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REVISITING THE MILES AND SNOW STRATEGIC FRAMEWORK: UNCOVERING INTERRELATIONSHIPS BETWEEN STRATEGIC TYPES, CAPABILITIES, ENVIRONMENTAL UNCERTAINTY, AND FIRM PERFORMANCE

WAYNE S. DESARBO,[1]* C. ANTHONY DI BENEDETTO,[2] MICHAEL SONG[3] and INDRAJIT SINHA[2]
[1] *Smeal College of Business Administration, Pennsylvania State University, University Park, Pennsylvania, U.S.A.*
[2] *Fox School of Business Administration, Temple University, Philadelphia, Pennsylvania, U.S.A.*
[3] *School of Business, University of Washington, Seattle, Washington, U.S.A.*

The Miles and Snow strategic type framework is re-examined with respect to interrelationships with several theoretically relevant batteries of variables, including SBU strategic capabilities, environmental uncertainty, and performance. A newly developed constrained, multi-objective, classification methodology is modified to empirically derive an alternative quantitative typology using survey data obtained from 709 firms in three countries (China, Japan, United States). We compare the Miles and Snow typology to the classification empirically derived utilizing this combinatorial optimization clustering procedure. With respect to both variable battery associations and objective statistical criteria, we show that the empirically derived solution clearly dominates the traditional P-A-D-R typology of Miles and Snow. Implications and directions for future research are provided.

INTRODUCTION

For nearly a quarter century, the Miles and Snow (1978) strategic choice typology has been widely embraced and been a subject of considerable research attention in both the management and marketing strategy literatures (see, for example, Conant, Mokwa, and Varadarajan, 1990; Hambrick, 1983; McDaniel and Kolari, 1987; McKee, Varadarajan, and Pride, 1989; Ruekert and Walker, 1987; Shortell and Zajac, 1990). Authors attribute the typology's longevity and excellence to its innate parsimony, industry-independent nature, and to its correspondence with the actual strategic postures of firms across multiple industries and countries (Hambrick, 2003). Miles and Snow (1978) originally envisaged strategy as an agglomeration of decisions by which a strategic business unit (SBU) aligns its managerial processes (including its capabilities) with its environment. Accordingly, businesses were conceptually classified on the basis of their patterns of decisions into the now familiar Prospector–Analyzer–Defender–Reactor (P-A-D-R) framework. *Prospectors* are technologically innovative and seek out new markets; *Analyzers* tend to prefer a 'second-but-better' strategy;

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*Correspondence to: Wayne S. DeSarbo, Smeal College of Business Administration, Pennsylvania State University, Room 701D, Business Administration Building, University Park, PA 16802-3007, U.S.A. E-mail: desarbows@aol.com

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Defenders are engineering-oriented and focus on maintaining a secure niche in relatively stable market segments; and *Reactors* lack a stable strategy and are highly responsive to short-term environmental exigencies.

The Miles and Snow framework continues to be the most enduring strategy classification system available (Hambrick, 2003). Despite the entrenched nature of the Miles and Snow (1978) framework, a number of researchers have commented on the need for further empirical validation and testing of its underlying assumptions (Conant *et al*., 1990; Zajac and Shortell, 1989; Shortell and Zajac, 1990). Such authors have noted the fact that the original Miles and Snow research was limited in the number of industries and the range of capabilities studied. They did not systematically study all the possible linkages between capabilities and strategic type, nor did they attempt to prove the validity of their typology across other industry types. Similarly, for the most part, they did not determine empirically whether, for example, *Prospectors* might outperform *Defenders* under some circumstances (one exception was Zajac and Shortell, 1989, who found that *Prospectors* outperformed *Defenders* in the volatile healthcare industry).

Hambrick (1983) noted that the parsimonious Miles and Snow model offers an incomplete view of strategy. Its generic character ignores industry and environmental peculiarities. In fact, Miles and Snow (1978) stressed that the various strategic types would perform equally well in any industry, provided that the strategy was well implemented. This latter stance is inconsistent with the more typical view that an environment favors certain types of strategies. As Hambrick (1983) noted, little consideration of the environment–strategy link has been given in Miles and Snow, and no systematic evidence has been provided on how strategic types differ in their functional attributes (Miles and Snow, 1978: 7).

Hambrick (1983) attempted to relate differences in strategy to differences in performance conditioning on environmental and functional attributes. Many of his findings conflict with those predicted from Miles and Snow (1978), and suggest that deeper empirical research into the relationships between capabilities, strategic type, and performance across a wider range of industries is warranted. Yet, despite the inferred role of environmental factors (Hambrick, 1983; Zajac and Shortell, 1989), environmental effects remained empirically uninvestigated. Additionally, capabilities other than marketing-related ones were not explored in the Conant *et al*. (1990) study. An optimal approach should be one that explicitly accounts for both capabilities and environmental attributes. In fact, Conant *et al*. (1990) called for future research to examine the synthesis and integration across multiple sets of items. Finally, Hambrick (1984) also criticized such general classification schemes in not being quantitatively based. 'Typologies represent a theorist's attempt to make sense out of non-quantified observations. They may have the advantage of being 'poetic' ..., that is ring true, often sounding very plausible. However, since they are the product of rather personal insight, they may not accurately reflect reality. Or, more likely, they may serve well for descriptive purposes but have limited explanatory or predictive power' (Hambrick, 1984: 28).

The research objective of this manuscript is to introduce a new quantitative methodology to derive strategic typologies empirically in an attempt to resolve some of these criticisms leveled against the Miles and Snow typology over the years. In particular, we address the criticisms of Hambrick (1983, 1984) discussed above by explicitly including environmental attributes and SBU strategic capabilities in empirically deriving strategic type via an objective quantitative methodology, as well as exploring performance differences across strategic types. Our procedure permits a more comprehensive modeling and grouping of SBUs, and provides the flexibility of testing alternative taxonomies in a comparative manner. Our goal is *not* to uncover generic strategic types that could be necessarily generalized across all time periods, industries, data samples, etc., as we believe this would be impossible to do. Rather, we propose a quantitative methodology to be utilized across any scenario in order to derive strategic types for a given empirical application (e.g., for a given time period, industry). We report an extensive empirical research study conducted with 709 SBUs in three different countries (China, Japan, United States). We find that the particular four mixed-type solution derived by our proposed methodology for this particular application empirically dominates the Miles and Snow classification in terms of objective statistical criteria and provides much better explanatory power in terms of relationships with related batteries of variables such as strategic capabilities, environmental uncertainties, and performance. While some similarity to the Miles and Snow typology is witnessed, we do, however, uncover significant differences in terms of strategic capabilities, environmental uncertainties, and performance compared to the Miles and Snow typology as applied to this sample. Since we do not impose any *a priori* single or fixed classification scheme to the data, our quantitative framework that we tailor to this particular classification problem allows for the optimally derived typology to be objectively compared in terms of overall fit with any alternative typology (e.g., Miles and Snow) that may be imposed from our dataset.

THEORETICAL BACKGROUND

The Miles and Snow typology

Based on their field studies conducted in four industries (textbook publishing, electronics, food processing, and health care), Miles and Snow (1978) proposed a strategic typology classifying business units into four distinct groups: *Prospectors, Analyzers, Defenders,* and *Reactors*. *Prospectors* lead change in their industries, principally by launching new products and identifying new marketplace opportunities. *Defenders* find and seek to maintain a secure niche in a stable product area. Rather than concentrating on new product or market development, *Defenders* stay within a limited range of products, focusing more on resource efficiency and process improvements that cut manufacturing costs. *Analyzers* share traits of both *Prospectors* and *Defenders*. While defending positions in some industries, they may selectively move quickly to follow promising new product or market developments. Although they may initiate product or market development, *Analyzers* are more likely to follow a second-but-better strategy. A business pursuing an *Analyzer* strategy competes sometimes as a *Defender*, and other times as a *Prospector*, since it requires substantial resources to be able to do both simultaneously. These three strategic types (*Prospectors, Defenders*, and *Analyzers*) are consistent in their strategic selection, and will perform well so long as their implementation is effective. They tend to outperform *Reactor* businesses who lack a consistent strategy, and respond, usually inappropriately, to environmental pressures as they arise. For a more extensive discussion of the strategic types, see Hambrick (1983), Conant *et al.* (1990), and Walker *et al.* (2003).

The Miles and Snow (1978) typology has been extensively applied in the strategy literature, and has generally been supported (Snow and Hambrick, 1980; Hambrick, 1983, 1984; McDaniel and Kolari, 1987; McKee *et al.*, 1989; Shortell and Zajac, 1990; Webster, 1992). Conant *et al.* (1990) developed an 11-item scale to classify firms into strategic types; this scale has been successfully applied elsewhere (e.g., Dyer and Song, 1997; DeSarbo *et al.*, 2004).

The role of firm strategic capabilities

Strategic capabilities have been defined as 'complex bundles of skills and accumulated knowledge that enable firms [or SBUs] to coordinate activities and make use of their assets' (Day, 1990: 38) to create economic value and sustain competitive advantage. Many kinds of strategic capabilities that are common to businesses can be identified. Technological, product development, production process, manufacturing, and logistics capabilities allow a firm to keep costs down and/or differentiate its offerings. Increased production efficiency reduces costs, improves consistency in delivery, and ultimately increases competitiveness (Day, 1994). Market sensing, channel and customer linking, and technology-monitoring capabilities allow a business to respond swiftly to changing customer needs and to exploit its technological strengths most effectively (Day, 1994). Marketing capabilities, such as skills in segmentation, targeting, pricing, and advertising, permit the business to take advantage of its market sensing and technological capabilities and to implement effective marketing programs. Capabilities in information technology (IT) help the firm diffuse market information effectively across all relevant functional areas that it can exploit to direct the new product development process. Finally, management-related capabilities support all of the above and include human resource management, financial management, profit and revenue forecasting, among others.

Miles and Snow (1978) had reported the existence of relationships across strategic types and such firm strategic capabilities. *Prospectors*, for example, tend to compete by anticipating new product or marketplace opportunities and through technological innovation. These firms thrive in unstable, volatile environments—those marked by rapid technological change such as in the biotechnology, medical care, and aerospace industries (Walker *et al*., 2003). *Prospectors* use a first-to-market strategy and typically succeed by being able to develop new technologies, products, and markets rapidly (McDaniel and Kolari, 1987; Conant *et al*., 1990). Walker *et al*. (2003) note that *Prospectors* require strength in product R&D and product engineering, and perform best when the amount spent on product R&D is high. They also rely on solid market research and build close ties with distribution channels to ensure that the R&D produces products that meet customer needs (Hambrick, 1983; McDaniel and Kolari, 1987; Shortell and Zajac, 1990). Also, IT capabilities facilitate internal communication and functional integration that are critical to new product success (Swanson, 1994; Moenaert and Souder, 1996; Griffin and Hauser, 1996; Bharadwaj, Bharadwaj, and Konsynski, 1999). Miles and Snow (1978) have noted that *Prospectors* need to have the most complex coordination and communication mechanisms, as they are most reliant on new product development to sustain competitiveness (Robinson, Fornell, and Sullivan, 1992).

In contrast, *Defenders* attempt to locate and maintain a secure niche in a relatively stable product or service area. They do not look outside their established product-market domain to identify new opportunities (McDaniel and Kolari, 1987; Shortell and Zajac, 1990). They tend to offer a more limited range of products or services than their competitors, and try to protect their domains by offering higher quality, superior service, and lower prices (Hambrick, 1983). Clearly, to be effective in achieving these objectives, *Defenders* need to possess a high level of marketing and market linking capabilities (Conant *et al*., 1990; Walker *et al*., 2003), and have to concentrate on resource efficiency, cost-cutting, and process improvements.

According to Miles and Snow (1978), successful prospecting will have the effect of strengthening technology and R&D capabilities. In other words, '*Prospectors* tend to want to continue prospecting' (Hambrick, 1983), since this is what they do best. Similarly, *Defenders* will likely keep on defending, while *Analyzers* will build upon both prospecting and defending capabilities. *Reactors* do not capitalize on the set of capabilities they already have built up, but rather they shift strategic orientation in reaction to competitive pressures, thus they will usually be at a disadvantage to those firms that are competing from an established position of strength.

The role of environmental uncertainty

The strategy literature generally posits that strategy selection is conditional on how closely a business is aligned with its environment (e.g., Hofer and Schendel, 1978; Porter, 1980). For example, in conditions of high uncertainty in technology, customer, or competitive environments, the firm must be able to accommodate to environmental change (Miller and Friesen, 1978, 1983; Utterback, 1979). Environmental uncertainty may require a firm to be able to respond more rapidly to unforeseen change in order to survive (Lawrence and Lorsch, 1967; Covin and Slevin, 1989).

Researchers commenting on the Miles and Snow typology have noted that different environmental circumstances may be conducive to certain strategic types (e.g., Hambrick, 1983). Factors of environmental uncertainty that are likely to be perceived important by managers include such issues as the degree of predictability of financial and capital markets, government regulation and intervention, actions of competitors, actions of suppliers, and general conditions facing the organization (Hrebiniak and Snow, 1980). According to Walker *et al*. (2003), the following environmental characteristics tend to favor *Prospector* strategies: (1) the industry is in the early stage of the product life cycle (PLC); (2) market segments are still unidentified or undeveloped; (3) industry technology is newly emerging; (4) there are few established competitors; (5) industry structure is still in the process of evolving; and (6) industry concentration is high, e.g., one firm holds most of the market share. The reverse conditions tend to favor *Defender* strategies, whereas *Analyzer* strategies are favored in the 'middle ground.' As an example, if a large number of competitors exist, but industry structure is still evolving and a shakeout is inevitable, an *Analyzer* strategy may be more appropriate.

Comparatively few research studies have attempted empirically to support the proposed relationships between environment, strategic capability, and Miles and Snow strategic types as outlined by Walker *et al*. (2003). Hambrick (1983) has examined the effects on strategic choice of two environmental variables, product life cycle stage, and industry innovation, using the PIMS database. Zajac and Shortell (1989) find that *Prospectors* and *Analyzer* hospitals outperform *Defender* hospitals in the rapidly changing health care environment. There is a need for a greater consideration of the effects of the environment and capabilities on strategic choice.

Strategic capabilities and environmental uncertainty as antecedents to strategic choice

It is clear from the above discussion that relationships exist across business capabilities, the environment, and strategic type. Yet, the precise nature of the relationships among the antecedent variables and strategic type remains unclear and in need of further empirical investigation. The four Miles and Snow types, originally developed for a small number of industries, may not sufficiently well describe the strategic types that exist in other industry settings. For example, a disparate set of antecedent circumstances may lead a business to adopt a *Prospector* strategy. It may be in a rapidly changing market, and rely on leadership in new product development to stay ahead of the competition. Or, it may be in a relatively stable market, but seek to exploit a new emerging technology to serve customer needs in novel ways. Similarly, several different paths may lead to the adoption of a *Defender* strategy. A market share leader in a predictable market may choose to defend its position, as may a business seeking to reduce risk exposure in an extremely unpredictable market. In sum, a business will select a particular strategic type based on its particular internal strengths (capabilities) and external (environment) circumstances, and the strategic types that are actually employed may not, in fact, be cleanly interpretable as the four Miles and Snow (1978) categories. This suggests the implementation of a contingency-based approach that can empirically derive such situation-specific strategic types.

Performance and strategic types

As stated earlier, Miles and Snow (1978) suggested that the three 'archetypal' strategic types (*Prospectors, Analyzers*, and *Defenders*) should all perform well, and should also all outperform *Reactors* due to the latter's lack of a stable strategy. Hambrick (1983) points out that the original Miles and Snow model does not seek to predict which of the archetypal strategic types would be highest in performance, or under what circumstances; in fact, 'performance' had not been clearly defined. He notes that his comment is not to be taken as a criticism of the Miles and Snow model, as their intent was to develop a typology of corporate strategy, not to explore the performance consequences. Nevertheless, it is clear that more research was needed on the topic of strategic type and performance. Subsequent empirical tests of the Miles and Snow framework (e.g., Conant *et al*., 1990; Dyer and Song, 1997) have generally supported the expectation that the three archetypal strategic types would outperform *Reactors*. More research is still warranted, particularly with regard to whether industry classification, environmental factors, or other variables might affect the performance achieved by different strategic types.

Next, we proceed with describing the methodology to be utilized for an empirical contingency-based approach for deriving strategic types. As indicated before, we do not begin the analysis with any *a priori* expectations about the number of strategic types, nor concerning their nature and composition, nor in how they differ. We allow the selection of the optimal typology to be objectively and empirically determined by the structure in the data and the statistical fit of the models. Analyzing the characteristics of the identified strategic types in the empirically derived 'best' solution permits us to explore the interrelationships discussed above. Hence, the result of our analysis is a strategic typology that yields significantly richer insights about the actual strategic postures adopted by firms across industries and that speaks to the associations between strategic capabilities, environmental attributes, strategic choice, and resulting performance.

METHODOLOGY

The constrained multi-objective classification approach

The procedure we employ here is a general, but flexible, modeling framework for constrained, multi-objective classification (called NORMCLUS) that is well suited for grouping entities such as firms or customers. DeSarbo and Grisaffe (1998) have formulated the original NORMCLUS procedure which we modify here offering greater flexibility in accommodating multiple data batteries collected on the same firms, and in permitting a variety of constraints such as allowing for different types of clusters, controlling the minimum size (e.g., number of firms) of the resulting clusters, etc. The overall benefits of this constrained, multi-objective, clustering methodology over traditional classification schemes lie in its ability to satisfy a number of key empirically grounded and managerially relevant criteria (see DeSarbo and Grisaffe, 1998, for a more complete discussion). What makes NORMCLUS particularly useful to the problem of strategic choice here is its ability to appropriately accommodate multiple batteries of variables (here, strategic types, firm capabilities, environmental uncertainty, and firm performance) in a multi-objective function setting. In addition, NORMCLUS provides a statistical framework in which competing solutions can be formally compared in terms of comparative goodness-of-fit statistics (pseudo F-tests) explicitly taking into consideration the number of estimated parameters and model degrees of freedom. This aspect is of particular interest in the strategic choice application to follow in deriving an optimal solution in terms of the 'best' number of strategic types. Also, the four strategic type solution of Miles and Snow (1978) provides a natural 'straw man' or 'benchmark' against which to compare alternative empirically derived solutions on statistical fit grounds (we will also examine traditional cluster analysis as an alternative comparison standard). Finally, NORMCLUS has the ability to accommodate user-specified constraints to control various aspects of the resulting cluster solution (e.g., minimum cluster size).

The NORMCLUS methodology

NORMCLUS utilizes recent developments in combinatorial optimization in finding partitions of firms to optimize a user-specified objective function subject to user-specified constraints. Suppose there are $m = 1, \ldots, M$ objective functions that are comparably scaled as to range and distribution, and that a particular clustering/classification problem implies their joint optimization (minimization or maximization). In the utility function method of multi-criteria optimization, a utility function $U_m(f_m)$ is defined for each objective, f_m, depending on the importance of f_m compared to the other objective functions. Then, one can define a total utility function U as:

$$U = \sum_{m=1}^{M} U_m(f_m) \quad (1)$$

A solution vector $\underline{\theta}^*$ is then found by optimizing U subject to user-specified constraints:

$$h_j(\underline{\theta}) = 0 \quad j = 1, \ldots, J \quad (2)$$

$$g_s(\underline{\theta}) \leq 0 \quad s = 1, \ldots, S \quad (3)$$

A specific form for Equation 1 above can be given by:

$$U = \sum_{m-1}^{M} U_m = \sum_{m-1}^{M} \alpha_m f_m(\underline{\theta}), \quad (4)$$

where α_m is a scalar weighting or importance factor associated with the mth objective function, $f_m(\underline{\theta})$, with $\sum_m \alpha_m = 1$, and $h_j(\underline{\theta})$ and $g_s(\underline{\theta})$ are linear or non-linear equality and inequality constraints respectively. In the absence of theory, α_m are typically set equal to $1/M$. Rao (1996) calls this the 'weighting function method' for solving multi-criteria optimization problems that typically generate Pareto optimal solutions. Rao (1996) describes a number of alternative multi-criteria optimization frameworks such as the inverted utility method, the global criterion method, the bounded objective function method, and lexicographic method, which can all be accommodated in NORMCLUS. Appendix 1 summarizes the various types of constraints that can be implemented or tailored to any particular taxonomy problem.

Estimation algorithms for strategic types analysis

A variety of optimization procedures are available in NORMCLUS for parameter estimation including ordinary least-squares, constrained least-squares, and a host of combinatorial optimization procedures employing genetic algorithms (cf. Rao, 1996, for a survey), simulated annealing (cf. DeSarbo, Oliver, and Rangaswamy, 1989), lambda-opt procedures (cf. Lin and Kernighan, 1973), as well as a variety of heuristics such as greedy algorithms and taboo search. The particular selection of which combinatorial optimization procedure to use depends very much on the structure of the classification problem at hand.

The primary objective for this strategic type classification problem is to derive strategic type clusters that satisfy many of the criteria discussed above. More specifically, we want clusters of firms whose strategic choices are different, whose environmental characteristics are different, whose strategic capabilities are distinct, with different performance levels, whose sizes are substantial, and whose results can be easily projected to the entire customer base. Given these objectives, and the multidimensional nature of the problem, a multi-criteria objective function is defined as earlier described in the weighted utility function method. Let **X** denote Conant's strategic type battery of variables, **Y** the environmental uncertainty battery of variables, **P** for the performance variable battery, and **Z** the firm strategic capabilities battery of variables. For this particular application, we define four separate parts of the combined utility function that is to be maximized:

$$f_1 = |\mathbf{M}_1/\mathbf{T}_1| \quad (5)$$

$$f_2 = |\mathbf{M}_2/\mathbf{T}_2| \quad (6)$$

$$f_3 = |\mathbf{M}_3/\mathbf{T}_3| \quad (7)$$

$$f_4 = |\mathbf{M}_4/\mathbf{T}_4| \quad (8)$$

where $\mathbf{M}_j =$ the between cluster sum-of-squares and cross-products for battery j; $\mathbf{T}_j =$ the total sum-of-squares and cross-products for battery j; and $|\quad| =$ the determinant operator.

Thus, f_i are eta square measures which measure separation in the component battery cluster variables. Note that all f_i range between 0 and 1, as does the combined function U in Equation 1. Here, we set $\alpha = 0.25$ to weigh each component of U (strategic choice, environment, strategic type, performance, and strategic capabilities) equally given the nature of this specific application and the lack of any strong *a priori* theory. Thus, we are looking to summarize the associations and interrelationships (not causal) between these four distinct batteries of variables and simultaneously derive a strategic type classification that optimizes these interrelationships. That is, what taxonomy can be estimated that maximizes the separation or differences between each of the variable items within each battery (i.e., quantitatively optimize Equation 4 above)?

In addition, we imposed a number of other constraints on the final solutions. First, a mutually exclusive partitioning of the sample into separate, non-overlapping clusters was desired given the Miles and Snow (1978) tradition. Second, no single cluster was specified to contain less than 5 percent of the sample to avoid outlier small clusters. Appendix 2 describes the modified lambda-opt constrained combinatorial optimization algorithm especially formulated for this particular application.

RESEARCH DESIGN

Instrument development

Our constructs are defined based on competitive capability theory (Day, 1994; Conant *et al*., 1990). Our review of the marketing and management literature, however, found no existing scales for most of the SBU capabilities being studied. We therefore carried out a multi-step instrument development procedure to be certain of the validity and reliability of the operationalized constructs (Churchill, 1979).

Step 1: Measurement items for each capability type

We identified relevant measurement scales from the marketing and management literatures, and grouped them into the five capability types to form the initial pool of items. In cases where we felt all the dimensions of the construct had not been adequately covered, we created new additional items. We refined the scales through focus interviews with managers in two SBUs, asking them to assess the completeness of the scales. The results of the interviews suggested that the scales were relevant and complete. The respondents were also asked to rate their own SBU relative to major competitors on each scale item using 11-point Likert-type scales (0 = much worse than competitors, 10 = much better than competitors); they had no difficulty completing this task.

Step 2: Scale development

Seven judges (two professors and five doctoral students with background in measurement development) were asked to sort a list of scale items into the strategic capability scales, following Davis's

(1986) procedure. Working independently, each judge sorted the scale items into the strategic capability types. Following Davis (1986, 1989), construct convergence and divergence were examined by assessing inter-rater reliability. The percentage of correct placement of items was calculated as the proportion of items placed by the seven judges within the intended theoretical construct. The minimum percentage obtained was 84 percent. The items that were frequently incorrectly placed were eliminated from the pool. As a second test of inter-rater reliability, Cohen's kappa (Cohen, 1960), measuring level of agreement in categorization, was calculated for each pair of judges. Kappa ranged from 0.97 to 0.82, exceeding the minimum acceptable level of 0.65 (Jarvenpaa, 1989). We concluded that the items demonstrated convergent validity within the related capability and discriminant validity across the capabilities (Davis, 1986, 1989).

Step 3: Instrument pre-testing

To further assess scale validity and reliability, the remaining items were combined into a single questionnaire, which was pre-tested with 32 managers in the two SBUs. The pre-test resulted in the deletion of two more scale items. A second pretest, this time with 41 EMBA students taking a new product development class, was then conducted. The results were factor analyzed and scale reliabilities were assessed. Two additional items were deleted, resulting in the final set of capability scale items.

Step 4: Cross-cultural validation of the research instrument

Here, we explicitly sought to avoid an American bias to the problem. Following Song and Parry (1996), the above three steps served only as a starting point for our scale development, recognizing that conducting international research requires an 'inside-out' approach in order to develop valid and reliable measures of appropriate constructs. The research was designed with the intent of establishing equivalent measures for the study of the Japanese and Chinese firms as appropriate and developing new measures and/or constructs as necessary.

To make sure the translation was accurate and that the question meanings were not altered, we used a double-translation method to translate the questionnaire into Japanese and Chinese (Song and Parry, 1996). A comparison of the resulting questionnaires revealed considerable consistency across translators. The questionnaires were first translated into the foreign language by a translator and then translated back into English by a different translator to ensure translation equivalence.

After the translation procedure, we conducted field research in six Japanese firms and two Chinese firms in which we examined SBU capabilities and innovation strategies. The purposes of the additional field research were: (1) to establish the content validity of the concepts and the hypothesized relationships among the constructs; (2) to establish equivalence of the constructs, concepts, measures, and samples; and (3) to assess the possibility of cultural bias and response format bias (Song and Parry, 1996). The field research studies were conducted over a 9-month period with multiple visits to the companies.

The field research studies were important for several reasons. First, they facilitated an assessment of construct equivalence (i.e., conceptual, functional, and category equivalence). Second, they indicated that (with minor modifications) the measurement scales were appropriate for studying strategic capability and strategic types in Japanese and Chinese context. Third, the results from these field research studies suggested that it is more appropriate to ask the respondents to rate their SBU on each of the strategic capability scale items *relative to their major competitors* (see Appendix 3 for exact wording). Fourth, 11-point Likert-type scales (from 0 to 10) were chosen for the four strategic capability scales. Song and Parry (1997a, 1997b) also suggest that this format is better understood across multiple nations than are the 1–7 or 1–6 scales more commonly seen in North American research, because of their structural similarities to the metric system. Thus, we used an 11-point scale to elicit levels of agreement, with values ranging from 0 (much worse than our competitors) to 10 (much better than our competitors).

Measures

Appendix 3 presents all of the measures utilized in these data collection phases. Five major strategic capability areas were explicitly measured:

1. *Market-Linking Capabilities*. These capabilities relate to focused market sensing and linking

outside the organization and were rated according to several scale items developed from Day's (1994) descriptions of such capabilities. The component items measure the relative capabilities in creating and managing durable customer relationships, creating durable relationships with suppliers, retaining customers, and bonding with channel members such as wholesalers and retailers.

2. *Technological Capabilities*. Technological capabilities, pertaining to production process efficiency, cost reduction, greater consistency in delivery, and greater competitiveness, were rated according to scale items drawn from Day's (1994) set of such capabilities. The items measure relative capabilities in the prediction of technological change, technology and new product development, and product facilities.
3. *Marketing Capabilities*. Marketing capabilities were measured using a set of scale items drawn from the Conant *et al*. (1990) study of marketing capability and strategic type. These include knowledge of customers, knowledge of competitors, integration of marketing activities, skills in segmentation and targeting, and effectiveness of pricing and advertising programs.
4. *Information Technology Capabilities*. Information technology capabilities refer to the relative capabilities that help an organization create technical and market knowledge and facilitate intra-organizational communication flow. We developed items that measure the possession of information technology systems for new product development, cross-functional integration, technology and market knowledge creation, and internal communication. These items were subject to the measurement development procedure described above.
5. *Management Capabilities*. These capabilities include the ability to integrate logistics systems, control costs, manage financial and human resources, forecast revenues, and manage marketing planning. We developed a set of six items that measure the possession of these management capabilities.

The second battery of survey items pertains to *environmental uncertainty*. Here, we employed three separate scales of six items each to assess different aspects of the business environment uncertainty. The *technological environment uncertainty* scale included the assessment of technological change, the extent of technical opportunity, the difficulty of technological forecasting, and other aspects of technology. The assessment of *the market environment uncertainty* was based on changes in customer preferences, customer price sensitivity, customer product needs, changing customer base, and ease of forecasting marketplace changes. The *competitive environment uncertainty* scale assessed the extent of promotion and price wars, ability of firms to match competitive offers, and other competitive aspects. On all of these scales, a higher score means that the environment is more uncertain.

The third battery of items concerned the *classification of Miles and Snow strategic types*. Here, we used the data collected in the second phase of the data collection process to classify the SBU/division into the four strategic types. The 11-item scale is the same one previously developed and validated by Conant *et al*. (1990).

Finally, performance data were collected. Of 709 SBUs, we collected complete performance data for 549 of them. The measures collected were: PROFIT (i.e., total revenue—total variable costs)/total revenue); ROIPEC (i.e., an average percentage of the return on investment in this business unit over the past 3 years); ROI (return on investment); ROA (return on assets); RMS (relative market shares); CUSRET (overall customer retention); CUSRET2 (retention of major customers); SALESGR (sales growth rate); PERF1 (overall profit margin relative to the objective for this business unit); PERF2 (overall sales relative to the objective for this business unit); and PERF3 (overall return on investment relative to the objective for this business unit). Note, the NORMCLUS procedure was modified accordingly to accommodate missing data concerning the performance battery.

Data collection procedures

Our data were obtained from a large-scale mail survey of the companies listed in *Ward's Business Directory, Directory of Corporate Affiliations*, and *World Marketing Directory*. A proportionate-stratified random sample of 800 firms from China, Japan, and the United States, with each industry as a stratum, was drawn. The questionnaires for Japanese and Chinese firms were translated into Japanese and Chinese using a double-translation method as noted above. These three countries were chosen for two reasons. First, they are, in that order, the three largest economies in the world, as measured by purchasing power parity (World Bank, 2000), and are by any measure among the top five economies worldwide. Second, the Japanese and Chinese business environments are very different from the U.S. business environment, which allows us to find evidence of the empirical generalizability of our model. We believe this represents the largest empirical test of the Miles and Snow framework done to date.

The data collection consisted of three stages: pre-survey, data collection on SBU strategies, and data collection on relative capabilities, environmental uncertainty, and performance. In the first stage, we sent a one-page survey and an introductory letter requesting participation to all the selected firms, and offered a list of available research reports to participating firms. Each firm was asked to select an SBU/division for participation and provide a contact person in that SBU/division. Of the 2400 firms contacted, 392 in the United States, 429 in Japan, and 414 in China agreed to participate and provided the necessary contacts at the SBU/division level.

In the second stage, concerning strategic types, the designated SBU managers were contacted directly by the researchers. A questionnaire, a personalized letter, and the agreement to participation form from the first stage were mailed to each SBU manager. We employed a three-wave mailing based on the recommendations of Dillman (1978). We received data on the multi-item measures of the strategic types from 308 firms in the United States, 354 firms in Japan, and 352 firms in China. Two items at the end of the instrument assessed respondents' confidence in their ability to answer the questions. The individuals with a low level of confidence (less than 6) were excluded from the final sample.

In the third stage, concerning the strategic capabilities, performance, and environmental variables, another questionnaire was sent to the SBU managers, followed again by a three-wave mailing. We received data on the relative capabilities from 216 U.S. firms, 248 Japanese firms, and 245 Chinese firms. This constituted our final sample from each country, and these sample sizes correspond to response rates of 27.0 percent in the United States, 31.0 percent in Japan, and 30.6 percent in China.

The final sample includes the following industries: chemicals and related products; electronics and electrical equipment; pharmaceuticals, drugs, and medicines; industrial machinery and equipment; telecommunications equipment; semiconductors and computer-related products; instruments and related products; and others (air conditioning; transportation equipment, etc.). The majority of participating SBUs/divisions had annual sales of \$11–750 million and 100–12,500 employees.

To examine possible non-response bias and the representativeness of the participating firms, we performed a MANOVA to compare early respondents with late respondents on all four capability variables. The results were not significant at the 95 percent confidence level, suggesting no significant difference between the early respondents and the late respondents. Therefore, we concluded that non-response bias is not a concern.

We classified the SBUs into the four Miles and Snow strategic types (*Prospector*, *Analyzer*, *Defender*, or *Reactor*) to permit comparison with our empirically derived strategic types. To do this classification, we used the 'majority-rule decision structure' (see Conant *et al*., 1990, for details),[1] with the following modification: for an SBU to be classified as a Prospector or a Defender, it must have at least seven 'correct' answers out of the 11 items. Using this procedure, we classified the 709 SBUs/divisions as follows: 234 Prospectors, 220 Analyzers, 168 Defenders, and 87 Reactors.

EMPIRICAL RESULTS

Fit of new strategic types vs. Miles and Snow strategic types

We conducted a series of analyses employing the constrained, multi-objective classification methodology (NORMCLUS) described in the Methodology section. Initially, we formed four batteries of items: the 11 strategic type items, the 27 strategic capability items, the 18 environment items, and the 11 performance variables. Each battery was equally weighted (0.25) in the analysis. Table 1 presents the various goodness-of-fit values for each battery as well as the total fit value overall for

[1] In this procedure, an SBU is classified as a *Prospector* if the majority of responses to the 11-item scale correspond to the *Prospector* answers. A similar rule is used to classify SBUs into the other three strategic types (see the Strategic Typology scale in Appendix 3).

Table 1. Comparative goodness-of-fit values

Number of groups	Strategic type	Capabilities	Environment	Performance	Total fit
2	0.255	0.465	0.637	0.646	0.501**
3	0.511	0.753	0.622	0.787	0.668**
4	0.689	0.819	0.771	0.881	0.790**
5	0.861	0.740	0.863	0.902	0.841n.s.
M&S(4)*	0.999	0.376	0.396	0.570	0.586n.s.
KMEANS(4)	0.554	0.567	0.584	0.655	0.592n.s.

* This is the four-group Miles and Snow solution used as the benchmark.
** $p < 0.001$; n.s., not significant improvement at $p < 0.10$.

$K = 2$, 3, 4, and 5 types (clusters). Based on nested model Pseudo F-tests on Φ for the various numbers of strategic types, we find that *four strategic types* result from this analysis, and subsequently increasing the number of strategic types from 4 to 5 does not produce a significant increase in the overall goodness-of-fit measure, Φ. As can be seen in Table 1, the four strategic group solution appears to render consistent fits over each of the four batteries of items (0.689, 0.819, 0.771, 0.881) and a highly significant ($p < 0.01$) improvement of 0.790 overall.

Table 1 produces the corresponding fits for the traditional Miles and Snow (1978) classification scheme for the purpose of comparison. Here, we clustered just the 11 strategic type items into four clusters, which resulted in very clear P, A, D, and R groups. As shown in the table, the 0.999 fit value for the strategic type items in this analysis approaches 100 percent, which indicates a near-perfect separation of the resulting strategic types when these 11 items are considered solely. However, one can see the price paid for sticking to this traditional approach in terms of very low fit values for the environment and strategic capability item batteries (0.376 and 0.396). This implies low statistical relationships or associations between the traditional Miles and Snow typology and environmental conditions and strategic capabilities of these firms, which is clearly counter to theory. Even the performance battery fit in the Miles and Snow taxonomy is much lower (0.570) than what we witness for the derived four-group solution. Of particular note is the fact that the overall goodness-of-fit value is substantially higher for the derived four-group solution obtained from NORMCLUS when applied to this dataset. In fact, as has been depicted in Table 1, the Miles and Snow four-group solution is even dominated statistically by the NORMCLUS two-group solution in this instance. As will be shown shortly, there are substantial gains and insights obtained from utilizing the proposed strategic type framework in a contingency sense together with other conceptually meaningful variables compared to the traditional Miles and Snow typology considered in exclusion.

Note that Table 1 also shows the comparable fit across the various variable batteries for a four-cluster traditional KMEANS clustering solution where one concatenates all the variables together in all four batteries together and treats the entire set as one large battery. The corresponding overall fit is comparable to that derived from the Miles and Snow typology, but is also considerably inferior to the four-group NORMCLUS solution. Thus, traditional clustering methodologies are not substitutes for the NORMCLUS procedure in this setting.

Characteristics of the four derived strategic types

Table 2 indicates how each of the four derived groups correspond to the P-A-D-R Miles and Snow framework based on the 11-item Conant *et al.* (1990) strategic type questionnaire. Each respondent was classified as one of the four Miles and Snow strategic types (see procedure above in the Measures section), and then assigned to either *Prospectors, Analyzers, Defenders*, or *Reactors*. Table 2 shows the cross-tabulation relationships between the derived four-group solution and the Miles and Snow typology:

- Group 1 is composed of about 52 percent *Prospectors* and 32 percent *Analyzers*.
- Group 2 is about 55 percent *Defenders*, with the remaining 45 percent *Reactors*.

Table 2. Correspondence between empirically derived strategic types and Miles and Snow typology

	Strategic types				
Miles & Snow:	Group 1	Group 2	Group 3	Group 4	Total
Prospectors (% in group)	120 (52.2%)	0 (0%)	27 (26.0%)	87 (45.8%)	234
Analyzers (% in group)	73 (31.7%)	0 (0%)	45 (43.3%)	102 (53.7%)	220
Defenders (% in group)	37 (16.1%)	102 (55.1%)	28 (26.9%)	1 (0.5%)	168
Reactors (% in group)	0 (0%)	83 (44.9%)	4 (3.8%)	0 (0%)	87
Total	230	185	104	190	709

Chi-square tests:

	Value	d.f.	Asymp. sig. (2-sided)
Pearson chi-square	535.543	9	0.000
Likelihood ratio	648.056	9	0.000

- Group 3 is a hybrid of *Analyzers* (43%), *Prospectors* (26%), and *Defenders* (27%).
- Group 4 is split between *Prospectors* (46%) and *Analyzers* (54%).

In sum, Groups 1 and 4 are primarily *Prospector/Analyzer* groups, Group 2 is primarily a *Defender/Reactor* group, and Group 3 is a mix of *Analyzers, Prospectors*, and *Defenders*. While the chi-square test indicates a clear dependence between these two classifications, the derived four-group solution is not isomorphic or cleanly mapped into the P-A-D-R framework.

The four derived strategic types and strategic capabilities

Table 3 presents additional information (mean responses) that allows us to characterize the four derived strategic types in terms of their predominant firm strategic capabilities. Looking at Table 3, Groups 2 and 4 have significantly higher marketing capability levels (i.e., customer and competitor knowledge, marketing activity integration, skill at segmenting and targeting, effective pricing, and advertising) than do the other two groups. Groups 2 and 4's means on the marketing capability scale items range from 3.97 to 4.67 (on a 10-point scale), while those of Group 1 range from 1.29 to 2.19. By contrast, Group 1 has the highest technology capabilities (NPD and technology development capabilities, manufacturing processes, predicting technological changes, and production facilities), followed by Groups 4, 2, and 3 in that order. In general, Group 1's means on the technology capability scale items are around 8, while those for Group 3 are about 1. Interestingly, the groups' means on the information technology scale items (IT systems for new products, for functional integration, for technical and market knowledge creation, and for internal communication) also occur in the same order: Group 1 has the highest IT capabilities (scale item means are almost 9 on a 10-point scale), followed by Groups 4, 2, and 3 in that order.

Groups 2 and 3's market linking capabilities (market sensing, customer linking, channel bonding, customer retention, and supplier relationship building) are generally significantly higher than those of the other groups. Group 2's scale item means range from 2.28 to 3.15, while those of Group 3 range from 1.36 to 3.08; these are in almost every case significantly higher than the corresponding means for Groups 1 and 4. On the management capability scale items (integrated logistics systems, cost control capabilities, financial management skills, human resource management capabilities, profit and revenue forecasting, and marketing planning process), Group 4's means were significantly higher (ranging from 6.17 to 7.22), and Group 1's means were significantly lower (ranging from 4.55 to 6.04).

Note the differences between the two groups made up primarily of *Prospectors* and *Analyzers* (Groups 1 and 4). Group 4 is highest among all groups in both marketing and management capabilities, while Group 1 is the lowest. Group 1 is highest among all groups in technology and IT capabilities, but Group 4 is second highest. Finally, in market linking capabilities, Group 4

Table 3. Means of strategic capability items for the empirically derived strategic types

	Group 1	Group 2	Group 3	Group 4
Marketing capabilities				
Knowledge of customers	2.19	**3.94**	2.25	**4.23**
Knowledge of competitors	1.29	**3.97**	2.17	**4.19**
Integration of marketing activities	1.52	**4.41**	2.00	**4.53**
Skill to segment and target markets	1.71	**4.40**	1.93	**4.29**
Effectiveness of pricing programs	1.70	**4.62**	3.48	**4.37**
Effectiveness of advertising programs	1.80	**4.67**	3.50	**4.72**
Technology capabilities				
NPD capabilities	**7.90**	6.24	1.00	7.15
Manufacturing processes	**8.01**	6.51	1.00	7.34
Technology development capabilities	**8.34**	6.84	1.23	7.61
Predicting technological changes	**7.86**	6.14	0.84	7.28
Production facilities	**8.26**	6.66	1.35	7.51
Market-linking capabilities				
Market-sensing capabilities	1.51	**2.40**	**2.83**	1.49
Customer-linking capabilities	1.77	**2.59**	2.13	**2.43**
Durable relationship with suppliers	0.92	**2.28**	**2.41**	1.49
Ability to retain customers	1.44	**2.34**	1.36	1.39
Channel-bonding capabilities	1.58	**3.15**	**3.08**	2.22
Information technology capabilities				
IT systems for NPD projects	**9.45**	7.52	6.19	8.63
IT systems for functional integration	**9.48**	7.66	6.57	8.82
IT systems for tech knowledge creation	**8.99**	7.77	5.68	8.56
IT systems for mkt knowledge creation	**8.70**	7.13	6.01	8.19
IT systems for internal communication	**8.97**	7.20	5.90	8.53
Management capabilities				
Integrated logistics systems	6.04	6.70	5.99	**7.22**
Cost control capabilities	4.55	5.79	**6.57**	**6.17**
Financial management skills	5.29	6.52	**7.54**	**7.06**
HR management capabilities	5.29	6.35	6.59	**6.81**
Profitability and revenue forecasting	5.23	**6.35**	**6.49**	**6.71**
Marketing planning process	5.14	**6.42**	**6.86**	**6.81**

For complete wording of questions, see Appendix 3.
Interpretation: The highest mean for each scale item is highlighted in bold; the lowest mean for each scale item is underlined. (If there are no significant differences between two or more means, all are highlighted.)

usually outscores Group 1 (though Group 2 is significantly higher than both). Thus, Groups 1 and 4 are *Prospector/Analyzer* groups with different profiles: Group 4 is strong in marketing, management, technology, and IT. Group 1 relies on its capabilities in technology and IT, and is in fact the weakest group in marketing, market linking, and management.

Group 2, the *Defender/Reactor* group, has relative strengths in marketing and market linking capabilities, but is relatively weaker in technology and IT capabilities. Group 3, comprising *Analyzers, Defenders*, and *Prospectors*, has relative strength in market linking and management capabilities but is the weakest or among the weakest in all other capabilities.

The four strategic types and environmental uncertainty

Table 4 provides additional insights by comparing the four derived strategic types' mean responses on the environmental uncertainty factors. Group 2 firms face the most uncertain marketing, competitive, and technological environment, followed by Group 4. Average scores on environment uncertainty scale items are in the range of 6.12 to 6.59 (on a 10-point scale) for Group 2, and 5.18 to 6.66 for Group 4, where a higher score mean indicates greater perceived uncertainty. Both other groups face relatively lower uncertainty in their marketing, competitive, and technological environments.

Table 4. Means of environment items for the empirically derived strategic types

	Group 1	Group 2	Group 3	Group 4
Market environment				
Preferences change through time	3.97	**6.38**	4.32	5.18
Customers look for new products	4.04	**6.27**	4.39	5.33
Price relatively unimportant	4.07	**6.25**	4.26	5.28
Product-related needs are different	3.97	**6.34**	4.35	5.37
Cater to many of the same customers	3.53	**6.59**	3.90	6.06
Difficult to predict marketplace changes	4.01	**6.23**	4.48	5.31
Competitive environment				
Competition is cutthroat	3.68	**6.40**	4.02	5.72
Many 'promotion wars' in industry	3.74	**6.33**	3.95	5.90
Competitors can match offers readily	3.80	**6.24**	4.03	5.78
Price competition in industry	3.77	**6.29**	4.07	5.85
New competitive moves every day	3.20	**6.58**	3.48	6.66
Competitors are relatively weak	3.74	**6.25**	4.11	5.78
Technological environment				
Technology changing rapidly	4.12	**6.28**	3.92	5.49
Tech change provides opportunities	4.10	**6.32**	3.69	5.71
Difficult to forecast technology	4.16	**6.12**	3.80	5.64
New product ideas from technology	4.06	**6.18**	3.77	5.69
Tech developments are minor	3.55	**6.52**	3.16	6.47
Technological changes are frequent	4.11	**6.10**	3.97	5.54

For complete wording of questions, see Appendix 3.
Interpretation: The highest mean for each scale item is highlighted in bold; the lowest mean for each scale item is underlined.

Table 5. Means of performance items for the derived four-group solution

Performance measure	Group 1 mean	Group 2 mean	Group 3 mean	Group 4 mean	Overall mean
PROF	29.13	7.21	3.20	**33.12**	20.68
ROIPEC	−1.66	**19.52**	0.06	16.80	9.07
ROI	1.82	6.11	1.97	**5.63**	3.98
ROA	1.65	5.90	1.70	**5.96**	3.92
RMS	1.85	**5.83**	1.83	5.69	3.92
CUSRET	2.27	**6.42**	1.73	6.13	4.31
CUSRET2	2.21	**6.41**	1.97	6.32	4.37
SALESGR	1.19	6.90	1.64	**7.91**	4.55
PERF1	1.99	**6.35**	2.63	6.16	4.34
PERF2	1.98	**6.01**	2.63	5.75	4.14
PERF3	1.67	5.38	1.69	**5.55**	3.68

Legend: PROF = profit margin (i.e., total revenue- total variable costs)/total revenue; ROIPEC = average return on investment in this business unit over the past 3 years (in %); ROI = return on investment; ROA = return on assets; RMS = relative market share; CUSRET = overall customer retention; CUSRET2 = retention of major customers; SALESGR = sales growth; PERF1 = overall profit margin relative to the objective for this business unit; PERF2 = overall sales relative to the objective for this business unit; PERF3 = overall return on investment relative to the objective for this business unit.
See Appendix 3 for measurement procedure for each of these performance measures.
Interpretation: The highest mean for each scale item is highlighted in bold; the lowest mean for each scale item is underlined.

The four strategic types and performance

Table 5 presents the means for the 11 performance variables for the four derived strategic types. It is evident from Table 5 that Groups 2 and 4 are the highest-performing groups on almost every performance variable. Average 3-year ROI (ROIPEC) for Groups 2 and 4 are 19.52 and 16.80 respectively, while for Groups 1 and 3 the comparable means are −1.66 and 0.06 (i.e., Group 1 actually shows a negative 3-year ROI). Similar results are obtained for 1-year ROI (Groups 2 and

4 = 6.11 and 5.63 respectively; Groups 1 and 3 = 1.82 and 1.97 respectively), return on assets, relative market shares, customer retention, retention of major customers, sales growth, profit margin relative to objective, sales relative to objective, and ROI relative to objective. Group 1 showed strong profit margin performance (means for Groups 4 and 1 = 33.1 and 29.1 respectively, Groups 2 and 3 = 7.2 and 3.2 respectively); Group 3 lagged behind in performance on all measures.

The four strategic types cross-tabulated by country and industry

Finally, to further characterize the four derived strategic types, they were cross-tabulated by country (Table 6) and by industry (Table 7). As shown in Table 6, both Groups 2 and 4 are relatively evenly balanced across the three countries. Group 2 is 40.0 percent Japanese firms, 23.2 percent U.S. firms, and 36.8 percent

Table 6. Cross-tabulation of the four derived groups by country

Country	Group 1	Group 2	Group 3	Group 4	Overall
Japan (% in group)	110 (47.8%)	74 (40.0%)	0 (0%)	64 (33.7%)	248
U.S. (% in group)	12 (5.2%)	43 (23.2%)	104 (100%)	57 (30.0%)	216
China (% in group)	108 (47.0%)	68 (36.8%)	0 (0%)	69 (36.3%)	245
Total	230	185	104	190	709

Chi-square tests:

	Value	d.f.	Asymp. sig. (2-sided)
Pearson chi-square	311.619	6	0.000
Likelihood ratio	345.186	6	0.000

Table 7. Cross-tabulation of the four derived groups by industry

Industry	Group 1	Group 2	Group 3	Group 4	Overall
1. Chemicals and Related Products (% in group)	32 (13.9%)	33 (17.8%)	11 (10.6%)	22 (11.6%)	98
2. Electronic and Electrical Equipment (% in group)	27 (11.7%)	21 (11.4%)	12 (11.5%)	20 (10.5%)	80
3. Pharmaceuticals, Drugs, and Medicines (% in group)	27 (11.7%)	4 (2.2%)	13 (12.5%)	23 (12.1%)	67
4. Industrial Machinery and Equipment (% in group)	19 (8.3%)	23 (12.4%)	6 (5.8%)	13 (6.8%)	61
5. Telecommunications Equipment (% in group)	23 (10.0%)	22 (11.9%)	15 (14.4%)	14 (7.4%)	74
6. Semiconductors and Computer-Related Products (% in group)	23 (10.0%)	22 (11.9%)	16 (15.4%)	18 (9.5%)	79
7. Instruments and Related Products (% in group)	24 (10.4%)	20 (10.8%)	9 (8.7%)	26 (13.7%)	79
8. Others (% in group)	55 (23.9%)	40 (21.6%)	22 (21.2%)	54 (28.4%)	171
Total	230	185	104	190	709

Chi-square tests:

	Value	d.f.	Asymp. sig. (2-sided)
Pearson chi-square	33.097	21	0.045
Likelihood ratio	37.082	21	0.016

Chinese firms; comparable figures for Group 4 are: 33.7 percent Japanese, 30.0 percent U.S., and 36.3 percent Chinese. By contrast, Group 1 is almost entirely composed of Asian firms (47.8% Japanese, 47.0% Chinese, 5.2% U.S.), and Group 3 is 100 percent U.S. firms. As shown by the chi-square tests provided in Table 6, the differences across countries are significant.

Table 7, which shows cross-tabulations by industry, has less obvious results. Considering the two top performing groups, Table 7 shows that Group 2 contained relatively more chemical firms, industrial machinery and equipment manufacturers, telecommunications equipment manufacturers, and semiconductor and computer-related products, while Group 4 had comparatively more pharmaceutical and drug makers and instrument manufacturers. Other than these observations, little of note was obtained from the industry cross-tabulation.

DISCUSSION

The four groups in our solution bear some resemblance to the familiar four-group (P-A-D-R) typology of Miles and Snow. We do, however, find differences across groups that are explainable in terms of the strategic capabilities, performance, and environmental factors which would have been otherwise obscured using the classic Miles and Snow typology for this dataset. For example, Groups 1 and 4 are both primarily *Prospector/Analyzer* groups, but differ in terms of marketing, management, and some market-linking capabilities. Group 4 also faces more challenging environments. Similarly, Groups 2 and 3 have a bigger representation of *Defenders*, but Group 2 significantly outperforms Group 3 in marketing, market linking, technology, and IT capabilities, despite facing a more challenging environment. Our results also suggest that *Analyzers* do not necessarily constitute a separate group, but rather tend to be 'like' *Prospectors* (Groups 1, 3, and 4) or 'like' *Defenders* (Group 3). Hence, we believe our solution clarifies and complements the familiar Miles and Snow typology in that the relationships between strategic types, capabilities, and environmental uncertainty are explicitly included in the empirical classification scheme derived. Whereas Miles and Snow found *Prospectors*, for example, we find *Prospectors* who are stronger in marketing, market linking, and management, *Prospectors* who are significantly weaker in marketing and market-linking capabilities, and *Analyzers* that share characteristics with both types of *Prospectors*. As noted above, we also found that certain types of environmental uncertainty were associated with strategic type selection as well.

At this point one can combine all the results presented in Tables 2–7 to compile descriptive characteristics of all four derived strategic groups:

- *Group 1*: *Asian-based prospecting firms with technology strengths.* These firms, comprising mostly Miles and Snow *Prospectors* and *Analyzers*, seek to maintain their competitive edge by prospecting using their strengths in technology and IT capabilities. They possess relative weaknesses in marketing, market linking, and management, which would seem to limit their ability to respond quickly to market changes; however, they operate in relatively uncertain markets, competitive and technological environments, which may mitigate the need for strength in market linking. These firms are overwhelmingly Asian (about 95% total Japanese and Chinese), and tend to do well in 1-year profit performance, though not on any of the other performance measures.
- *Group 2*: *Defensive firms with marketing skills.* This group is slightly over one-half *Defenders*, and the remaining firms (about 45%) are *Reactors*. These firms stay competitive by defending their established positions through superior marketing, market linking, and management capabilities. They are among the weakest in technology and IT capabilities, however. Though they operate in relatively uncertain markets, competitive and technological environments, they are among the leaders on almost all performance measures. This group includes a mix of firms from all three countries.
- *Group 3*: *U.S.-based firms with market linking and management strengths.* This group is a mix of Miles and Snow types, including roughly half *analyzers* and the rest approximately evenly split between *Prospectors* and *Defenders*. Notably, all Group 3 firms are U.S.-based. These firms are relatively strong in market linking and management capabilities, but among the weakest in marketing, technology, and IT. These weaknesses contribute to the uniformly low performance of this group on all performance measures, despite the fact that these firms face

relatively low market, competitive, and technological uncertainties.

- *Group 4*: *Balanced prospecting firms.* This group is about evenly split between *Prospectors* and *Analyzers* and also includes a relatively even mix of Japanese, Chinese, and U.S. firms. These firms have the highest marketing and management capabilities and are also among the leaders in technology and IT capabilities (hence the name 'balanced'), though they have a potential weakness in market-linking capabilities. These firms perform extremely well on all performance variables, despite facing relatively high market, competitive, and technological uncertainties.

Here, we can make some overall observations about the four groups and how our findings correlate with the expectations of the Miles and Snow model. There are two clear paths to higher performance, and both are pursued by U.S. as well as Asian-based firms. Group 4 firms are *Prospectors* and *Analyzers* who have balanced marketing, technology, IT, and management capabilities. The Miles and Snow model would suggest that *Prospectors* require strengths in technology and IT, yet also need to receive information on customer needs efficiently to drive product development: this would be consistent with the 'balanced' set of capabilities possessed by Group 4 firms. Group 2 firms are Miles and Snow *Defenders* (and *Reactors* that behave like *Defenders*). Miles and Snow would predict that these firms would particularly require strategic capabilities in marketing and market linking for optimum performance; this is indeed consistent with our findings for Group 2. There were two paths to lower performance and, interestingly, one was predominant among Asian firms and one among U.S. firms. Asian low-performance firms (Group 1) tended to be strong in technology and IT but deficient in marketing, market linking, and management. One could infer that they attempt to compete on the basis of their technological strengths, but lack the marketing and management skills to be successful. U.S. low-performance firms (Group 3) are in some ways an opposite to Group 1: their relative strengths lie in market linking and management, but their technological and marketing capabilities are lacking. In short, both Groups 1 and 3 are deficient in several of the capability sets, while Groups 2 and 4 show few if any glaring capability weaknesses.

CONCLUSIONS

In this article, we revisit the long-established Miles and Snow (1978) strategic typology in the light of recent theoretical discussions as to inclusion of conceptually relevant variables as well as through the prism of a new classification methodology. The modified NORMCLUS constrained, multi-objective, classification procedure was utilized to derive a typology empirically from data pertaining to strategic type, strategic capabilities, environmental uncertainty, and performance. This methodology is well suited to obtain a parsimonious and flexible grouping of entities in accordance with established empirical and statistical criteria. The relative goodness-of-fit of the derived classification scheme is compared with that of the Miles and Snow grouping (used as a benchmark), and is found to more accurately capture the data associations and better explicate the interrelationships among the variables.

Our framework augments the scope of the original Miles and Snow model by considering the roles of three batteries of variables: strategic firm capabilities, environmental uncertainty, and performance. All of these have been discussed in past research (Hambrick, 1983; Zajac and Shortell, 1989; Conant *et al*., 1990), but have never been included together when deriving or testing a typology. In their original study, Miles and Snow (1978) suggested that there might be a complex framework of interrelationships among firm capabilities, environmental uncertainty, and strategy. However, they did not explicitly model the role of environmental factors or strategic capabilities *in the shaping of strategic types* (Hambrick, 1983). The Miles and Snow model implies that it is the SBU's strategic type *that shapes its capabilities* (i.e., *Prospectors* keep on prospecting). Hambrick (1983) suggested that a more complex relationship among all of these variables exists. Our results suggest that capabilities, and environmental factors, do in fact interrelate with strategic type, and understanding this framework of interactions is important to managers in that it does have significant impact on SBU performance.

As detailed in the above sections, we find that including strategic capabilities, environmental uncertainty, and performance results in a somewhat different classification that varies from Miles and Snow in the compositions of the four derived groups. They do not, however, negate the Miles and Snow grouping. In fact, the groups identified here can be viewed as *second-order derivatives* of the pure and conceptually distinct P-A-D-R groups being considered as first-order 'primitives.' Our study highlights a general point that strategic types as empirically derived from field samples tend to be highly context-dependent and do not neatly fall into the tight Miles and Snow groupings. As an obvious example, in our study, Groups 1 and 4 both behave much like classic Miles and Snow *Prospectors* and *Analyzers*, but one group has superior capabilities in marketing and management, and clearly dominates the other in terms of performance. The empirically derived strategic types provide a more accurate representation of strategic behavior for the industries under consideration, and provide better insights into the dynamics of strategy with respect to how firms cope with environmental uncertainty using their available capabilities (see Discussion section above).

We expect that in different contexts, different numbers and/or compositions of groups will emerge. For example, given a different set of industries, it is possible that five groups might be found, including two groups that are essentially *Prospectors* (but with different capabilities or facing different environments), and one each of *Analyzers, Defenders*, and *Reactors*. Without including the capability and environment variables in the analysis, one would miss the complex interrelationships between these variables and strategic type, and the performance implications. The derived strategic types capture the context-specific conditions that shape strategic decisions within a given set of industries, and therefore add a layer of understanding on top of the classic Miles and Snow strategic types. Our findings suggest that SBU managers need to consider both environment and capability when developing strategy, as there is a clear relationship between these batteries of variables and SBU performance.

In addition, we would also expect empirically derived strategic types would differ if alternative classification methods were utilized in such a contingency-based approach. We recommend the further use of the NORMCLUS methodology for deriving the strategic types as it provides considerably more sophistication and flexibility than raw conceptualization or standard cluster analysis in providing the ability to embed application constraints reflecting a priori knowledge, having a heuristic to test for the appropriate number of clusters, and building a framework to compare alternative classifications with respect to the same objective function and input variables. With these advantages, NORMCLUS is ideally suited to incorporating all the batteries of variables required in our capability-environment framework, including performance outcomes. We have demonstrated the superiority of NORMCLUS over traditional KMEANS cluster analysis for this application.

This study can be extended in a number of ways. Further studies should seek to validate the strategic typology using data sets obtained from a different set of industries using the NORMCLUS methodology as described above. It is expected that the derived strategic types are very context-dependent, so different groups might be found in different contexts. However, it would be intriguing to determine whether the groups derived from different industry settings bear some resemblance to the original Miles and Snow strategic types. Our derived strategic types can be easily understood as variants of classic Miles and Snow types, viewed within the context of the capability–environment framework. If empirically derived strategy types in other settings are also second-order derivatives of the Miles and Snow types (even if different groups are obtained), it supports our belief that the Miles and Snow strategic typology, viewed in conjunction with the capability–environment framework, is a powerful model of strategic behavior with real implications for SBU performance.

Future research can also extend our cross-cultural findings. We found four strategic groups across the United States, Japan, and China, and determined that the two strategic types that led to highest performance contained firms from all three countries. Thus, we have some evidence that managers from these three countries 'think alike' when reacting to similar capability and environmental settings. These two top-performing groups also resemble classic Miles and Snow groups: Group 2 resembles *Defenders*, while Group 4 is a combination of *Prospectors* and *Analyzers*. We therefore have some preliminary evidence that the Miles and Snow model generalizes across the United States, Japan, and China: managers from top performing firms in those three countries choose strategies not too different from those of the Miles and Snow model. It is unknown, however, whether this observation holds true in industries other than the ones we studied, or in other countries. Possibly, the business environment in other countries might be so different as to make the Miles and Snow model inapplicable. Future studies could develop hypotheses regarding business or cultural environmental conditions in other countries that would affect strategic choice, and determine whether the best-performing firms in those countries choose strategies that resemble the Miles and Snow strategic typology. It would be worthwhile to determine whether firms in different business environments (the European Union, for example, or emerging markets such as Eastern Europe or Southeast Asia) employ significantly different strategic types. A fertile area for future research here would be to conduct separate NORMCLUS analyses within each country and then compare the results across countries using the Miles and Snow typology as a benchmark. In addition, estimating overlapping clusters or strategic types in comparison with traditional partitions in NORMCLUS would prove to be an interesting direction.

Finally, given the cross-sectional nature of this empirical study, it was not possible to observe the effects of strategic adjustments on SBU performance through time. Much insight on the interrelationships among the variables would be obtained by conducting a longitudinal analysis. One could observe SBUs through time, examining how their environment evolves, how their capabilities develop, and whether adjustments in strategy yield payoffs in terms of long-run performance.[2]

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APPENDIX 1: NORMCLUS CONSTRAINT IMPLEMENTATION OPTIONS

The parameter vector $\underline{\theta}$ can include cluster membership information ($\underline{\mathbf{M}}$), as well as other parameters (e.g., cluster level regression coefficients ($\underline{\mathbf{B}}$) as in a cluster-wise regression framework). NORMCLUS can accommodate ordinary cluster analysis where, for example, $f_1(\underline{\theta})$ can be specified as a ratio of between- to within-cluster sum-of-squares to be maximized with respect to binary $\underline{\theta} = \underline{\mathbf{M}}$ indicating cluster membership. Alternatively, $\underline{\theta}$ can include both cluster membership and cluster level regression parameters as in a cluster-wise regression approach (cf. DeSarbo *et al.*, 1989; DeSarbo and Grisaffe, 1998; DeSarbo and Cron, 1988), where $f_1(\underline{\theta})$ can be specified as a residual sum-of-squares to be minimized. Or, in normative classification applications where costs and revenues are readily available, $f_1(\underline{\theta})$ can be an expected profit function to be maximized. Again, a variety of optimization frameworks are accommodated in NORMCLUS depending upon the nature of the classification application at hand.

The remaining flexibility in NORMCLUS can be best illustrated in terms of the user-specified constraints that can be accommodated in Equations 2 and 3 in the text. Let:

$i = 1, \ldots, I$ firms/SBUs;
$k = 1, \ldots, K$ variables;
$r = 1, \ldots, R$ clusters (R is user specified);

X_{ik} = the value of the k-th variable or characteristic for firm i;
m_{ir} = the degree of membership of firm i in cluster r $(0 \leq m_{ir} \leq 1)$;
S_r = the set of firms in cluster r;
I_r = the number of firms (cardinality) in cluster r;
$\overline{X}_k^{(r)}$ = the mean of variable k in cluster r.

Then, for several types of classification applications, the following section discusses several types of possible constraints representing prior information specified by the user or institutional constraints which can be addressed (cf. DeSarbo and Mahajan, 1984; DeSarbo and Grisaffe, 1998).

Types of cluster

(a) $$m_{ir}(1 - m_{ir}) = 0 \quad \forall\, i = 1 \ldots I, \quad \forall\, r = 1 \ldots R \tag{A1}$$

This set of constraints restricts m_{ir} to be either 0 or 1.

(b) $$\sum_{r=1}^{R} m_{ir} = 1 \quad \forall\, i = 1 \ldots I \tag{A2}$$

This set of constraints, together with (a) above, provides for a non-overlapping cluster analysis where each firm can belong to one and only one cluster. Note that without this set of constraints (i.e., only with this (b) set), one can allow for overlapping clusters—that is, allow for cases where firms can belong to more than one cluster.

(c) $$0 \leq m_{ir} \leq 1 \quad \forall\, i = 1 \ldots I, \quad \forall\, r = 1 \ldots R \tag{A3}$$

This set of constraints, together with those in (b) above, allow for 'fuzzy-set' clusters, where objects can be fractional members of all clusters.

(d) $$\sum_{r=1}^{R} m_{ir} \substack{\leq \\ = \\ \geq} c_i \tag{A4}$$

This constraint, together with constraints in (a), restrict the number of clusters (c_i) firm i can belong to in an overlapping scheme.

Constraints concerning cluster membership

We assume that the constraints in Equation A1 hold in the following discussion.

(a) $$m_{sr*} + m_{nr*} = 2 \tag{A5}$$

Here, one wants firms s and n to belong to the same cluster r^*.

(b) $$\sum_{i \in T_{r*}} m_{ir*} = c_{r*} \tag{A6}$$

This is a generalization of constraint (a) above in that one wants the firms in some set T_{r*}, whose cardinality is c_{r*}, in the same cluster r^*.

(c) $$m_{sr} + m_{nr} \leq 1 \quad \forall\, r = 1, \ldots, R \tag{A7}$$

This constraint forbids firms s and n to be in the same cluster.

(d) $$(1) \quad \sum_{i=1}^{I} m_{ir} \geq Min_r$$
$$(2) \quad \sum_{i=1}^{I} m_{ir} \leq Max_r \tag{A8}$$

These constraints allow one to restrict the number of firms that get allocated to cluster r. Constraint (d1) states that the number of members in cluster r is to be greater than or equal to some minimum number Min_r. Conversely, constraint (d2) restricts membership to be equal or less than some maximum number Max_r.

(e) $$\sum_{i=1}^{I} m_{ir'} = \sum_{i=1}^{I} m_{ir} \quad \forall\, r \neq r' = 1 \ldots R \tag{A9}$$

This set of constraints restricts the number of firms in any clusters r and r' to be equal (e.g., for performance equalization).

(f) $$\left| \sum_{i=1}^{I} m_{ir} - \sum_{i=1}^{I} m_{ir'} \right| \leq \varepsilon_I \quad \forall\, r \neq r' = 1 \ldots R \tag{A10}$$

These constraints restrict the range or distribution of acceptable differences (ε_1) in the number of firms in clusters r and r'. This set of constraints is basically equivalent to specifying *both* sets of constraints in (d1) and (d2) above where all the ceiling values (Max_r) and all floor values (Min_r) are identical for all clusters.

Characteristics of clusters

$$\text{(a)} \quad X_{ik}m_{ir} \geq V_{kr}^{\min} \quad \forall\, i \in S_r \qquad \text{(A11)}$$

These constraints guarantee that all members of cluster r possess at least $V_{kr}^{\min}$ of characteristic or variable k. Similarly, one could generalize constraint to:

$$\frac{\sum_{i \in S_r}^{I_r} X_{ik}m_{ir}}{I_r} \leq V_{kr}^{\min} \qquad \text{(A12)}$$

where the average cluster value on variable k must be greater than some minimum value. Similar constraints can be constructed to insure that each member or cluster average be less than some maximum value $V_{kr}^{\max}$ by substituting '$\leq$' and '$V_{kr}^{\max}$' for '$\geq$' and '$V_{kr}^{\min}$' respectively above. These constraints can insure a stable amount of homogeneity amongst the derived clusters.

$$\text{(b)} \quad \left| \sum_{i \in S_{r'}}^{I_r} X_{ik}m_{ir} - \sum_{i \in S_r}^{I_{r'}} X_{ij}m_{ir'} \right| \begin{matrix} \leq \\ = \\ \geq \end{matrix} \varepsilon_2 \qquad \text{(A13)}$$

This constraint establishes a range or distribution of acceptable differences (ε_2) of characteristic k in clusters $r \neq r'$. Similarly, one can generalize this to:

$$\left| \frac{\sum_{i \in S_r}^{I_r} X_{ik}m_{ir}}{I_r} - \frac{\sum_{i \in S_{r'}}^{I'_r} X_{ij}m_{ir'}}{I_{r'}} \right| \begin{matrix} \leq \\ = \\ \geq \end{matrix} \epsilon_2 \qquad \text{(A14)}$$

where the range of differences in mean values of characteristic k in clusters $r \neq r'$ is constrained. For example, this constraint can be gainfully utilized for insuring clusters will differ as to performance.

$$\text{(c)} \quad |m_{jr}m_{ir}(X_{jk} - X_{ik})| \leq t_{rk}^{\max} \quad \forall\, j, i \in S_r \qquad \text{(A15)}$$

This set of constraints restricts the maximum deviation allowed ($t_{rk}^{\max}$) on characteristic k for any two members of the same cluster r. Accordingly one could also constrain the maximum distance or dissimilarity allowed (D_r) between any two objects in cluster r via:

$$\left[\sum_{k=1}^{K} (m_{jr}m_{lr}(X_{jk} - X_{lk}))^2 \right]^{1/2} \leq D_r \qquad \text{(A16)}$$

$$\text{(d)} \quad \left| m_{jr}(X_{jk} - \overline{X}_k^{(r)}) \right| \leq \gamma_{kr}^{\max} \quad \forall\, j \in S_r \qquad \text{(A17)}$$

This set of constraints restricts the maximum deviation ($\gamma_{kr}^{\max}$) on characteristic k between any object in cluster r and cluster r's mean value on variable k. Similarly, one could generalize this to all variables via:

$$\left[\sum_{k=1}^{K} (m_{jr}(X_{jk} - \overline{X}_k^{(r)}))^2 \right]^{1/2} \leq \Gamma, \quad \forall\, j \in S_r \qquad \text{(A18)}$$

where there is a restriction placed on the maximum distance or dissimilarity allowed between any firm j in cluster r and the centroid of cluster r. The constraints in sets (a) through (d) impose restrictions that affect the 'compactness' of a cluster, or the within sum-of-squares of a cluster. For example, such constraints can be used in a geographical-based classification scheme.

$$\text{(e)} \quad |\overline{X}_k^{(r)} - \overline{X}_k^{(r')}| \geq B_{rr'}^{\min} \qquad \text{(A19)}$$

This constraint restricts the 'separability' (affecting the between sums of squares) between the mean of variable k in cluster r and r'. This can be generalized to the case involving all variables via:

$$\sum_{k=1}^{K} (\overline{X}_k^{(r)} - \overline{X}_k^{(r')})^2 \geq \boldsymbol{C}_{rr'}^{\min} \qquad \text{(A20)}$$

where restrictions are made on the between sums of squares between clusters r and r'.

These and other application-specific constraints are discussed in more detail in DeSarbo and Mahajan (1984) and DeSarbo and Grisaffe (1998).

APPENDIX 2: ESTIMATION ALGORITHM DETAILS

For the strategic type application discussed in the Empirical Results section, we attempt to estimate the cluster membership indicators $\underline{\mathbf{M}} = ((m_{ir}))$ in order to maximize:

$$\Phi = \alpha_1 f_1 + \alpha_2 f_2 + \alpha_3 f_3 + \alpha_4 f_4, \tag{B1}$$

where f_1, f_2, f_3, and f_4 are defined in Equations 5, 6, 7, and 8 respectively, $0 < \alpha < 1$ is user specified (as is R, the number of clusters), and constraints A1, A2, and A8 are enforced. For this particular application, a modified lambda-opt combinatorial optimization procedure (cf. Lin and Kernighan, 1973) is devised. The general steps are as follows:

A. Set $J = 0$; select n from $(1, 2, \ldots, I)$.
 Set the maximum number of iterations (MAXIT); generate a random map of the sequence $1 \ldots I$, indicating the order in which customer cluster memberships are altered. Evaluate Φ, and let $\Phi^* = \Phi$.
B. For these n customers, change their cluster memberships randomly (i.e., alter n row vectors in $\mathbf{M} = ((m_{ir}))$ and check for feasibility of all constraints. Iterate until feasibility is maintained.

Note, for such problems containing a cluster-wise regression component, a next step would be to estimate the cluster-level betas. For such problems where a need exists to enforce positivity constraints, a constrained optimizer must be utilized in each of the R least-squares. Here, we utilize a modification of the Lawson and Hanson (1972) procedure which follows directly from the Kuhn–Tucker conditions for constrained minimization. For a given $r = 1, \ldots, R$, define:

$$\mathbf{h}_r = (h_i^r) = M_{ir}^{1/2} \cdot y_i \tag{B2}$$

$$\mathbf{E}_r = \left(\left(E_{ik}^r\right)\right) = M_{ir}^{1/2} \cdot X_{ik} \tag{B3}$$

We can then reformulate this estimation problem in terms of r non-negative least-squares problems: Minimize $||\mathbf{E}_r\mathbf{b}_r - \mathbf{h}_r||$ subject to $\mathbf{b}_r \geq 0$, for $r = 1, \ldots,$ R, (excluding such constraints on intercepts), which trivially can be shown to conditionally (holding $\mathbf{M}$ fixed) optimize B1. The algorithm, briefly outlined below, follows directly from the Kuhn–Tucker conditions for constrained minimization. For a given r, we form the $I \times K$ matrix of 'independent variables,' $\mathbf{E}_r$, and the $I \times 1$ vector (acting as the dependent variable) $\mathbf{h}_r$. In the description below, the $K \times 1$ vectors $\mathbf{w}_r$ and $\mathbf{z}_r$ provide working spaces. Index sets P_r and Z_r will be defined and modified in the course of execution of the algorithm. Parameters indexed in the set Z_r will be held at the value zero. Parameters indexed in the set P_r will be free to take values greater than zero. If a parameter takes a non-positive value, the algorithm will either move the parameter to a positive value or else set the parameter to zero and move its index from set P_r to set Z_r. On termination, $\mathbf{b}_r$ will be the solution vector and $\mathbf{w}_r$ will be the dual vector.

1. Set $P_r :=$ Null, $Z_r: = \{1, \ldots, K\}$, and $\mathbf{b}_r: = \mathbf{0}$.
2. Compute the vector $\mathbf{w}_r: = \mathbf{E}_r'(\mathbf{h}_r - \mathbf{E}_r\mathbf{b}_r)$.
3. If the set Z_r is empty or if $w_{rj} \leq 0$ for all $k \in Z_r$, go to Step 12.
4. Find an index $a \in Z_r$ such that $w_{ra} = \max\{w_{rk}: k \in Z_r\}$.
5. Move the index a from set Z_r to set P_r.
6. Let $\mathbf{E}_P^{(r)}: =$ denote the $I \times K$ matrix defined by

 Column k of $\mathbf{E}_p^{(r)}$

 $$:= \begin{cases} \text{column } k \text{ of } \mathbf{E}_r \text{ if } k \in P_r \\ 0 \text{ if } k \in Z_r \end{cases}$$

 Compute the vector $\mathbf{z}_r$ as a solution of the least-squares problem $\mathbf{E}_P^{(r)}\mathbf{z}_r \cong \mathbf{h}_r$. Note that only the components z_{rk}, $k \in P_r$, are determined by this problem. Define $z_{rk} = 0$ for $k \in Z_r$.
7. If $z_{rk} > 0$ for all $k \in P_r$, set $\mathbf{b}_r: = \mathbf{z}_r$ and go to Step 2.
8. Find an index $v \in P_r$ such that $b_{rv}/(b_{rv} - z_{rv}) = \min\{b_{rk}/b_{rk} - z_{rk}) : z_{rk} \leq 0, k \in P_r\}$.
9. Set $Q_r := b_{rv}/(b_{rv} - z_{rv})$.
10. Set $\mathbf{b}_r: = \mathbf{b}_r + Q_r(\mathbf{z}_r - \mathbf{b}_r)$.
11. Move from set P_r to set Z_r all indices $k \in P_r$ for which $\phi_{rk} = 0$. Go to Step 6.
12. Next r.

On termination, the solution vector $\mathbf{b}_r$ satisfies:

$$b_{rk} > 0, \qquad k \in P_r \tag{B4}$$

and

$$b_{rk} = 0, \qquad k \in Z_r \tag{B5}$$

and is a solution vector to the constrained least-squares problem:

$$\mathbf{E}_P^{(r)}\mathbf{b}_r \cong \mathbf{h}_r \tag{B6}$$

The dual vector $\mathbf{w}_r$ satisfies:

$$w_{rk} = 0, \qquad k \in P_r \tag{B7}$$

and

$$w_{rk} \leq 0, \qquad k \in Z_r \tag{B8}$$

where:

$$\mathbf{w}_r = \mathbf{E}_r'(\mathbf{h}_r - \mathbf{E}_r\mathbf{b}_r) \tag{B9}$$

Equations B4, B5, B7, B8, and B9 constitute the Kuhn–Tucker conditions characterizing a solution vector $\mathbf{b}_r$ for this constrained least-squares problem. Equation B6 is a consequence of B5, B7, and B9. These 12 steps are then repeated for the next value of $r = 1, \ldots,$ R.

C. Set $J = J + 1$;
D. Evaluate Φ in trying to improve. If there is improvement, set $\Phi = \Phi^*$, store the **M** and **B** that resulted in that solution, and go to step B. If no improvement, return to previous **M, B**, and $\mathbf{\Phi}^*$ values and return to step B, unless $J >$ MAXIT, in which case output best solution.

APPENDIX 3: ROADMAP OF SCALE, MEASUREMENT ITEMS, AND SOURCES

I. Miles and Snow typology items (adapted from Conant *et al*., 1990)

The following statements describe some characteristics of this selected strategic business unit/division. Please circle the description that best describes this selected business unit.

1. In comparison to our competitors, the products which we provide to our customers are best described as: (Entrepreneurial—product market domain)
   a. Products that are more innovative, and continually changing.
   b. Products that are fairly stable in certain markets while innovative in other markets.
   c. Products that are stable and consistently defined throughout the market.
   d. Products that are in a state of transition, and largely respond to opportunities and threats in the marketplace.
2. In contrast to our competitors, we have an image in the marketplace that: (Entrepreneurial—success posture)
   a. Offers fewer, select products which are high in quality.
   b. Adopts new ideas and innovations, but only after careful analysis.
   c. Reacts to opportunities or threats in the marketplace to maintain or enhance our position.
   d. Has a reputation for being innovative and creative.
3. The amount of time our business unit spends on monitoring changes and trends in the marketplace can best be described as: (Entrepreneurial—surveillance)
   a. Lengthy: We are continuously monitoring the marketplace.
   b. Minimal: We really don't spend much time monitoring the marketplace.
   c. Average: We spend a reasonable amount of time monitoring the marketplace.
   d. Sporadic: We sometimes spend a great deal of time and at other times spend little time monitoring the marketplace.
4. In comparison to our competitors, the increases or losses in demand that we have experienced are due most probably to: (Entrepreneurial—growth)
   a. Our practice of concentrating on more fully developing those markets which we currently serve.
   b. Our practice of responding to the pressures of the marketplace by taking few risks.
   c. Our practice of aggressively entering into new markets with new types of products.
   d. Our practice of assertively penetrating more deeply into markets we currently serve, while adopting new products after a very careful review of their potential.
5. One of the most important goals in these business units in comparison to our competitors is our dedication and commitment to: (Engineering—technological goal)
   a. Keep our costs under control.
   b. Analyze our costs and revenues carefully,

to keep costs under control and to selectively generate new products or enter new markets.
 c. Insure that the people, resources and equipment required to develop new products and new markets are available and accessible.
 d. Make sure we guard against critical threats by taking any action necessary.

6. In contrast to our competitors, the competencies (skills) which our managerial employees possess can best be characterized as: (Engineering—technological breadth)
 a. Analytical: their skills enable them to both identify trends and then develop new products or markets.
 b. Specialized: their skills are concentrated into one, or a few, specific areas.
 c. Broad and entrepreneurial: their skills are diverse, flexible, and enable change to be created.
 d. Fluid: their skills are related to the near-term demands of the marketplace.
7. The one thing that protects us from its competitors is that we: (Engineering—technological buffers)
 a. Are able to carefully analyze emerging trends and adopt only those which have proven potential.
 b. Are able to do a limited number of things exceptionally well.
 c. Are able to respond to trends even though they may possess only moderate potential as they arise.
 d. Are able to consistently develop new products and new markets.
8. More so than many of our competitors, our management staff in this business unit tends to concentrate on: (Administrative—dominant coalition)
 a. Maintaining a secure financial position through cost and quality control.
 b. Analyzing opportunities in the marketplace and selecting only those opportunities with proven potential, while protecting a secure financial position.
 c. Activities or business functions which most need attention given the opportunities or problems we currently confront.
 d. Developing new products and expanding into new markets or market segments.
9. In contrast to many of our competitors, this business unit prepares for the future by: (Administrative—planning)
 a. Identifying the best possible solutions to those problems or challenges which require immediate attention.
 b. Identifying trends and opportunities in the marketplace which can result in the creation of product offerings which are new to the industry or reach new markets.
 c. Identifying those problems which, if solved, will maintain and then improve our current product offerings and market position.
 d. Identifying those trends in the industry which our competitors have proven possess long-term potential while also solving problems related to our current product offerings and our current customers' needs.
10. In comparison to our competitors, our organization structure is: (Administrative—structure)
 a. Functional in nature (i.e., organized by department—marketing, accounting, personnel, etc.).
 b. Product or market oriented.
 c. Primarily functional (departmental) in nature; however, a product- or market-oriented structure does exist in newer or larger product offering areas.
 d. Continually changing to enable us to meet opportunities and solve problems as they arise.
11. Unlike our competitors, the procedures we use to evaluate performance are best described as:
 a. Decentralized and participatory encouraging many organizational members to be involved.
 b. Heavily oriented toward those reporting requirements which demand immediate attention.
 c. Highly centralized and primarily the responsibility of senior management.
 d. Centralized in more established product areas and more participatory in new product areas.

II. Strategic capability items

The following is a set of possible business strategic capabilities. Please evaluate how well or poorly you believe that this selected business unit performs the specific capabilities relative to your three major competitors. Please use the following response scale: 0 = Much worse than the top three major competitors in the industry; 10 = Much better than the top three major competitors in the industry.

	Much worse										**Much better**
Marketing capabilities											
Knowledge of customers	0	1	2	3	4	5	6	7	8	9	10
Knowledge of competitors	0	1	2	3	4	5	6	7	8	9	10
Integration of marketing activities	0	1	2	3	4	5	6	7	8	9	10
Skill to segment and target markets	0	1	2	3	4	5	6	7	8	9	10
Effectiveness of pricing programs	0	1	2	3	4	5	6	7	8	9	10
Effectiveness of advertising programs	0	1	2	3	4	5	6	7	8	9	10
Market linking capabilities											
Market sensing capabilities	0	1	2	3	4	5	6	7	8	9	10
Customer-linking (i.e., creating and managing durable customer relationships) capabilities	0	1	2	3	4	5	6	7	8	9	10
Capabilities of creating durable relationship with our suppliers	0	1	2	3	4	5	6	7	8	9	10
Ability to retain customers	0	1	2	3	4	5	6	7	8	9	10
Channel-bonding capabilities (creating durable relationship with channel members such as whole sellers, retailers, etc.)	0	1	2	3	4	5	6	7	8	9	10
Relationships with channel members	0	1	2	3	4	5	6	7	8	9	10
Information technology capabilities											
Information technology systems for new product development projects	0	1	2	3	4	5	6	7	8	9	10
Information technology systems for facilitating cross-functional integration	0	1	2	3	4	5	6	7	8	9	10
Information technology systems for facilitating technology knowledge creation	0	1	2	3	4	5	6	7	8	9	10
Information technology systems for facilitating market knowledge creation	0	1	2	3	4	5	6	7	8	9	10
Information technology systems for internal communication (e.g., across different departments, across different levels of the organization, etc.)	0	1	2	3	4	5	6	7	8	9	10
Information technology systems for external communication (e.g., suppliers, customers, channel members, etc.)	0	1	2	3	4	5	6	7	8	9	10
Technology capabilities											
New product development capabilities	0	1	2	3	4	5	6	7	8	9	10
Manufacturing processes	0	1	2	3	4	5	6	7	8	9	10
Technology development capabilities	0	1	2	3	4	5	6	7	8	9	10
Ability of predicting technological changes in the industry	0	1	2	3	4	5	6	7	8	9	10
Production facilities	0	1	2	3	4	5	6	7	8	9	10
Quality control skills	0	1	2	3	4	5	6	7	8	9	10
Management capabilities											
Integrated logistics systems	0	1	2	3	4	5	6	7	8	9	10
Cost control capabilities	0	1	2	3	4	5	6	7	8	9	10
Financial management skills	0	1	2	3	4	5	6	7	8	9	10
Human resource management capabilities	0	1	2	3	4	5	6	7	8	9	10
Accuracy of profitability and revenue forecasting	0	1	2	3	4	5	6	7	8	9	10
Marketing planning process	0	1	2	3	4	5	6	7	8	9	10

III. Environmental uncertainty items

In general, how much do you disagree or agree with each of the following statements characterizing the business environment or conditions in the primary markets your SBU currently serves? Please indicate the degree to which you agree or disagree with the following statement regarding this selected business unit (anchors: 0 = strongly disagree/10 = strongly agree)

	Strongly disagree										**Strongly agree**
Market environment											
In our kind of business, customers' product preferences change quite a bit over time.	0	1	2	3	4	5	6	7	8	9	10
Our customers tend to look for new products all the time.	0	1	2	3	4	5	6	7	8	9	10
Sometimes our customers are very price-sensitive, but on other occasions, price is relatively unimportant.	0	1	2	3	4	5	6	7	8	9	10
New customers tend to have product-related needs that are different from those of our existing customers.	0	1	2	3	4	5	6	7	8	9	10
We cater to many of the same customers that we used to in the past.	0	1	2	3	4	5	6	7	8	9	10
It is very difficult to predict any changes in this marketplace.	0	1	2	3	4	5	6	7	8	9	10
Technological environment											
The technology in our industry is changing rapidly.	0	1	2	3	4	5	6	7	8	9	10
Technological changes provide big opportunities in our industry.	0	1	2	3	4	5	6	7	8	9	10
It is very difficult to forecast where the technology in our industry will be in the next two to three years.	0	1	2	3	4	5	6	7	8	9	10
A large number of new product ideas have been made possible through technological breakthroughs in our industry.	0	1	2	3	4	5	6	7	8	9	10
Technological developments in our industry are rather minor.	0	1	2	3	4	5	6	7	8	9	10
The technological changes in this industry are frequent.	0	1	2	3	4	5	6	7	8	9	10
Competitive environment											
Competition in our industry is cutthroat.	0	1	2	3	4	5	6	7	8	9	10
There are many 'promotion wars' in our industry.	0	1	2	3	4	5	6	7	8	9	10
Anything that one competitor can offer, others can match readily.	0	1	2	3	4	5	6	7	8	9	10
Price competition is a hallmark of our industry.	0	1	2	3	4	5	6	7	8	9	10
One hears of a new competitive move almost every day.	0	1	2	3	4	5	6	7	8	9	10
Our competitors are relatively weak.	0	1	2	3	4	5	6	7	8	9	10

IV. Performance measures

PROFIT = gross margin (i.e., total revenue − total variable costs)/total revenue)
ROIPEC = the average return on investment in this business unit over the past 3 years (in %)

Customer retention (CUSRET), sales growth (SALESGR), relative market share (RMS), and return on assets (ROA) (adapted from Naver and Slater, 1990)

Please rate how well this business unit has performed relative to all other competitors in the principal served market segment over the past year.

0	1	2	3	4	5	6	7	8	9	10
0%	1–10%	11–20%	21–30%	31–40%	41–50%	51–60%	61–70%	71–80%	81–90%	91–100%

Example: If you believe that your sales growth is greater than that of approximately 45% of all competitors in your principal served market segment, rate yourself a 5 for the sales growth.

Return on investment (ROI): ___________;
Relative market shares (RMS): ___________;
Major customer retention: (cusret2) ___________;
Return on Assets (ROA): ___________;
Overall customer retention: (cusret) ___________;
Sales growth (salesgr): ___________.

Overall performance (adapted from Moorman, 1995)

Please rate the extent to which your business unit has achieved the following outcomes during the last year. (Eleven-point scale, where 0 = low and 10 = high)

Overall profit margin relative to the objective for this business unit (perf1).
Overall sales relative to the objective for this business unit (perf2)
Overall return on investment relative to the objective for this business unit (perf3)