. (1991) employed three items each to measure state and effect uncertainty and four items to measure response uncertainty based on Duncan (1972) but encountered wording and reliability problems.

The final group of research studies uses both objective and perceptual measures. For example, Karimi et al. (2004) used perceptions to measure environmental dynamism, heterogeneity, and hostility and a variety of archival data to measure task environments.

This review leads us to make several observations. First, the measurement of environmental uncertainty is characterized by the diversity of approaches. Not only are there three generic methods, but within the first two categories—objective and perceptual measures—there are three variants: a composite measure, measurement of individual environmental characteristics, and state, effect, and response uncertainty measures.

Table 1
A Taxonomy of Environmental Uncertainty Measures

Type	Exemplar Studies	Key Features
Objective Measures	Anderson and Schmittlein (1984)	The use of statistical analysis (e.g., of sales variation) to infer environmental uncertainty
(a) One composite measure	Lee and Park (2008)	
(b) Environmental characteristic	Environmental dynamism: Simerly and Li (2000)	
	Supplier's environmental uncertainty: Camuffo, Furlan, and Rettore (2007)	
	Industry competitiveness: Dean and Snell (1996)	
(c) State, effect, and response uncertainty	Miller and Shamsie (1999)	
Perceptual Measures		
(a) One composite measure	Buvik and Grønhaug (2000)	The use of measures of respondents' perceptions of environmental uncertainty
	Li and Atuahene-Gima (2002)	
	Waldman et al. (2001)	
(b) Environmental characteristic	Environmental complexity: Newkirk and Lederer (2006)	
	Environmental variability: Tung (1979)	
	Technological uncertainty: Fink et al. (2008)	
	Governmental uncertainty: Yusuf (2002)	
	Competitor uncertainty: De Sarbo et al. (2005)	
	Demand uncertainty: Robertson and Gatignon (1998)	
	Market uncertainty: Bstieler and Gross (2003)	
	Supply uncertainty: Ryu and Eyuboglu (2007)	
(c) State, effect, and response uncertainty	Doty et al. (2006)	
	Gerloff et al. (1991)	
	Milliken (1990)	
Objective and Perceptual Measures	Karimi et al. (2004)	The use of both objective and perceptual measures in a simple study
	Pagell and Krause (2004)	
	Song, Droge, Hanvanich, & Calantone (2005)	

Second, within the subcategory of perceptual composite measures, there is much inconsistency regarding how the PEU construct is measured. For example, although Buvik and Grønhaug (2000), Li and Atuahene-Gima (2002), and Waldman, Ramírez, House, and Puranam (2001) all claim to measure PEU, the measures used were four items capturing perceived changing economic conditions and technological dynamism (Buvik & Grønhaug, 2000); four items reflecting the perceived degree of price, product, technological, and competitive change (Li & Atuahene-Gima, 2002); and four items relating to perceived environmental dynamism, risk, market expansion, and hostility (Waldman et al., 2001). Furthermore, these studies illustrate a second weakness in how PEU is measured. PEU can arise from any of its subcomponents that can be broadly categorized as the macro-environment (political/legal, economic, social/cultural, technological, and physical environments) and the micro(task)-environment (the end user [consumer], competitor, supplier, market, and distributor environments). With the exception of Miller's (1993) scale, which was tested for dimensionality and reliability (but not validity) by Werner, Brouthers, and Brouthers (1996), none of the scales claiming to measure PEU capture the domain of content of the construct. Instead, the scales measure various aspects of uncertainty while ignoring others. This is further illustrated in the only study that has successfully established convergent and discriminant validity for a composite PEU scale. Selnes and Sallis (2003) demonstrated high reliability and validity for their PEU scale, but their five items referred to end users, competitors, and technology, omitting other important factors that constitute the macro- and micro-environments in which their sample of firms existed.

We, therefore, conclude that composite measures of PEU lack consistency, fail to provide adequate coverage of the domain of the construct, and with the exception of only one study, fail to provide adequate evidence of convergent and discriminant validity of their measures. Consequently, we intend to bring coherence to the composite measurement of PEU by developing and validating a state uncertainty scale that adequately covers the domain of content of the construct.

The third striking feature of our review is the wide range of perceptual environmental characteristics measured in uncertainty studies. These fall into three categories: sources of environmental uncertainty, macro-environmental factors, and micro(task)-environmental factors. We consider environmental complexity and variability to be antecedents (sources) of PEU. Complexity refers to the extent of heterogeneity in the environment. An organizational environment with high complexity would contain many customers, many final users (consumers), and many competitors with high dissimilarity among them (Klein, Frazier, & Roth, 1990). Variability refers to the degree of turbulence that prevails in the environment. A highly variable environment would encounter a high rate of change (Tung, 1979). Following Milliken (1987), we consider these to be antecedents to state uncertainty. We also believe they have the potential to raise levels of effect and response uncertainty, as high levels of environmental complexity and turbulence may increase uncertainty about how the environment will affect the organization and how it should respond. By developing valid and reliable scales for the three uncertainty constructs, we hope to contribute to management research by allowing such relationships to be tested.

Two macro-environmental (technological and governmental uncertainty) and four micro-environmental (competitor, demand, market, and supply uncertainty) factors have

been measured in PEU studies. When hypotheses specifically related to particular subcomponents of PEU have been developed (e.g., DeSarbo, Di Benedetto, Song, & Sinha, 2005), this approach is valid, but when one subcomponent is used as a proxy for a composite measure of PEU (e.g., Fink et al., 2008), the validity of the procedure is questionable.

The literature review also revealed two insights that are relevant to the contribution of our research. First, Miller and Shamsie (1999) noted that the results of prior studies into the effects of uncertainty on product line simplicity were contradictory. Some studies found that uncertainty encouraged more product variations or a broader range of competitive tactics, whereas other studies suggested that uncertainty induced firms to simplify their product lines or to focus on fewer competitive tactics. They believed, in part, that such disagreements were because researchers had not distinguished between state, effect, and response uncertainty, constructs that can have very different effects on strategy (Miller & Shamsie, 1999). Using objective measures of the three constructs, they justified and tested the hypotheses that state uncertainty would give rise to product variety, whereas effect and response uncertainty would discourage such variety. Their results largely supported their hypotheses and, therefore, suggest that future empirical research should measure the three constructs. Our study is designed to facilitate such research by the development of reliable and valid scales for their measurement. Furthermore, we test the proposition that perceptual measures of state, effect, and response uncertainty will have differential impacts on the perceived usefulness of two marketing information system (MkIS) characteristics as part of our check for nomological validity. This test will provide further evidence of the value in measuring all three constructs.

The second insight from our literature review was that an important strand of uncertainty research—transaction cost economics—could benefit from measuring state, effect, and response uncertainty. A full description of transaction cost economics (TCE) is beyond the scope of this article, but in the context of uncertainty, the essential prediction is that so long as asset specificity (the degree to which assets are specific to a particular transaction and so cannot be redeployed) is nontrivial (the situation in most transactions), high uncertainty renders hierarchies (i.e., integration through, for example, vertical integration or internal research and development [R&D]) preferable to hybrids (e.g., alliances) or market governance through the price mechanism (Williamson, 1991). A review of empirical studies by David and Han (2004) found that results were contradictory, with 24% of tests in the direction posited by TCE and 16% counter to the theory. They also revealed that the most commonly used measure of uncertainty was the volatility of technology, appearing in 18 tests. Only three of these were supportive of the theory, and two were in the opposite direction. For example, whereas Majumdar and Ramaswamy (1994) found that firms were more likely to integrate into distribution in the presence of technological change, Robertson and Gatignon's (1998) findings did not support the theory, as they found that the rate of technological change was associated with the use of hybrids (alliances) rather than integration (internal R&D). An explanation for these contradictory findings is that by focusing on one subcomponent of PEU (technology), researchers have neglected other macro- and micro-environmental elements of PEU that may, in sum, affect a manager's perception of uncertainty differently to that based on volatility of technological change alone. Furthermore, even measuring the entire range of PEU (state) uncertainty subcomponents may be insufficient if effect and/or response uncertainty are ignored. For example, a manager may be certain about the state of the environment, but if

uncertainty about the effect of that environment on the organization is perceived, rather than choosing market-based governance (as predicted by TCE research when only PEU [state] uncertainty or a subcomponent is measured), integration (e.g., vertical integration) should be the predicted course of action to cope with that uncertainty. We believe, therefore, that Milliken's (1987) conceptualization may explain some of the conflicting findings of TCE research and should be considered in future research in this area. By psychometrically testing measures for state, effect, and response uncertainty, we hope to facilitate this process.

Data Collection

First, we give a brief overview of our approach to scale development and testing. Data collection was done initially by exploratory in-depth interviews to gain insights into how managers view the concept of environmental uncertainty, to check if Milliken's (1987) conceptualization was consistent with these perceptions, and to generate items for psychometric testing. Following questionnaire pretesting, quantitative data were gathered by a mail survey, enabling psychometric testing of state, effect, and response uncertainty. The sample was split to provide information on scale stability. Using the first sample, dimensionality was assessed using common factor analysis and reliability by calculating Cronbach's alphas. The second sample was retained as a holdout sample for scale validation. Convergent and discriminant validity were determined using confirmatory factor analysis. Finally, we extended usual practice in scale validation by including a test for nomological validity. This was not to test theory, per se, but to assess the extent to which state, effect, and response uncertainty predict relevant outcomes (the perceived usefulness of broad scope marketing information and aggregated analytical marketing information).

Exploratory Research

Although Milliken's (1987) classification provides a conceptually appealing framework, it is important that the chosen scheme is broadly consistent with marketing executives' own perceptions of uncertainty relating to the environment. To this end, a qualitative research approach was adopted involving an experience survey (key informant survey) with organizational members responsible for marketing decision making. An experience survey was selected as the data collection method, given its applicability for studying organizational decision makers (Robson & Foster, 1989).

Twenty in-depth interviews were conducted with SMEs from large (employing 100+ employees) New Zealand manufacturing, business-to-business, and service organizations. Given the exploratory nature of this stage of the research, the sample size was deemed suitable for gaining preliminary insights into the issues of interest and generating suitable items for the measurement development procedure (Denzin & Lincoln, 1994; Hart, 1987).

Data analysis followed the steps described by Miles and Huberman (1994: 10), who "define analysis as consisting of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification." Data reduction was undertaken for each of the 20 interviews, using a list of basic codes devised prior to fieldwork. Subcodes were added to

categorize information further within each of the main codes. The coding was undertaken by both members of the research team. Following Miles and Huberman (1994), both researchers coded the same data independently as a reliability check. This process achieved an intercoder reliability of 80%. We were satisfied with these results, as Krippendorf (1980) and Miles and Huberman (1994) suggest that 80% or more may be regarded as good agreement. Each researcher also checked the codes generated for each transcription a few days after the initial coding to ensure internal consistency (Miles & Huberman, 1994). This resulted in code-recode reliability of more than 90%. Following Zimmer and Golden (1988), not all codes were prespecified. Additional insights frequently surfaced during data collection and transcription analysis, with additional codes emerging as a result.

Qualitative data analysis revealed that Milliken's (1987) classification was consistent with SME's own perceptions of uncertainty when they scan, interpret, and respond to change in the external marketing environment. In talking about the concept of uncertainty, there were three components that were mentioned by some or all of the 20 respondents. The three components were (a) a lack of information regarding environmental factors composing the decision maker's environment/not being able to predict what is going to happen, (b) not knowing the impact of the external marketing environment on the organization, and (c) not knowing how to respond to what is happening in the external marketing environment. These descriptions clearly relate to Milliken's concepts of state, effect, and response uncertainty.

In addition to the type of uncertainty experienced, the exploratory results also suggested that some items relating to state and effect uncertainty should be studied in relation to specific subenvironments or components of the external marketing environment (such as economic, technological, suppliers, competitors, and so on) to identify the domain of the marketing environment about which the marketing decision maker is uncertain. Ten different subenvironments of the external marketing environment were identified by respondents, including five factors representing the macro(remote)-environment (economic, political/legal, technology, sociocultural, and natural/physical) and five factors representing the micro(task)-marketing environment (distributors, actual end users, market characteristics, competitors, and suppliers). These correspond closely to Miller's (1993) classification, with the addition of sociocultural, natural/physical, and distributor factors.

Domain Specification and Item Generation

Following recommended procedures (e.g., DeVellis, 2003) to develop a suitable bank of items for measuring the nature of the uncertainty experienced by SMEs, an initial set of 17 items (Appendix A) was generated from (a) a review of prior research on perceived uncertainty relating to the environment (Boyd & Fulk, 1996; Downey, Hellriegel, & Slocum, 1975; Duncan, 1972; Gerloff et al., 1991; Milliken, 1990; Tung, 1979) and (b) the findings of the exploratory research. There were five items for state uncertainty, five items for effect uncertainty, and seven items for response uncertainty. Throughout this process, care was taken to avoid redundancy among items as well as exceptionally lengthy items, multiple negatives, and jargon (DeVellis, 2003).

Instrument Pretesting and Data Collection

Instrument pretesting took the form of a protocol interview with 10 of the 20 SMEs participating in the exploratory study to assess the adequacy of the questionnaire and 10 academic researchers (expert judges) who were asked to identify which of the three defined uncertainty constructs each of the 17 items represented. As shown in Appendix B, 12 items survived this content validation process and, as such, were ready to be administered to a development sample for further scale purification.

The exploratory interviews indicated that the first three items measuring state and effect uncertainty (see Appendix B) should be measured in relation to specific subenvironments of the external marketing environment, as responses could differ according to the specific subenvironment in question. Consequently, the SMEs were asked to identify those subenvironments that they took directly into consideration in their marketing decision making. *Directly* was defined as a factor that had a direct bearing on their marketing decision making. Respondents were then asked to respond to the first three items for state and effect uncertainty for each of their chosen subenvironments. The resulting score for each item was an average of the responses across the salient subenvironments (Tung, 1979). All other items required only a single response from SMEs.

The item pool was subsequently incorporated into a questionnaire. Responses to the questionnaire items were elicited on 5-point scales. Other variables were also measured, given their anticipated theoretical relationships with state, effect, and response environmental uncertainty and, therefore, their usefulness as validation items. Appendix C shows these additional constructs and their measures.

The questionnaire was mailed to a sample of 568 SMEs employed in New Zealand manufacturing, services, consumer, and industrial product businesses. Two hundred and four respondents returned the questionnaire, generating a response rate of just under 36%, an adequate sample size for measurement development purposes (Spector, 1992). Preliminary data screening did not reveal discrepancies in coding errors. The data matrix thus comprised 204 cases and 12 indicators.

Three separate sets of nonresponse analysis were performed. First, early and late respondents were compared on all variables of interest, using traditional *t* tests following Lesley's (1972) and Armstrong and Overton's (1977) recommendations. Unpaired *t* tests were used to compare the group means to each other. Differences between the means were not statistically significant at the .05 level, indicating that there were no differences between the group means of early and late respondents. Hence, it was assumed that nonresponse bias was not likely. In addition, 100 randomly selected nonrespondents were contacted by telephone to directly ascertain reasons for nonresponse; this showed that time pressures or company policy prevented participation in the survey. Finally, a comparison of the sample profile to the industry sectors investigated indicated that the sample was representative of the population of firms employing more than 100 employees.

Measurement Development Procedure

The psychometric properties of the three uncertainty scales were assessed using established measurement development procedures (Churchill, 1979; DeVellis, 2003; Nunnally &

Bernstein, 1994; Spector, 1992). All three uncertainty variables were measured with reflective indicators, as they all measure the same underlying phenomena. The original sample ($N = 204$) was randomly split into two subsamples, as suggested by DeVellis (2003). Splitting the original sample in this way provided valuable information about scale stability. With the first subsample, the opportunity exists for unstable, chance factors to be confused with reliable covariation among items (DeVellis, 2003). No such opportunity for systematically attributing chance results to reliability exists for the second subsample because its data do not influence item selection.

Sample 1 ($N = 120$) was used for item reduction and scale refinement using exploratory factor analysis. This provided a sample ratio of 10:1, as 10 items survived the content validation process, which meets the recommended ratio suggested by Hair, Anderson, Tatham, and Black (2006). Dimensionality was examined first, as it has been argued that the most critical assumption of measurement theory is that a set of items captures just one underlying construct (Gerbing & Anderson, 1988; Hattie, 1985). The second step involved an examination of internal consistency.

Sample 2 ($N = 84$) was retained as a holdout sample for scale validation. The sample size exceeded the recommended minimum number for model estimation. With reflective indicators, PLS requires a minimum sample size that equals 10 times the largest number of predictors leading to an endogenous construct (Barclay, Higgins, & Thompson, 1995). In our study, this was three, meaning that our holdout sample size was satisfactory as it exceeded 30. Tests for convergent and discriminant validity were performed on this sample using confirmatory factor analysis. Also, nomological validity was established by linking the scales to other theoretically relevant constructs via a literature review of the information systems and strategic management literature (Peter, 1981) using the SEM-based PLS methodology (PLS Graph Version 3.00; Chin, 2003). PLS was chosen because of the small sample size for Sample 2 and the exploratory nature of the research.

Dimensionality and Reliability Assessment Using Sample 1

Common factor analysis (principal axis factoring with OBLIMIN rotation) was run on the entire set of items to provide initial support for the threefold classification. Table 2 contains the pattern matrix with the factor loadings for each variable on each factor. As can be seen from the table, the common factor analysis produced three factors explaining 69.89% of the variance, which are easily interpretable as representing state, effect, and response uncertainty perceptions. Hair et al. (2006) consider a factor solution that accounts for 60% or more of total variance to be satisfactory in the social sciences, and Diekhoff (1992) and Heck (1998) regard 50% of total variance explained as the threshold. Each factor clearly reflected one of the three *a priori* dimensions. Three items—prediction of environmental factors, measuring state uncertainty; feedback, measuring effect uncertainty; and alternative courses, measuring response uncertainty—exhibited cross-loadings less than .50 and low communalities and were subsequently dropped from further analysis (Table 2). For a sample of 120 respondents, factor loadings of .50 and higher are considered significant at a .05 significance level (Hair

Table 2
Exploratory Factor Analysis of Uncertainty Items

Items[a]	*a priori* Prediction	OBLIMIN-Rotated Loadings: Factor 1 (Effect)	Factor 2 (Response)	Factor 3 (State)	Communality
How often do you feel you have the information you need to understand how this factor will change in the future? (*never/always*) **Information Needed**	S	–.01	.01	.88	.71
How often do you believe that the marketing information you have about this factor is adequate for your marketing management decision making? (*never/always*) **Adequate Information**	S	–.09	–.06	.85	.79
How often do you feel you are unable to get the necessary information about this factor for your marketing management decision making? (*never/always*) **Necessary Information**	S	–.02	–.04	.92	.81
How often do you feel are you able to predict which external marketing environment factors will be important considerations for future marketing management decision making? (*never/always*) **Prediction of Environmental Factors**	S	–.19	–.32	.06	.26
How often do you feel you are unable to predict the impact of this factor on your organization? (*never/always*) **Predict Factor Impact**	E	.80	–.05	–.16	.67
Please indicate your "sureness" (level of certainty) as to how each factor affects your organization (*not at all sure/completely sure about how it will affect my decision making*) **Sureness**	E	.89	–.09	–.02	.66
How often do you feel you fully understand the effect of this factor on your organization? (*never/always*) **Understand Effect**	E	.82	–.01	–.16	.71
In general, what is the average length of time before you receive feedback concerning the effect external environmental factors have on your organization? (*1 day/1 year+*) **Feedback**	E	.11	.12	.06	.07
How often do you feel you can consider and then evaluate alternative courses of action before making a decision to follow a specific course of marketing action? (*never/always*) **Alternative Courses**	R	.16	.25	–.12	.16
How often do you feel you are unable to accurately anticipate the consequences/outcomes of making marketing management decisions before they are made? (*never/always*) **Consequences**	R	–.15	.94	–.04	.81
How often do you feel you know how to respond to changes in the external marketing environment? (*never/always*) **Respond**	R	–.16	.98	–.02	.81
How often do you feel you are unable to determine what the marketing response options should be in light of changes in the external marketing environment? (*never/always*) **Response Options**	R	–.01	.89	–.02	.89
Eigenvalue		4.48	2.61	1.29	
Variance explained (%)		37.33	21.78	10.77	
Cumulative (%)		37.33	59.11	69.89	

Note: S = state; E = effect; R = response.

a. Respondents were asked to answer these questions in the context of the organization's principal industry for which the senior marketing executive is responsible. Three items measuring state uncertainty and three items measuring effect uncertainty were studied in relation to those factors in the organization's external marketing environment directly considered in decision making (the term *directly* meant that a factor had a direct bearing on marketing management decision making). Scores for each item were then calculated by averaging scores for each environmental factor. Item scores were then summated to derive an overall uncertainty score for each uncertainty construct.

et al., 2006). A communality of less than .50 signifies that less than half of the variance in the item has been taken into account in identifying the latent construct (Hair et al., 2006).

Reliability assessment, based on internal consistency, resulted in a Cronbach's alpha of .81 for the three-item state uncertainty scale, .89 for the three-item effect uncertainty scale, and .74 for the three-item response uncertainty scale. Alpha estimates of between .60 and .70 are considered acceptable and higher than .70 are considered (Hair et al., 2006). Analysis of interitem correlations and item-total correlations showed that no improvement could be made to the Cronbach's alpha statistic for each scale.

Once dimensionality and reliability assessment were complete, scale validation was undertaken.

Scale Validation

Content Validity

All scale items were taken from the literature and the exploratory research with SMEs, making sure that the different aspects of each type of uncertainty were included in the item pool. Although the assessment of content validity is a subjective process (Carmines & Zeller, 1979), the comprehensive content of the scales derived from an extensive literature search, the exploratory research, and the use of expert judges provided support for acceptable content validity (DeVellis, 2003; Spector, 1992).

Convergent and Discriminant Validity

Comparison with different constructs. Although the exploratory analysis resulted in groups of items reflective of the three *a priori* dimensions, the extent to which multidimensionality was truly captured needed to be verified. Assessment of discriminant and predictive validity requires comparison with different constructs. Given that this research was part of a wider research study examining relationships between uncertainty perceptions and information-seeking behavior of SMEs, additional variables (broad scope marketing information and aggregated analytical marketing information) were chosen for use in these analyses. In our research, SMEs were asked to rate the extent to which a series of information items provided by an MkIS would be useful to them in carrying out their marketing management tasks.

Information broad in scope and information in an aggregated analytical format are two characteristics of marketing information identified in the MkIS literature as being potentially important in the marketing decision-making process (Kotler & Keller, 2006; Senn, 1987; Talvinen, 1995). Broad scope information characterizes a wide range of essentially basic descriptive information relating to the marketing environment; aggregated analytical information characterizes environmental information that has been summarized and processed to understand its relevance to the organization and for use in analytical decision models (Mangaliso, 1995; McDonald, 1996; Senn, 1987; Specht, 1986).

Given that no measures of broad scope and aggregated analytical marketing information exist, an initial pool of 10 items was generated from the MkIS, Accounting Information

Systems (AIS), and Management Information Systems (MIS) literature and an exploratory study of SMEs. We specified the domain of content of the construct broad scope marketing information as information that relates to possible future events, the likelihood of these events occurring, information on broad factors external to the organization, and both qualitative and quantitative information about the external marketplace. Aggregated analytical marketing information was specified as information processed around time periods, functional areas, and formats consistent with analytical decision models. Following preliminary screening, five items were generated to measure broad scope information, and four items were used to measure aggregated analytical marketing information.

Using the second sample (N = 84), the purified item measure scores from the initial exploratory stages of the data analysis were used to estimate a confirmatory factor analysis model. Specifically, a three-factor structure was specified, with state, effect, and response uncertainty serving as the latent constructs and the nine items as the observed variables. Broad scope information and aggregated analytical information were each measured with five and four items, respectively.

Convergent Validity

Convergent validity of the measurement model was assessed by three measures: item reliability, construct (composite) reliability, and average variance extracted (AVE; Fornell & Larcker, 1981). Item reliability was evaluated by the size of the loadings of the measures on their corresponding constructs. Falk and Miller (1992) and Chin (1998) state that most of the loadings should be at least .60 and ideally at .70 or higher, indicating that each measure is accounting for 50% or more of the variance of the underlying latent variable (Bagozzi, 1994; Fornell & Larcker, 1981; Hair et al., 2006). Table 3 shows the item loadings for the measurement model, indicating adequate convergent validity. Seventeen items exhibited loadings greater than .70, and one item exhibited a loading between .60 and .70.

Composite reliability was assessed by using the internal consistency formula of Werts, Linn, and Joreskog (1974). Table 3 shows that the composite reliabilities were satisfactory.

Finally, the AVE scores for state, effect, and response uncertainty were .74, .81, and .65, respectively (see Table 3). Convergent validity is adequate when constructs have an AVE of at least .50 (Fornell & Larcker, 1981). The three uncertainty constructs therefore achieve high degrees of construct validity.

Discriminant Validity

Constructs may be considered to have adequate discriminant validity if the square root of the AVE for each construct is larger than the correlation between the construct and any other construct in the model (Chin, 1998; Fornell & Larcker, 1981). As shown in Table 4, all constructs in the estimated model fulfilled this condition of discriminant validity. Because none of the off-diagonal elements exceeded the respective diagonal element, discriminant validity was achieved.

Table 3
Measurement Model Items

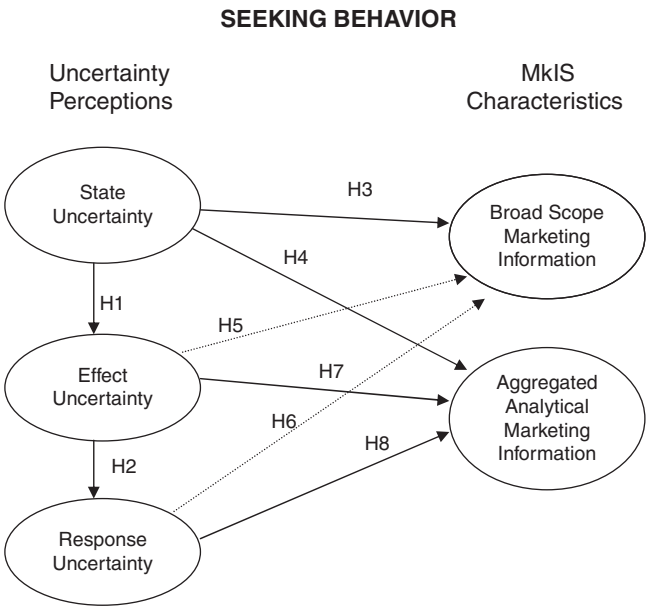
Construct Items	Loading	*t*	Average Variance Extracted	Internal Consistency[a]
State uncertainty			.74	.89
Information needed	.78	16.58		
Adequate information	.91	21.60		
Necessary information	.89	23.74		
Effect uncertainty			.81	.92
Predict factor impact	.87	20.51		
Sureness	.90	24.79		
Understand effect	.91	25.76		
Response uncertainty			.65	.85
Consequences	.83	7.07		
Respond	.87	10.01		
Response options	.71	5.97		
Broad scope marketing information			.74	.93
Future events	.91	29.40		
Likelihood occurring	.87	21.01		
Broad factors	.84	22.12		
Information qualitative	.83	19.50		
Information quantitative	.84	16.84		
Aggregated analytical marketing information			.60	.86
Formats	.82	12.73		
Aggregated analytical information, decisions	.77	9.67		
Time periods	.69	8.03		
Aggregated analytical information, external	.80	9.95		

a. Based on the internal consistency formula of Werts et al. (1974), Partial Least Squares uses an alternative measure to Cronbach's alpha as a measure of internal consistency. Rather than weighting the items equally, this measure uses the item loadings obtained within the nomological network or causal model.

Table 4
Descriptive Statistics and Correlation Among Construct Scores (Square Root of Average Variance Extracted in the Diagonal)

	State Uncertainty	Effect Uncertainty	Response Uncertainty	Broad Scope Marketing Information	Aggregated Analytical Marketing Information
State uncertainty	.86				
Effect uncertainty	.56	.90			
Response uncertainty	.28	.35	.81		
Broad scope marketing information	.82	.50	.29	.97	
Aggregated analytical marketing information	.33	.59	.33	.32	.77
M	7.44	7.15	7.06	13.77	11.95
SD	1.29	1.27	1.24	3.51	1.97

Figure 1
Proposed Model of Senior Marketing Executive Information



Note: Dotted arrows indicate a hypothesized non-significant path.

Nomological Validity

The final empirical assessment of the validity of the three uncertainty scales was to investigate how they performed nomologically (see Figure 1).

We first examined the extent to which the three environmental uncertainty constructs were related to each other. Previous conceptual research (Gerloff et al., 1991; Milliken, 1990) suggests that all three constructs are expected to be positively related. Higher levels of state uncertainty are likely to produce higher levels of effect uncertainty (i.e., uncertainty regarding the state of the environment is likely to increase uncertainty in how that environment is likely to affect the organization) (Hypothesis 1). If SMEs perceive less understanding of what the major events or trends in the external marketing environment are, they are more likely to have less understanding of the impact of this environment on the organization.

Higher levels of effect uncertainty are also likely to result in higher levels of response uncertainty (Hypothesis 2). Where there is less understanding of the impact of the environment on the organization (higher effect uncertainty), the less certain SMEs will be about how the organization should respond effectively. Conceptually, the linkage should be from state to effect to response. In responding to the external marketing environment, the SME first asks, "What is the state of my environment?" If this question can be answered, the second question becomes, "How will it affect my organization?" Where the second question is answered, the third question becomes, "How shall I respond?" (Gerloff et al., 1991).

As shown in Table 5, the path coefficients between state and effect uncertainty (beta coefficient = .57, $p < .001$) and between effect and response uncertainty (beta coefficient = .35, $p < .001$) are significant, positive, and in the expected theoretical direction. The results thus support the prediction that these uncertainty constructs are positively related to one another.

Nomological validity was also tested by demonstrating that the three uncertainty constructs are related to the two marketing information characteristic constructs. A number of key relationships were expected. First, we expected a positive relationship between perceived uncertainty regarding the state of the external marketing environment (e.g., what the major events and trends are) and the perceived usefulness of broad scope marketing information because it provided such basic descriptive information (Hypothesis 3). Second, we expected a positive association between perceived uncertainty regarding the state of the external marketing environment and the perceived usefulness of aggregated analytical marketing information because such information will provide knowledge about how events and trends have relevance to the organization (Hypothesis 4).

However, no relationship between perceived effect uncertainty and the perceived usefulness of broad scope marketing information was expected (Hypothesis 5) because effect uncertainty concerns the impact of the environment on the organization (Milliken, 1987) rather than describing the events and trends taking place in the environment. Similarly, no relationship between perceived response uncertainty and the perceived usefulness of broad scope marketing information was expected (Hypothesis 6) because response uncertainty concerns the response choices available to the organization rather than knowledge about events and trends taking place in the environment.

Also, we expected perceived effect uncertainty to have a positive relationship with the perceived usefulness of aggregated analytical marketing information (Hypothesis 7) because the latter consists of information that has been processed to understand its impact on the organization (Chenhall & Morris, 1986; Wright & Ashill, 1998). Finally, we expected perceived response uncertainty to have a positive relationship with the perceived usefulness of aggregated analytical marketing information (Hypothesis 8) because the latter can be used in decision models (e.g., assessing the impact on sales and profitability by changing price or promotion), which can assist the selection of the best response option.

As shown in Table 5, the *R*-squares for broad scope marketing information and aggregated analytical marketing information are .68 and .37, respectively. The percentage of variance explained for these dependent variables are all greater than 10%, implying a satisfactory and substantive value and predictive power of the PLS model (Falk & Miller, 1992).

The structural model results indicate that five of the six hypotheses linking the uncertainty constructs to the marketing information characteristics are supported, exhibiting high nomological validity of the constructs. Specifically, three of the anticipated relationships are significant at the .001 level ($p < .001$), and one is statistically significant at the .05 level ($p < .05$). Also, as hypothesized, two relationships are nonsignificant.

Finally, we performed the Stone-Geisser test of predictive relevance to assess model fit in PLS analysis (Geisser, 1975; Stone, 1974). Specifically, the PLS model was evaluated by looking at the *Q*-square predictive relevance for the model constructs. The *Q*-square is a measure of how well the observed values are reproduced by the model and its parameter estimates. When *Q*-square is greater than zero, the model has predictive relevance. In our model, *Q*-square is .60 for broad scope marketing information and .33 for aggregated analytical marketing information.

Table 5
Structural (Inner) Model Results

	Proposed Effect	Path Coefficient	Observed *t* Value	Significance Level	Hypothesis Support
Effects on effect uncertainty (*R*-square = .32)					
Hypothesis 1: State uncertainty	+	.57	10.34	****	Yes
Effects on response uncertainty (*R*-square = .12)					
Hypothesis 2: Effect uncertainty	+	.35	5.42	****	Yes
Effects on broad scope marketing information (*R*-square = .68)					
Hypothesis 3: State uncertainty	+	.78	22.58	****	Yes
Hypothesis 5: Effect Uncertainty	*ns*	.04	0.96	*ns*	Yes
Hypothesis 7: Response uncertainty	*ns*	.05	1.43	*ns*	Yes
Effects on aggregated analytical information (*R*-square = .37)					
Hypothesis 4: State uncertainty	+	–.03	0.35	*ns*	No
Hypothesis 6: Effect uncertainty	+	.56	7.65	****	Yes
Hypothesis 8: Response uncertainty	+	.14	2.01	**	Yes

**** < .001; ** < 0.05; ns = not significant.

Method Biases

Because of the self-report nature of the survey, method variance is a potential issue. Spector (1987) reported that the most frequently found sources of method variance in self-reports are acquiescence and social desirability bias. Acquiescence bias is the tendency to agree with items independent of content. We avoided this by using frequency (*never* to *always*) rather than Likert-type (*strongly disagree* to *strongly disagree*) scales. Social desirability refers to the need for social approval and acceptance and the belief that it can be achieved by means of culturally acceptable and appropriate behaviors (Crowne & Marlowe, 1964). Given that the nature of our focal variables relate to PEU, it is highly unlikely that such bias is present in our study.

To assess the extent of methods bias in our study, two tests were conducted. First, the Harman one-factor test was performed following the approach described by Podsakoff, Tudor, Grover, and Huber (1984) and Schriesheim (1979). This can best be described as a diagnostic technique for assessing the extent to which method bias may be a problem (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). According to this test, if a single factor emerges from the exploratory factor analysis or one factor accounts for more than 50% of the variance in the items, methods bias is present (Mattila & Enz, 2002). All of the items measuring the three constructs were entered into a common factor analysis with OBLIM rotation. The results revealed a three-factor structure with no one factor accounting for more than 50% of the variance. Therefore, method bias, per se, cannot explain our study results.

Second, the marker-variable technique was also used to test for method bias. This is a more stringent test than the Harman technique and involves the use of a marker-variable to assess the extent of method bias in self-report surveys (Lindell & Brandt, 2000; Lindell & Whitney, 2001).

If a variable can be identified on theoretical grounds that should not be related to at least one study variable, it can be used as a marker. Method bias can be assessed based on the correlation between the marker-variable and the theoretically unrelated study variable(s). This technique has proven to be as reliable as other well-established conventional tools in terms of their ability to detect method bias in the information systems area (Malhotra, Kim, & Patil, 2006).

We chose to apply the technique by using the variable "task variability" as the marker-variable because it was not expected to be related to state, effect, or response uncertainty. Task variability was defined as the frequency of unexpected and novel events that occur in the work process when performing marketing tasks. It was measured by four items that displayed sound measurement properties (space considerations preclude a description of the tests conducted). Usually, one study variable is used, but we chose to apply a more stringent test by selecting all three constructs. The correlations were .05 for state, .06 for effect, and .07 for response uncertainty. Tests of statistical significance indicated that none of the correlations was different from zero, indicating that methods bias did not affect our results (Malhotra et al., 2006).

Conclusion and Future Research

Researchers interested in the environment's impact on organizations have generally aggregated uncertainty conditions into a single global measure of environmental uncertainty (or have measured individual subcomponents of that environment) and have not attempted to examine the process of understanding, interpreting, and responding to change in the external environment as separate phenomena. Milliken's three environmental uncertainty constructs provide a much richer framework for analysis, but research depends on the existence of reliable and valid scales to capture their measurement. Specifically, we have systematically developed and validated three uncertainty scales using Milliken's (1987) conceptualization of state, effect, and response uncertainty. This is the first study to provide a psychometrically sound and operationally valid measure of different types of uncertainty experienced by managers as they make sense of, interpret, and respond to an external environment. In doing so, we have demonstrated the application of a rigorous procedure for scale development that includes split-sample psychometric testing, the extension of the usual convergent and discriminant validity tests to an assessment of nomological validity, and evaluation of common method bias.

The overall results of the *a priori* analysis indicated that 9 of the 12 uncertainty items load significantly onto three factors that correspond to state, effect, and response uncertainty perceptions. The confirmatory factor analysis model results using PLS also support this representation. A key outcome of our procedure is that by asking respondents to respond to those parts of perceived environmental (state) uncertainty that are salient to them, we are creating a composite scale that is not only reliable and valid but also covers the domain of content of the construct.

The second research objective related to the usefulness of measuring all three constructs rather than the usual procedure of measuring only state uncertainty. The study findings relating to the nomological validity tests strongly support the measurement of all three constructs. The tests show that state, effect, and response uncertainty are differentially associated with the perceived usefulness of broad scope and aggregated analytical marketing information.

Specifically, state uncertainty is directly related to the perceived usefulness of broad scope marketing information, whereas effect and response uncertainty are directly linked to the perceived usefulness of aggregated analytical marketing information. Such understanding of how environmental contingences affect the perceived usefulness of key characteristics of MkIS design would not have emerged had only state (perceived environmental) uncertainty been measured. These results support Miller and Shamsie's (1999) findings related to product line simplicity (based on objective measures) and point to the value of using all three constructs in future studies of uncertainty. The first use of our scales in future management research, therefore, is to allow the testing of the differential impact of the constructs on other outcome variables.

A second use of reliable and valid scales to measure the three uncertainty constructs is for researching, and hence understanding, the determinants of managerial decision making and processes. Within the domain of strategic management, for example, state and effect uncertainty may be expected to influence the speed and nature of response to changes in the environment: When state and effect uncertainty is low, response to opportunities and threats is expected to be fast and decisive, whereas when state and effect uncertainty is high, response is expected to be slow and cautious. Furthermore, the existence of reliable and valid scales means that Milliken's (1987) 10 hypotheses (each specific to state, effect, and response uncertainty), relating to strategic planning processes, can now be tested. Although some research has explored the relationship between state uncertainty and environmental scanning behavior (Ebrahimi, 2006), no attempt has been made to link effect and response uncertainty to such processes. For example, our scales can be used to test her hypotheses that under conditions of high effect uncertainty, managers spend a lot of time (and use many resources) in the environmental threat and opportunity phase of strategic planning and that when a high level of response uncertainty is experienced, strategic response may be to imitate or copy the strategic responses of competitors.

Third, the three scales can be used to provide a platform for future managerial research into the antecedents of state, effect, and response uncertainty. For example, the possible differential effects of environmental characteristics, such as stability of change and complexity, on uncertainty can be assessed. Also, future streams could investigate how individual differences, such as cognitive processes and biases, social expectations, and behavioral response repertoires (experience; Downey & Slocum, 1975; Drea, 1997; Menon & Varadarajan, 1992), may introduce variation into different types of uncertainty. Predictions could also be made about organizational characteristics. Managers' perceptions of their organization's effectiveness may influence their interpretation of environmental changes. For example, Milliken (1990) suggested that the perceived strength of an organization's identity may influence managerial perception of their organization's environment. It may be that managers who perceive their organizations as having a strong sense of identity, and as effective, may be more certain of the state of their external environment and the effect of this environment on decision making. They may also be more certain of their organization's ability to adapt effectively to environmental changes and therefore have high response certainty. Finally, resource dependence characteristics may influence environmental uncertainty perceptions. The existence of, and adherence to, strategic planning procedures and processes may influence managers' certainty about how to respond to a changing external environment. Factors

such as whether the organization has undertaken a competitor analysis and whether it has a strategic planning process in place could influence perceptions of response uncertainty.

Fourth, we believe that the use of the three scales has the potential to reconcile, in part, the conflicting empirical results of TCE studies, where the most usual approach is to measure the volatility of technological change. Not only is this an inadequate measure of PEU (state) uncertainty, but the method neglects the impact of effect and response uncertainty that, separately or together, may paint a very different picture of the totality of uncertainty facing a manager than that formed from measuring technology volatility alone and lead to different predictions about governance, as explained earlier. We therefore believe that researchers in this field should consider measuring and testing the impact of these constructs.

Fifth, another area that could benefit from the measurement of the three constructs is real options theory. The theory is based on behavior within financial markets where an investor makes a small investment to buy an option contract to retain the right to future investment choices without being obliged to invest (Cox & Rubinstein, 1985). When the time arrives, the investor decides between striking the option or abandoning it. This application of the theory has been broadened to include organizational resource investments. Bowman and Hurry (1993) propose that high PEU will lead to managers holding options open, reducing potential losses as much as possible. However, when managers perceive low environmental uncertainty, they will be motivated to strike options, thus earning gains and profits. As with TCE research, their focus was on PEU (though with an emphasis on a composite measure). Future real options research may benefit from measuring not only PEU (state uncertainty) but also effect and response uncertainty to gain a more complete understanding of how environmental uncertainty affects strategic investment.

Finally, researchers may use the three scales to develop an understanding of the process of information gathering and interpretation. Because the three uncertainty types bear varying impacts on different facets of information, future research should attempt to highlight congruency more specifically. Specifying the contingency factors information characteristics relationships and their consequent effects on managerial performance would provide more precise grounds on which a contingency model might encompass information processing in varying contexts. An interesting question for future research is how environmental uncertainty perceptions affect actual information use to facilitate decision making and the relationship between information use and managerial performance. If managers use broad scope information and aggregated analytical information to assist decision making, then given comparable decision-making skills, their application of this information should provide a relative advantage in performing managerial tasks and thus improve performance. A logical extension of this study in examining the predictive validity of the three uncertainty constructs would be to extend the analysis to look at the extent of use of information with these characteristics and performance issues.

The final research objective was to examine the linkages between state, effect, and response uncertainty. The findings show that they are conceptually distinct although empirically related. The PLS analysis revealed statistically significant relationships between state

and effect uncertainty, and effect and response uncertainty. Environmental interpretation appears to follow the sequence hypothesized by Gerloff et al. (1991) in that managers' interpretation of the effects of the environment on the organization is dependent on their perceptions of the state of that environment. Furthermore, their response is dependent on their interpretation of the effects.

In addition to these implications and future research uses, our study also has practical implications for managers. First, application of the state uncertainty scale provides the opportunity to assess where their environmental intelligence is weak. Because the three items composing the scale require managers to assess the degree of uncertainty within different subenvironments of the external marketing environment (e.g., economic, sociocultural, actual end users, and competitors), its use will formally identify the source(s) of environmental uncertainty and, hence, where research may be required. For example, if a high level of uncertainty is found to be associated with competitors, this finding may stimulate the collection of competitor intelligence to overcome this weakness.

Second, if application of response scale reveals a high degree of uncertainty, managers should consider formal ways of dealing with this problem. For example, brainstorming could be used with stakeholders such as other employees, distributors, and/or suppliers to identify alternative response options and the likely consequences of decisions.

Finally, a limitation of this study is that development and validation was conducted among a sample of senior marketing managers. This necessitated wording the items in terms that were relevant to them. For example, many items used the term *marketing management decision making*, and some used the expression *external marketing environment*. However, we can see no *a priori* reason why the use of the scales developed in this study cannot be used with equal validity in other contexts simply by removing the word *marketing* in such cases.

APPENDIX A
State, Effect, and Response Uncertainty Items and Their Sources

State Uncertainty Items	Illustrative Sources
State 1	Duncan (1972)
How often do you feel you have the information you need in order to understand how this factor will change in the future? (*never/always*)	Downey et al. (1975)
State 2	Tung (1979)
How often do you believe the marketing information you have about this factor is adequate for your marketing management decision making? (*never/always*)	Miles & Snow (1978)
State 3[c]	Pfeffer & Salancik (1978)
How difficult is it for you to get the necessary information about this factor for your marketing management decision making? (*never/always*)	Govindarajan (1984)
State 4[a]	Ireland, Hitt, Bettis, & De Porras (1987)
How difficult is it for you to obtain additional information about this factor when you need it for your marketing management decision making? (*never/always*)	Gerloff et al. (1991)
State 5[c]	Gul (1991)
How difficult is it for you to predict which external environmental factors will be important considerations for future marketing management decision-making? (*never/always*)	Miller (1993)
	Werner et al. (1996)

Effect Uncertainty Items	Illustrative Sources
Effect 1[c]	
How often do you feel you are able to predict how this factor is going to affect your organization? *[A low level of predictability means that you are very unsure about how this factor will affect your organization. A high level of predictability means that you are very sure about how this factor will affect your organization.]* (*never/always*)	Duncan (1972)
Effect 2[c]	Downey et al. (1975)
To summarize your beliefs about each of the factors you consider in your marketing management decision making, please indicate your "sureness" (level of certainty) as to how each factor affects the success of your marketing decisions. (*not sure at all about how it will affect the success/failure of my decision making/completely sure about how it will affect the success/failure of my decision making*)	Tung (1979)
Effect 3[c]	Milliken (1987)
What is the typical length of time involved before you can obtain feedback concerning the effect external marketing environment factors have on your organization? (*1 day/1 year+*)	Gerloff et al. (1991)
	Boyd & Fulk (1996)

(continued)

APPENDIX A (continued)

Effect Uncertainty Items	Illustrative Sources
Effect 4[a]	
How often do you feel you are able to analyze this factor? *[Analyzability means the extent to which you can understand or describe cause and effect relationships. A low level of analyzability means that cause and effect relationships are not well understood. A high level of analyzability means that cause and effect relationships are readily described and measured.]* (*never/always*)	
Effect 5[c]	
How often do you feel you are able to quantify the effect/impact of this factor on your marketing decision making? (*never/always*)	
Response Uncertainty Items	**Illustrative Sources**
Response 1	Duncan (1972)
How often do you feel you can consider and then evaluate alternative courses of action before making a decision to follow a specific course of marketing action? (*never/always*)	Downey et al. (1975) Tung (1979) Milliken (1987) Gerloff et al. (1991)
Response 2[b]	
How often do you feel you can accurately anticipate the consequences of making marketing management decisions before they are made? (*never/always*)	
Response 3[a]	
How often do you feel you are able to tell if the marketing management decisions you make will have a positive or negative effect on your organization's performance? (*never/always*)	
Response 4[b]	
How often do you feel you can determine the outcome of your marketing management decisions before they are made? (*never/always*)	
Response 5	
How often do you feel you know how to respond to changes in the external marketing environment? (*never/always*)	
Response 6[a]	
How often do you feel you know which direction to take in response to changes in the external marketing environment? (*never/always*)	
Response 7	
How often do you feel you are able to determine what the marketing response options should be in light of changes in the external marketing environment? (*never/always*)	

a. Items dropped
b. Items combined.
c. Items reworded.

APPENDIX B
Uncertainty Items Used in the Final Questionnaire

State Uncertainty Items (Reflective)

How often do you feel you have the information you need in order to understand how this factor will change in the future? (*never/always*) **Information Needed**

How often do you believe the marketing information you have about this factor is adequate for your marketing management decision making? (*never/always*) **Adequate Information**

How often do you feel you are able to get the necessary information about this factor for your marketing management decision making? (*never/always*) **Necessary Information**

How often are you able to predict which external marketing environment factors will be important considerations for future marketing management decision making? (*never/always*) **Prediction of Environmental Factors**[a]

Effect Uncertainty Items (Reflective)

How often do you feel that you are able to predict the impact of this factor on your marketing management decision making? [*A low level of predictability means that you are very unsure about how this factor affects your marketing decision making. A high level of predictability means that you are very sure about how this factor affects your marketing decision making.*] (*never/always*) **Predict Factor Impact**

Please indicate your "sureness" (level of certainty) as to how each factor affects your marketing management decision making? (*not at all sure about how it will affect my decision making/completely sure about how it will affect my decision making*) **Sureness**

How often do you feel you fully understand the effect of this factor on your marketing management decision making? (*never/always*) **Understand Effect**

In general, what is the average length of time before you receive feedback concerning the effect external environmental factors have on your marketing management decision making? (*1 day/1 year+*) **Feedback**[a]

Response Uncertainty Items (Reflective)

How often do you feel you can consider and then evaluate alternative courses of action before making a decision to follow a specific course of marketing action? (*never/always*) **Alternative Courses**[a]

How often do you feel you can accurately anticipate the consequences/outcomes of making marketing management decisions before they are made? (*never/always*) **Consequences**

How often do you feel you know how to respond to changes in the external marketing environment? (*never/always*) **Respond**

How often do you feel you are able to determine what the marketing response options should be in light of changes in the external marketing environment? (*never/always*) **Response Options**

a. Items dropped after dimensionality assessment using Sample 1.

APPENDIX C
Other Variable Measures and Their Sources

Construct	Measures	Illustrative Sources
Broad scope marketing information (five reflective items)	Information that relates to possible future events that may affect your marketing management decision making (e.g., future regulatory policies, competitor activities in the marketplace [existing and new], future predictions of market growth/decline [*not at all useful/extremely useful*]) **Future Events** Information on the likelihood of these future events occurring so as to generate marketing opportunities and threats (e.g., probability estimates of changes in the external marketing environment and competitor activities in the marketplace [*not at all useful/extremely useful*]) **Likelihood Occurring** Information on broad factors external to the organization (e.g., economic conditions, technology developments, government regulation, political conditions, social/lifestyle changes [*not at all useful/extremely useful*]) **Broad Factors** Qualitative and often subjective information about changing conditions in the marketplace (e.g., shifts in buyer behavior, competitor activities, and information on broad factors external to the organization such as regulatory change and technological developments [*not at all useful/extremely useful*]) **Marketplace Information Qualitative** Quantitative information about your external marketplace (e.g., market size, market growth/decline, performance data of competitors [*not at all useful/extremely useful*]) **Marketplace Information Quantitative**	Chenhall & Morris (1986) Abernethy & Guthrie (1994) Mangaliso (1995) Talvinen (1995) McDonald (1996) Yasai-Ardekani & Nystrom (1996) Ebrahimi (2000) Li, Chen, & Roan (2000/2001)
Aggregated analytical marketing information (four reflective items)	Information in formats to aid your marketing management decision making (e.g., SWOT [strengths, weaknesses, opportunities, and threats], segmentation and targeting analysis, new product development frameworks, marketing plan frameworks [*not at all useful/extremely useful*]) **Formats** Analytical information that has been processed to show the impact of your marketing management decisions on performance (e.g., the impact on sales and profitability by changing price and/or promotions expenditure [*not at all useful/extremely useful*]) **Analytical Information Decisions**	Chenhall & Morris (1986) Specht (1986) Mangaliso (1995) McDonald (1996) Wright & Ashill (1998)

(continued)

APPENDIX C (continued)

Construct	Measures	Illustrative Sources
	Information pertaining to particular time periods (e.g., weekly, monthly, quarterly, and annual summary reports detailing trends and comparisons [*not at all useful/extremely useful*]) **Time Periods**	
	Analytical information that has been processed to show the impact of external events on the organization's marketing activities (e.g., information that summarizes why something happened, what is likely to happen next, and "what-if" queries such as the impact of a new competitor in the market [*not at all useful/extremely useful*]) **Analytical Information External**	

References

Abernethy, M. A., & Guthrie, C. C. 1994. An empirical assessment of the "fit" between strategy and management information system design. *Accounting and Finance*, 34(2): 49-66.

Achrol, R. S., & Stern, L. W. 1988. Environmental determinants of decision making uncertainty in marketing channels. *Journal of Marketing Research*, 25(1): 36-50.

Anderson, E., & Schmittlein, D. C. 1984. Integration of the sales force: An empirical examination. *The Rand Journal of Economics*, 15(3): 385-395.

Armstrong, S. J., & Overton, T. S. 1977. Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 14(3): 396-402.

Bagozzi, R. P. 1994. Measurement in marketing research: Basic principles of questionnaire design. In R. P. Bagozzi (Ed.), *Principles of marketing research*: 1-49. Cambridge, MA: Blackwell.

Barclay, D., Higgins, C., & Thompson, T. 1995. The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration (with commentaries). *Technology Studies*, 2(2): 285-324.

Bourgeois, L. J. 1980. Strategy and environment: A conceptual integration. *Academy of Management Review*, 5: 25-39.

Bowman, E. H., & Hurry, D. 1993. Strategy through the option lens: An integrated view of resource investments and the incremental-choice process. *Academy of Management Review*, 18(4): 760-782.

Boyd, B., & Fulk, J. 1996. Executive scanning and perceived uncertainty: A multidimensional model. *Journal of Management*, 22(1): 1-21.

Bstieler, L., & Gross, C. W. 2003. Measuring the effect of environmental uncertainty on process activities, project team characteristics, and new product success. *The Journal of Business and Industrial Marketing*, 18(2-3): 146-162.

Buvik, A., & Grønhaug, K. 2000. Inter-firm dependence, environmental uncertainty and vertical co-ordination in industrial buyer-seller relationships. *Omega*, 28: 445-454.

Camuffo, A., Furlan, A., & Rettore, E. 2007. Risk sharing in supplier relations: An agency model for the Italian air-conditioning industry. *Strategic Management Journal*, 28: 1257-1266.

Carmines, E. G., & Zeller, R. A. 1979. *Reliability and validity assessment*. Beverly Hills, CA: Sage.

Chenhall, R. H., & Morris, D. 1986. The impact of structure, environment and interdependence on the perceived usefulness of management accounting systems. *The Accounting Review*, 61(1): 16-35.

Chin, W. W. 2003. *PLS-graph* (Beta Version 03.00). Houston, TX: Soft Modeling, Inc.

Chin, W. W. 1998. The partial least squares for structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research*: 295-336. Mahwah, NJ: Lawrence Erlbaum.

Churchill, G. A. 1979. A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 16(1): 64-73.

Conrath, D. W. 1967. Organizational decision-making behavior under varying conditions of uncertainty. *Management Science*, 13(8): 487-500.

Cox, J. C., & Rubinstein, M. 1985. *Options markets*. Englewood Cliffs, NJ: Prentice Hall.

Cronbach, L. J. 1951. Coefficient alpha and the internal structure of tests. *Psychometrica*, 16: 297-334.

Crowne, D. P., & Marlowe, D. 1964. *The approved motive: Studies in evaluative dependence*. New York: Wiley.

David, R. J., & Han, S.- K. 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal*, 25: 39-58.

Dean, J. W., Jr., & Snell, S. A. 1996. The strategic use of integrated manufacturing: An empirical investigation. *Strategic Management Journal*, 17: 459-480.

Denzin, N. K., & Lincoln, Y. S. 1994. *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

DeSarbo, W. S., Di Benedetto, C. A., Song, M., & Sinha, I. 2005. Revisiting the Miles and Snow strategic framework: Uncovering interrelationships between strategic types, capabilities, environmental uncertainty, and firm performance. *Strategic Management Journal*, 26: 47-74.

DeVellis, R. F. 2003. *Scale development theory and applications*. Thousand Oaks, CA: Sage.

Diekhoff, G. 1992. *Statistics for the social and behavioral sciences: Univariate, bivariate, multivariate*. Dubuque, IA: William C. Brown Publishers.

Doty, D. H., Bhattacharya, M., Wheatley, K. K., & Sutcliffe, K. M. 2006. Divergence between informant and archival measures of the environment: Real differences, artifact, or perceptual error? *Journal of Business Research*, 59(2): 268-277.

Doty, D. H., Glick, W. H., & Huber, G. P. 1993. Fit, equifinality, and organizational effectiveness: A test of two configurational theories. *Academy Management Journa*l, 36(6): 1196-1250.

Downey, H. K., & Slocum, J. W. 1975. Uncertainty: Measures, research and sources of variation. *Academy Management Journal*, 18(3): 562-577.

Downey, H. K., Hellriegel, D., & Slocum, J. W. 1975. Environmental uncertainty: The construct and its application. *Administrative Science Quarterly*, 20(4): 613-629.

Drea, J. T. 1997. Perceived environmental uncertainty: Planning implications for small banks. *American Business Review*, 15(1): 49-56.

Duncan, R. B. 1972. Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, 17(3): 313-327.

Ebrahimi, B. P. 2000. Perceived strategic uncertainty and environmental scanning behaviour of Hong Kong Chinese executives. *Journal of Business Research*, 49(1): 67-77.

Falk, R. F., & Miller, N. B. 1992. *A primer for soft modeling*. Akron, OH: University of Akron Press.

Fink, R. C., James, W. L., & Hatten, K. J. 2008. Duration and relational choices: Time based effects of customer performance and environmental uncertainty on relational choice. *Industrial Marketing Management*, 37: 367-379.

Fornell, C. R., & Larcker, D. F. 1981. Structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(2): 39-50.

Geisser, S. 1975. The predictive sample reuse method with applications. *Journal of the American Statistical Association*, 70: 320-328.

Gerbing, D. W., & Anderson, J. C. 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*, 25(2): 186-192.

Gerloff, E. A., Muir, N. K., & Bodensteiner, W. D. 1991. Three components of perceived environmental uncertainty: An exploratory analysis of the effects of aggregation. *Journal of Management*, 17(4): 749-768.

Govindarajan, V. 1984. Appropriateness of accounting data in performance evaluation: An empirical evaluation of environmental uncertainty as an intervening variable. *Accounting, Organizations and Society*, 9(2): 125-135.

Gul, F. A. 1991. The effects of management accounting systems and environmental uncertainty on small business managers' performance. *Accounting and Business Research*, 22(85): 57-61.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. 2006. *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Prentice Hall.

Hart, S. 1987. The use of the survey in industrial market research. *Journal of Marketing Management*, 3(1): 25-38.

Hattie, J. 1985. Methodology review: Assessing unidimensionality of tests and items. *Applied Psychological Measurement*, 9(2): 139-164.

Heck, R. H. 1998. Factor analysis: Exploratory and confirmatory approaches. In G. A. Marcoulides (Ed.), *Modern methods for business research*: 177-216. Hillsdale, NJ: Lawrence Erlbaum.

Hough, J. R., & White, M. A. 2004. Scanning actions and environmental dynamism: Gathering information for strategic decision making. *Management Decision*, 42(5/6): 781-793.

Huber, G. P., & Daft, R. 1987. The information environments of organizations. In F. Jablin, L. L. Putnam, K. H. Roberts, & L. W. Porter (Eds.), *Handbook of organizational communications: An interdisciplinary perspective*: 130-164. Newbury Park, CA: Sage.

Ireland, R. D., Hitt, M. A., Bettis, R. A., & De Porras, D. A. 1987. Strategy formulation processes: Differences in perceptions of strength and weaknesses indicators and environmental uncertainty by managerial level. *Strategic Management Journal*, 8(5): 469-485.

Karimi, J., Somers, T. M., & Gupta, Y. P. 2004. Impact of environmental uncertainty and task characteristics on user satisfaction with data. *Information Systems Research*, 15(2): 175-194.

Klein, S., Frazier, G., & Roth, V. J. (1990). A transaction cost analysis model of channel integration in international markets. *Journal of Marketing Research*, 27(2): 96-208.

Kotler, P., & Keller, K. L. 2006. *Marketing management* (12th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Krippendorf, K. 1980. *Content analysis*. Newbury Park, CA: Sage.

Lal, M., & Hassel, L. 1998. The joint impact of environmental uncertainty and tolerance of ambiguity on top management. *Scandinavian Journal of Management*, 14(3): 259-271.

Lee, H.- U., & Park, J.- H. 2008. The influence of top management team international exposure on international alliance formation. *Journal of Management Studies*, 45(5): 961-981.

Lesley, L. 1972. Are high response rates essential to valid surveys? *Social Sciences Research*, 1(3): 323-334.

Li, E. Y., Chen, H., & Roan, J. 2000/2001. Marketing information systems usage in Taiwan's top 1000 companies. *Journal of Computer Information Systems*, 41(2): 85-96.

Li, H., & Atuahene-Gima, K. 2002. The adoption of agency business activity, product innovation, and performance in Chinese technology ventures. *Strategic Management Journal*, 23: 469-490.

Li, H., Bingham, J. B., & Umphress, E. E. 2007. Fairness from the top: Perceived procedural justice and collaborative problem solving in new product development. *Organization Science*, 18(2): 200-218.

Lindell, M. K., & Brandt, C. J. 2000. Climate quality and climate consensus as mediators of the relationship between organizational antecedents and outcomes. *Journal of Applied Psychology*, 85(3): 331-348.

Lindell, M. K., & Whitney, D. J. 2001. Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology*, 86(1): 114-121.

Linn, G., Casey, K. M., Johnson, G. E., & Ellis, T. S. 2001. Do broad scope managerial information systems moderate the effects of budget emphasis, budget participation and perceived environmental uncertainty on the propensity to create budget slack? *The Journal of Computer Information Systems*, 42(1): 90-97.

Majumdar, S. K., & Ramaswamy, V. 1994. On the role of social asset specificity in the channel integration decision. *Journal of Institutional and Theoretical Economics*, 150: 375-400.

Malhotra, N. K., Kim, S. S., & Patil, A. 2006. Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research. *Management Science*, 52(12): 1865-1883.

Mangaliso, M. 1995. The strategic usefulness of management information as perceived by middle managers. *Journal of Management*, 21(2): 231-250.

Mattila, A., & Enz, C. 2002. The role of emotions in service encounters. *Journal of Service Research*, 4(4): 268-277.

McDonald, M. 1996. *Strategic marketing planning* (2nd ed.). London: Kogan Page.

Menon, A., & Varadarajan, R. 1992. A model of marketing knowledge use within firms. *Journal of Marketing*, 56(4): 53-71.

Miles, M., & Huberman, A. M. 1994. *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage.

Miles, R. E., & Snow, C. C. 1978. *Organizational strategy, structure and process*. New York: McGraw-Hill.

Miller, K. D. 1993. Industry and country effects on executive' perceptions of environmental uncertainties. *Journal of International Business Studies*, 24(4): 693-714.

Miller, K. D., & Shamsie, J. 1999. Strategic responses to three kinds of uncertainty: Product line simplicity at the Hollywood Film studios. *Journal of Management*, 25(1): 97-116.

Milliken, F. J. 1987. Three types of uncertainty about the environment: State, effect and response uncertainty. *Academy of Management Review*, 12(1): 133-143.

Milliken, F. J. 1990. Perceiving and integrating change: An examination of college administrators' interpretation of changing demographics. *Academy of Management Journal*, 33(1): 42-63.

Newkirk, H. E., & Lederer, A. L. 2006. The effectiveness of strategic information systems planning under environmental uncertainty. *Information and Management*, 43: 481-501.

Nunnally, J. C., & Bernstein, I. H. 1994. *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Pagell, M., & Krause, D. R. 2004. Reexploring the relationship between flexibility and the external environment. *Journal of Operations Management*, 21: 629-649.

Peter, J. P. 1981. Construct validity: A review of basic issues and marketing practices. *Journal of Marketing Research*, 18(2): 133-145.

Pfeffer, J., & Salancik, G. R. 1978. *The external control of organizations*. New York: Harper and Row.

Podsakoff, P. M., Mackenzie, S. B., Lee, J., & Podsakoff, N. P. 2003. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5): 879-903.

Podsakoff, P. M., Tudor, W. D., Grover, R. A., & Huber, V. L. 1984. Situational moderators of leader reward and punishment behaviors: Fact or fiction? *Organizational Behavior and Human Decision Processes*, 34(1): 21-63.

Robertson, T. S., & Gatignon, H. 1998. Technological development mode: A transaction cost conceptualization. *Strategic Management Journal*, 19(9): 515-531.

Robson, S. R., & Foster, A. 1989. *Qualitative research in action*. London: Edward Arnold.

Ryu, S., & Eyuboglu, N. 2007. The environment and its impact on satisfaction with supplier performance: An investigation of the mediating effects of control mechanisms from the perspective of the manufacturer in the U.S.A. *Industrial marketing Management*, 36: 458-469.

Sawyerr, O. O., McGee, J., & Peterson, M. 2003. Perceived uncertainty and firm performance in SMEs. *International Small Business Journal*, 21(3): 269-271.

Schriesheim, C. A. 1979. The similarity of individual directed and group directed leader behavior descriptions. *Academy of Management Journal*, 22(2): 345-355.

Selnes, F., & Sallis, J. 2003. Promoting relationship learning. *Journal of Marketing*, 67(July): 80-95.

Senn, J. A. 1987. *Information systems in management*. Belmont, CA: Wadsworth.

Simerly, R. L., & Li, M. 2000. Environmental dynamism, capital structure and performance: A theoretical integration and an empirical test. *Strategic Management Journal*, 21: 31-55.

Song, M., Droge, C., Hanvanich, S., & Calantone, R. 2005. Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. *Strategic Management Journal*, 26: 259-276.

Specht, P. H. 1986. Job characteristics as indicants of CBIS data requirements. *MIS Quarterly*, 10(3): 270-288.

Spector, P. E. 1987. Method variance as an artifact in self-reported affect and perceptions at work: Myth or significant problem? *Journal of Applied Psychology*, 72(3): 438-443.

Spector, P. E. 1992. *Summated rating scale construction: An introduction*. Newbury Park, CA: Sage.

Stone, M. 1974. Cross-validatory choice and assessment of statistical predictions. *Journal of the Royal Statistical Society*, 36(2): 111-133.

Swamidass, P. M., & Newell, W. T. 1987. Manufacturing strategy, environmental uncertainty and performance: A path analytic model. *Management Science*, 33: 509-524.

Talvinen, J. M. 1995. Information systems in marketing. *European Journal of Marketing*, 29(1): 8-26.

Taylor, R. N. 1984. *Behavioral decision making*. Glenview, IL: Scott, Foresman and Co.

Tung, R. 1979. Dimensions of organizational environments: An exploratory study of their impact on organizational structure. *Academy of Management Journal*, 22(4): 672-693.

Tushman, M. L., & Nadler, D. A. 1978. Information processing as an integrating concept in organizational design. *Academy of Management Review*, 3(3): 613-624.

Waldman, D. A., Ramírez, G. G., House, R. J., & Puranam, P. 2001. Does leadership matter? CEO leadership attributes and profitability under conditions of perceived environmental uncertainty. *Academy of Management Journal*, 44(1): 134-143.

Werner, S., Brouthers, L. E., & Brouthers, K. D. 1996. International risk and perceived environmental uncertainty: The dimensionality and internal consistency of Miller's measure. *Journal of International Business Studies*, 27(3): 571-588.

Werts, C. E., Linn, R. L., & Joreskog, K. G. 1974. Intraclass reliability estimates: Testing structural assumptions. *Educational and Psychological Measurement*, 34(1): 25-33.

Williamson, O. E. 1991. Strategizing, economizing, and economic organization. *Strategic Management Journal*, 12(Winter): 75-94.

Wright, M., & Ashill, N. J. 1998. A new approach to marketing information systems. *European Journal of Marketing*, 32(1-2): 125-144.

Yasai-Ardekani, M., & Nystrom, P. C. 1996. Design for environmental scanning systems: Tests of a contingency theory. *Management Science*, 42(2): 187-204.

Yusuf, A. 2002. Environmental uncertainty, the entrepreneurial orientation of business ventures and performance. *International Journal of Commerce and Management*, 12(3/4): 83-103.

Zimmer, M., & Golden, L. L. 1988. Impressions of retail stores: A content analysis of consumer images. *Journal of Retailing*, 64(3): 265-294.

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