A Dissertation

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An Investigation of the Relationship between Strategy Making and Performance; the Role of Adaptive Decision Making in the Development of Strategy in Small and Medium-sized Manufacturing Companies

by

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Submitted as partial fulfillment of the requirements for

the *Doctor of Philosophy in Manufacturing Management and Engineering*

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An Abstract of

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This research investigates the role of adaptive decision making in the development of strategy in small and medium-sized manufacturing companies. In a survey of 3,965 SME manufacturing companies in Michigan, Indiana, and Ohio a total of 547 valid responses were obtained (13.74% response rate). In a research framework that relates strategic contextual factors consisting of external (industry competitive forces) and internal (internal resources and capabilities) factors to strategy making constructs (environmental scanning, manufacturing strategy, and adaptive decision making) and performance we identified several significant relationships. Two new constructs are proposed, explored, confirmed, and tested using the structural model including a multi-dimensional performance construct and adaptive decision making. Adaptive decision making is defined as a "conscious or unconscious tendency to place a high priority on adaptation to ones environment throughout the decision making process". Another important contribution of this research includes identifying antecedents to environmental scanning activity and the linkages between environmental scanning, adaptive decision making, manufacturing strategy, and performance.

Dedication:

This dissertation is dedicated to the many souls who have helped me in my pursuit of higher education. Beginning with my parents who fostered positive attitudes and respect for higher learning and ending finally with my dissertation committee who ushered me through the final stages of my doctorate degree.

In between these two book ends are several significant people, both within and outside of formal education, that opened doors, provided some unique insight, gave me opportunity, or merely showed an inspiring level of confidence in my abilities. In each of our lives, there are times in which we intuitively know that something incredibly important is about to happen and that to some extent the event will impact our lives forevermore. This time, no doubt, is such a time for me. I know that I will cherish the memories, the intensity, and the completion of my doctoral studies for the rest of my life.

In the final analysis there are always a few people that are standouts, the all-stars of our experiences, and when it comes to my academic pursuits, there are two that must be mentioned here. Dr. S. Subba Rao and Dr. T. S. Ragu-Nathan have been with me throughout most of my academic career and have given of themselves beyond that which is the duty of a committed teacher. In particular they have demonstrated uncommon commitment and dedication to me throughout my doctoral studies and never waivered to the very end; serving as co-chairs of my dissertation.

Finally, to Dr S. Subba Rao I have a special dedication. If it were not for your interest in me as a student, I may not have completed this program. On a

rainy day in March a few years back you took the time to call me and encourage me to return to the program after I had withdrawn temporarily for business reasons. Your words were kind and your interest was uncommon and deeply appreciated. Because of this I regard you as my mentor and a master of your craft. I believe that I speak for many who have worked under you over the years when I say – you are the quintessential teacher and academic.

Acknowledgements:

I would like to express special thanks to the many people and organizations whose cooperation made this research possible including those who participated in validating the survey instrument as well as those who participated in the survey effort by responding to the survey. A special thanks to the manufacturing associations of Michigan, Indiana, and Ohio for their active participation and financial support in surveying their membership.

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Chapter 1

Introduction

Over the last few decades there has been increasing interest in research on smaller organizations. This research stream has largely focused on small and medium-sized enterprises (SMEs) in the United States and abroad. SMEs play a major role in the US and the world's developing and industrialized economies. Study after study in the US and abroad verify the significant economic contribution made by SMEs. The USSBA (2000) reports that over 50 percent of employees and 45 percent of payroll dollars in the United States are contributed by SMEs. The contribution of SMEs to our economy has not come without significant risk on the part of small company investors and employees. In a longitudinal study on financial difficulties in small firms, the USSBA (1999a) found that over 95 percent of bankruptcies were filed by companies with 50 or fewer employees indicating the total percent of bankruptcies represented by SMEs may very well exceed 99 percent of all bankruptcies. So, while SMEs are extremely valuable to our economy, they are also highly vulnerable.

The importance of SME manufacturers to the economy of the US is highlighted by government reports on business firms, employment, and payroll. According to the USSBA (2000) there were 306,033 manufacturing firms in the US at the end of 2000. Of this total, SME firms numbered 301,369 representing

98.48% of manufacturing firms, contributing 6.8 million jobs and 226 billion dollars in payroll. Further importance of the small manufacturing sector in the US and other industrialized economies is demonstrated by their role in major industries such as the automotive industry in which SMEs constitute a significant part of the supply base. Small and medium sized manufacturing companies make up the majority of the suppliers to large scale manufacturing.

Although there has been a significant amount of research on SMEs (Peel and Bridge, 1998), empirical research has fallen short considering the important economic contributions made by this group (Barnes, 2002; McCarthy and Leavy, 2000). In the manufacturing sector specifically, empirical research on SMEs is severely lacking. More specifically, there is a lack of empirical research in understanding the decision making, strategy development, and the metrics of performance as well as the relationships between them. The study of such relationships can possibly help us to discover the levers of change for performance improvement in SMEs.

This research addresses this shortfall in empirical research by studying strategy making and performance in SME manufacturing companies. This research effort contributes to the literature on strategy making and performance of SMEs in general, and manufacturing SMEs in particular. The contributions are made by testing a research framework that examines the relationships between contextual strategic factors, strategy making, and performance in manufacturing SMEs.

The research framework is consistent with prior bodies of literature based on industrial organization (IO) economics and the design school perspective of strategy development. Early work by Bain (1956, 1968) and Mason (1939) provided the foundation for the structure-conduct-performance (SCP) paradigm which views strategy as a process beginning with structural factors which lead to conduct on the part of managers producing some level of performance. Also, the design school perspective (Andrews, 1971, 1980, 1987; Christensen, Andrews, Bower, Hamermesh, and Porter, 1982) which views strategy making as "a process of informal conception" involving "the use of a few essential concepts to design "grand strategy" (Mintzberg, 1990) provides additional support for the proposed framework.

Andrews (1987) articulated the design school view of strategy making as "the intellectual processes of ascertaining what a company might do in terms of environmental opportunity, of deciding what it can do in terms of ability and power, and of bringing these two considerations together in optimal equilibrium". The implication is that a company must be aware if its "environmental opportunities" prior to deciding what course of action it should follow. Therefore, internal and external factors form a set of strategic contextual factors for a given organization and these strategic contextual factors should be assessed before any strategy is "designed". According to this perspective, strategy making is viewed as a consequence of "environmental opportunities" based on a company's "ability and power" with the ultimate goal of producing an "optimal equilibrium" between the two. Our research framework follows this view as

external and internal contextual strategic factors lead to strategy making resulting in organizational performance.

The strategy making literature has converged around two different schools of thought (Miller 1987). The first described as synoptic (Frederickson, 1984; Lindblom, 1959), planning (Mintzberg, 1973b), or rational (Miller and Friesen, 1984) and the second as bounded rationality (March and Simon, 1958). The bounded rationality model is characterized by informality where strategy is formulated by a disjointed process of intuition and spontaneity. This view is most suitable to the SME environment where strategy is the consequence of an adaptive "visionary" approach (Mintzberg, 1994) in which strategy is "realized" rather than planned for. Such a view is consistent with the resource constrained environment in which most SMEs operate. This is not to say that SMEs do no planning, rather it implies that strategy is more action oriented, a result of the "pattern of decisions" emanating from the chief strategist.

Decisions are not made without information (inputs) and resulting outcomes (outputs). Therefore it is reasonable to view strategy making as the result of the interplay of information, decision, and a "realized" output that reflects the intentions of the strategist. Such a concept in a small organizational environment would logically be based on informal information gathering activities and strategic formulations. Information gathering activities in many SMEs is the result of informal environmental scanning activities (Aguilar, 1967), and strategic formulations are from a decision making process resulting in a "realized" strategy output. In a SME, this output could be viewed as an informal strategy.

The importance of manufacturing strategy and its linkage to organizational performance (Skinner, 1969) is based on the idea that performance is the result of coordinated action. Such a concept does not require planning, nor is it constrained to large organizations. Therefore, we would expect the basic concept to apply to smaller organizations such as SME manufacturers as well. In smaller organizations, strategy has been viewed as "some form of order emerging from the chaos of an organization's actions" (Brown and Eisenhardt, 1999). These actions, in an SME manufacturing environment, produce an informal manufacturing strategy. Based on prior literature (Skinner, 1969; Wheelwright, 1981; Leong, 1990) this strategy would logically emphasize one or more of the manufacturing strategic imperatives including cost, quality, delivery, or flexibility. The "actions" would produce varying degrees of emphasis on one or more of these factors to positively impact organizational performance. Furthermore, we may ask "Is it possible to formulate strategy, formally or informally, without making a decision?" If strategy is the result of a "pattern of decisions" (Slack, Chambers, Harland, Harrision, and Johnson, 1998) one can assume that there is also a pattern to the decision making process itself. In the case of SMEs, which operate in a resource constrained environment, it is reasonable to assume that some type of adaptation may play a role in the decision making process.

Sharfman and Dean (1997) suggest that the core of all organizational adaptation is the decision making process. In an SME environment the decision maker is often the CEO who is also the chief strategist. Therefore, if SMEs exhibit adaptation in decision making it would be at the chief strategist level. Prior

research has investigated the role of adaptation in several different business contexts including buyer-supplier relationships (Brennan and Turnbull, 1999), supply chain (Quayle, 2003), decision support systems (Fazlollahi, Parikh, and Verma, 1997), firm economizing behavior (Cyert and Kumar, 1996), investor strategy (Marinov and Marinov, 1998), psychological adaptations (James, 1999), product adaptation (Leonidou, 1996), supplier-customer relationships (Canning and Hammer-Lloyd, 2001) and cultural adaptation (Fang, 2001). Although there has been considerable research on adaptation, no prior research has investigated the role of adaptation in the decision making process of the strategist in smaller organizations and the interrelationships that such decision making would have with environmental scanning and strategy development. This research framework views strategy making as consisting of three constructs representing the information base for decision making, the adaptive focus of the decision maker, and the resulting realized strategy. We propose and test a model in which informal environmental scanning is related to adaptive decision making and manufacturing strategy.

Over the past few decades the strategy literature has primarily focused on large organizations creating a situation in which relatively little is understood about the strategy making processes of smaller organizations (SMEs). SMEs differ from large organizations in many ways but two of the primary differences is their limited resources and lack of market power. For this reason SMEs have been difficult to classify by strategy types (Miles and Snow, 1978). We believe that this is because strategy making in SMEs has not been adequately identified.

We believe that in SMEs, the strategy making process is largely informal and is driven by economic necessity. That the limited resources of SMEs create a situation in which decisions are driven by an attempt to adapt, consciously or sub consciously, the limited resources of the firm to its environment in such a way as to maximize profitability. We propose that this "adaptive" orientation in SMEs drives the informal strategy making process. Therefore SMEs may exhibit divergent strategies (cost and niche) simultaneously, making them difficult to classify according to the findings of large organization strategy research efforts. Identifying adaptive decision making as an important construct in strategy-making among SMEs would be a significant contribution to the strategy literature.

This research makes several contributions to the existing bodies of literature of environmental scanning, strategy making, and performance. The model posits that the strategic context of the firm, consisting of external factors represented by Porters (1991) industry forces (I/O view) and internal factors represented by the firm's unique resources (resource-based view), directly and indirectly influence performance. If successful, the research would confirm prior research that suggests that these factors influence performance without regard to future activities of the firm. Such a finding would confirm that there is a systematic economic rent to the firm based on industry association (Porter 1980, Spanos and Lioukas, 2001) and the firm's unique resources (Teece, Pisano, Shuen, 1997; Barney 1991). The indirect effects on performance are through the strategy making constructs (environmental scanning, adaptive decision making,

and manufacturing strategy) and represent the unsystematic component of economic rent.

This research also contributes to the environmental scanning literature by proposing that the firm's strategic context, consisting of a set of internal and external factors, is an antecedent of environmental scanning activities and that environmental scanning mediates the relationship between the firm's strategic context and adaptive decision making in SMEs. Prior literature has not proposed any antecedent relationships to environmental scanning and generally only considers its role in strategy making as an input (exogenous construct).

Strategy in manufacturing SMEs, and in SMEs in general, is driven largely by a pattern of informal decision making (Mintzberg 1994). This research goes further by proposing that the informal decision making process within SMEs is driven by a specific and measurable focus on adaptation. We believe that this is true based on the situation in which typical SMEs operate, a business environment characterized by limited resources and low power. SMEs have very little power over suppliers or customers, limited access to capital and markets, virtually no influence on their industry or the markets that they compete in, typically serve a local or regional customer base, are vulnerable financially, and therefore have very little choice but to adapt to things which they have little influence over and cannot change. The choice of adaptation may be one of survival or at a minimum a way to exploit one of their advantages over larger firms, which is the ability to change quickly and be flexible. Adaptation of SMEs is an attempt to match their limited resources, capabilities, and strategic emphasis

to business environmental factors in a manner which optimizes their performance and future survival. This focus on adaptive decision making constitutes a new strategy making construct for SMEs. We propose that most manufacturing SMEs focus on adaptation in their strategy making decisions.

A final contribution will be made to prior literature on organizational performance. The performance construct is arguably an important construct in business research for the simple reason that almost every model attempts to relate the constructs of interest to performance. Also, the quality of the performance measures used in SME research is even more problematic because of the lack of standardized accounting and reporting methods and the variety of entity types used in smaller enterprises. The use of constructs such as return on equity has questionable value in SME research because of the fact that the equity portion of any small enterprise balance sheet is often distorted by several factors present in smaller organizations.

This research effort proposes a framework for, and empirically tests, a more comprehensive measure of performance based on a schema first proposed by Venkatraman and Ramanujam (1986) in which performance was viewed in three dimensions; business economic performance, operational performance, and organizational effectiveness (constituency performance). Several authors have called for multi-dimensional measures of performance (Kaplan, 1983; Gupta, 1987; Randolph, Spienza, and Watson, 1991). In the case of SMEs the multi-dimensional approach is especially important since financial measures have been found to be unreliable (Murphy, Trailer, and Hill, 1996). SMEs

financial measures are inherently unstable since they typically do not follow Generally Accepted Accounting Principles (GAAP) standards of accounting and exist in several different entity types (sole proprietor, partnership, corporation, limited liability company LLC...) some of which do not even require a balance sheet for governmental reporting. They also generally report income on a tax basis of accounting which understates financial income. All of these and other factors distort the interpretation of financial measures typically used in business research such as return on investment (ROI), return on assets (ROA), and profitability. Multi-dimensional measures capture a broader range of organizational performance including operational and constituency performance (Thompson, 1967; Pfeffer and Salancik, 1978; Zamuto, 1984). A validated multi-dimensional measure of performance will fill a void in business research by providing a more stable and comprehensive measure that can be applied in future organizational research.

In summary this research effort will contribute greater understanding of the strategy making processes in SME manufacturing organizations. Adding to prior linkages between strategic contextual factors, strategy making, and performance will make an important contribution to research in the field of strategy. Building upon prior literature, this research explores several linkages that have not been examined in strategy research. The linkages between two competing views of competitive advantage (industry forces model and the resourced based view as external and internal contextual factors) to environmental scanning has not been investigated in prior research. The linkages

from environmental scanning to adaptive decision making, and from adaptive decision making to manufacturing strategy and performance, increases our understanding of the role adaptivity plays in the decision making processes of smaller organizations. Lastly, the multidimensional performance measure for SME manufacturing companies contributes to the performance literature. This research has the promise of benefiting researchers and practitioners alike as it extends our understanding of the inter-relationships among important constructs in research that will eventually improve practitioner conceptions of strategy making and performance in manufacturing SMEs.

The next chapter reviews prior literature, develops a theoretical base for this research, and proposes a set of hypotheses to test our model. Chapter three includes a review of the methodology and the results of the pilot study (Q-sort), and chapter four describes the results of the large scale study, exploratory factor analysis, and confirmatory analysis of all scales. Chapter five presents the structural model and discusses the results of hypotheses testing. Chapter six concludes with presentation of the alternate model, research conclusions, and recommendations for future research.

Chapter 2

Literature Review and Hypotheses Development

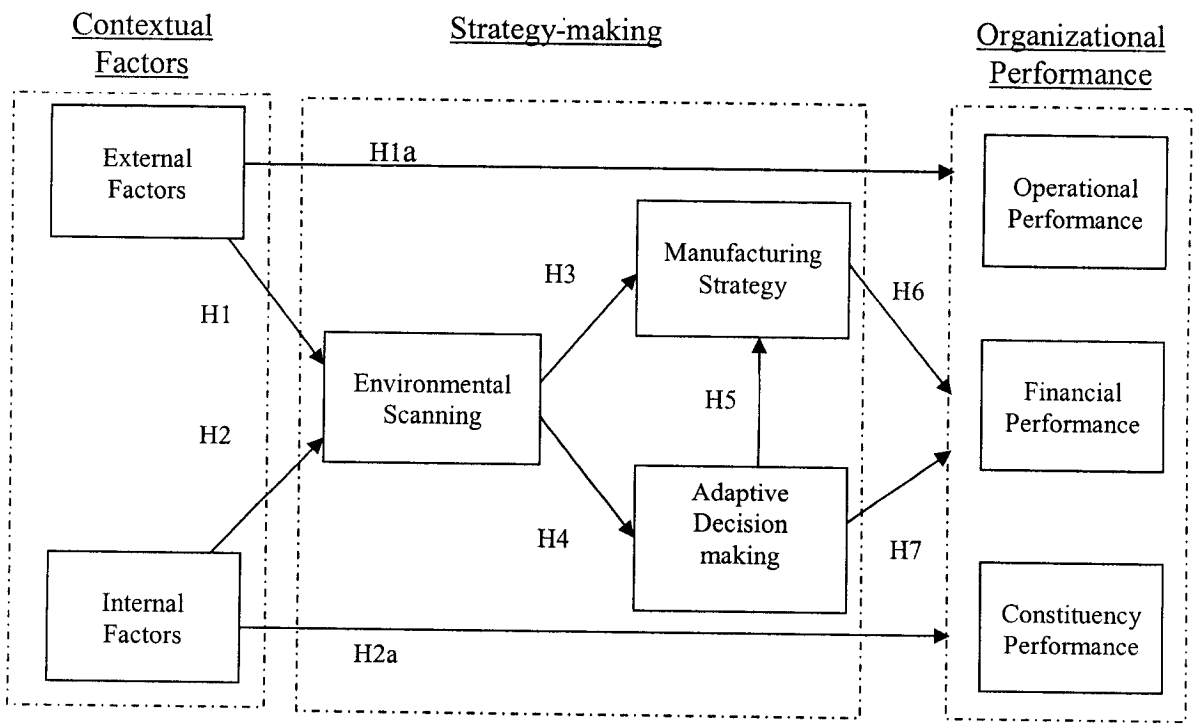
In this chapter we present our research framework and model, develop theory, review prior literature, and present the hypotheses to be tested. The research framework investigates the strategy-making process within small and medium-sized manufacturing companies (SMEs) and its impact on organizational performance. The strategy-making constructs include environmental scanning activities, adaptive decision making, and manufacturing strategy. Environmental scanning is conceptualized as an informal activity engaged in by management by which information enters the strategy-making process. This collection of information is influenced by internal factors and external factors. The adaptive decision making construct is a new construct conceptualized as a particular focus in decision making. We believe that the primary decision making focus in SMEs is toward adaptation to the business environment in an effort to insure continuation and profitability of the organization. Manufacturing strategy is the degree to which the organization emphasizes strategic imperatives such as cost, quality, delivery and flexibility.

The proposed research model posits that strategy in SMEs is the result of informal environmental scanning and an adaptive decision making process resulting in the organization's realized strategy. The model also proposes that

performance is a multi-dimensional construct consisting of financial performance, operational performance (manufacturing performance) and constituency performance.

The model presented in Figure 2.01 illustrates the interactions among various constructs of interest. The left side of the model depicts internal and external factors which have both direct and indirect impacts on organizational performance. The indirect impact is through environmental scanning which directly impacts adaptive decision making and manufacturing strategy. Adaptive decision making directly impacts organizational performance with an indirect effect through manufacturing strategy. Finally, manufacturing strategy is shown to directly impact organizational performance.

Figure 2.01: Research model



The review of prior literature first highlights the importance of SMEs in our regional and national economy. This is followed by a discussion of competitive advantage, environmental scanning, strategy, and firm performance to provide a theoretical base for our model of the adaptive nature of strategy development in small and medium-sized manufacturing enterprises (SMEs). We conclude with an explanation of the linkages within our model and a set of hypotheses that will be empirically investigated.

2.1 Small and medium-size enterprises (SMEs):

Small and medium-size enterprises play a major role in the economy of the United States and around the world. The importance of this role is supported on the national level as well as regionally throughout the US. SMEs have been referred to as "the life-blood of modern economies" (Ghobadian and Gallear, 1996). According to the United States Small Business Administration's (USSBA) 1999 report, small businesses with less than 500 employees accounted for 53 percent of the nonfarm work force, 51 percent of gross domestic product and 47 percent of sales. Industries dominated by small firms contributed a major share of the 3.1 million jobs created in 1998 (USSBA 1999b).

Another study on small firms by the USSBA (1999c) studied the employment growth rates of small firms. According to this longitudinal study using data from 1994 to 1997, most of the fastest growing small companies were "boundary crossers" during the study. The term "boundary crossers" is used to

identify companies that met the criteria for small company classification at the beginning of the study (less than 500 employees) but did not meet the criteria by the end of the study. This study points to a problem in comparing SMEs to larger firms. When SMEs grow they become "large" firms. SMEs are a finite statistical category based on employment so as they grow they move on to a different statistical group while large firms do not. This attrition rate in the small company classification, as they become more successful, skews the analysis of this group.

In addition to the statistical differences, SMEs have other points of distinction that separate them from larger firms such as their flat organizational structure and lack of formality. These distinguishing features justify the parallel research streams that have developed over the last two decades. SME organizational structure is more organic and less bureaucratic than larger firms (Ghobadian and Gallear, 1996). They are also characterized by a lack of formal working relationships and the absence of standardization. These characteristics make SMEs more flexible than larger firms (Storey and Cressy, 1995; Levy, 1998).

In this study of SME manufacturing companies particular attention is paid to these distinguishing characteristics in theoretical specification of the model, operationalization of constructs, survey design, and testing of hypotheses.

2.2 Competitive advantage:

Over the last decade the field of strategic management has continued the debate on the sources of competitive advantage. This continuing research effort

has produced two views of competitive advantage including one developed from traditional Industrial Organization literature (IO) (Porter 1980,1985,1991) and another based on the work of Penrose (1959) further developed by Barney (1986), Rumelt (1991) and Wernerfelt (1984) among others. The Industrial Organization view as articulated by Spanos and Lioukas (2001) is:

> "the organization is viewed as a *bundle of strategic activities* aimed at *adapting* to the industry environment by seeking an attractive position in the market arena"

thus generating a competitive advantage leading to better performance. By contrast, the resourced-based view looks at the organization as a *bundle of unique resources* which leads to competitive advantage and increased levels of performance.

While many scholars consider these two views to be opposing, others have espoused the complimentary nature of the views (Mauri and Michaels 1998; Spanos and Lioukas, 2001). In this research we do not seek to resolve this argument, but we use these two views as representative of the contextual factors affecting strategy development and performance in SMEs. In this perspective Porter's industry forces model is looked upon as external factors that impact the environmental scanning activities and decision processes in strategy development. In a similar vein we view the resource-based perspective as representing internal factors that impact these same processes. In this view both are hypothesized to be antecedents of the strategy development process in SMEs.

2.2.1 Industrial Organization view of competitive advantage:

The classical industrial organization literature (Bain, 1956; Mason, 1939) views firm conduct as constrained by industry forces. Within this viewpoint firms have little, if any, influence on their industry conditions or their own performance. Given these assumptions managerial influence is viewed as having little or no influence and thus can be ignored.

Porter's work (1980, 1985, 1990, and 1991) modified this classical view by re-focusing on firm rather than industry performance. According to this view, industry structure is partially influenced by firm activities. While industry structure plays the central role in firm performance, the structure is viewed as influenced by firm activities. Porter's view (1991) of strategy as "a bundle of activities" results in the positioning of the firm to create competitive advantage.

In Porter's book on Competitive Strategy (1980) he introduced three generic strategies which can help firms develop competitive advantage. These strategies include cost leadership, differentiation, and focus. While following any of these strategies may produce superior performance, mixing them can have adverse effects, according to Porter. This "*stuck in the middle*" strategy produces mediocrity and is void of any defining impact resulting in lower performance.

The cost leadership strategy concentrates on maintaining low cost relative to competitors as a means of increasing market share and profits. Such a strategy would make sense for large firms involved in mass production in an

effort to reduce the production cost per unit and gain efficiencies from economies of scale (Wright, 1987).

Following a differentiation strategy, firms create competitive advantage by emphasizing products and services that offer unique qualities. The differentiation strategy is most appropriate for targeting customers in less competitive markets where buyers are not as price sensitive.

The third generic strategy, focus, involves niche marketing to a unique subset of the larger market involving narrowly defined segments which are under-served. With a focus strategy a firm attempts to achieve either a product/service or cost advantage within a target market.

With all of the generic strategies, the influence of industry affiliation is central to a firm's options for positioning itself among competitors to create superior performance. These forces within a particular industry act on the firm and consequently limit their options. Porter's (1991) view of these industry effects on the firm, known as the five-forces model, summarizes the challenges facing firms with regard to the competitive environment and structural artifacts of the industry. These forces include the threat of substitute products, bargaining power of suppliers, bargaining power of customers, barriers to entry and competitive rivalry. The forces are viewed as constantly acting upon, influencing, and limiting firm choices with regard to strategy and positioning. The firm is "jockeying for position" within this framework in order to identify an appropriate generic strategy to pursue.

While Porter's framework suggests that these forces act upon all firms in all industries similarly, it is reasonable to assume that the impact of these forces will vary based on firm size. In the case of SMEs, many of these forces can vary dramatically in comparison to larger firms. For example, barriers to entry are typically much lower in smaller firms because of lower capitalization. There is also a dramatic mismatch caused by the capital structure differences (stock vs debt) in situations where typical small firm industries are attacked by larger firms (the Wal-mart effect). When large industries enter smaller firm markets, smaller firms are at a disadvantage based on the fact that their capital structure is almost exclusively debt instead of publicly traded stock. This mismatch increases the cost and risk associated with capital to defend markets in small firms and lowers the short-term cost of capital in large firms when seeking new markets.

Another example of the differences in the effects of industry forces can be found in bargaining power with customers and suppliers. In SMEs, many of their customers and suppliers are considerably larger, resulting in less or inverse bargaining leverage. In regard to threat of substitute products, SMEs may actually have an advantage on larger firms in that many smaller organizations compete in niche markets providing a unique service or product that is scarce in the market, both in demand and supply (USSBA 1997). Although there are several examples of the differences in effect that the industry forces have on organizations based on their relative size, it is clear that Porter's conceptualization is equally relevant to both. The external nature of these forces

is evidenced by their definitions and the fact that the forces apply to all firms is easily understood.

While Porter's conceptualization recognizes that firms can and do influence their industry, the primary impact on performance comes from the industry itself. We argue that these industry forces are almost exclusively external in SMEs since these firms have little impact on the market in which they compete. One of the reasons for this is that smaller firms typically have more competitors and fewer dominant players in the market in terms of market share. We would argue that larger firms typically have fewer direct competitors as firm size is related to market size. In other words, larger firms compete in larger more organized markets (i.e. automobile manufacturing) and smaller firms compete in smaller, less organized, or even fragmented markets (i.e. tool and die shops). In our model, Porter's industry forces are used to represent external factors that impact the firm. These factors exist, or are present, whether or not the firm acknowledges or acts upon them.

Measures for industry forces were adopted from a scale developed by Spanos and Lioukas (2001) based on prior work by Dess and Davis (1984) and Miller (1988). The Spanos and Lioukas (2001) study of 1090 firms generated a response rate of 17% and reported average firm size of 160 employees (median 67). Several factors motivated the use of this scale: 1) the firms surveyed were SMEs, 2) the study was recently published, and 3) methodological robustness of the study including tests for content validity, construct validity, and nomological validity. To establish construct validity, tests were employed for

unidimensionality, reliability, and convergent validity. Competitive rivalry is measured by four items consisting of product characteristics, promotional strategies, access to distribution channels, and service strategies to customers. Barriers to entry, threat of substitute products, bargaining power of suppliers, and bargaining power of buyers were single item measures. Spanos and Lioukas (2001) reported Cronbach's alpha of 0.83 and measurement model fit statistics for the competitive rivalry construct including a χ^2 (2) of 7.278, *p* value of 0.026, a CFI of 0.968, and Robust CFI value of 0.995.

2.2.2 Resource-based view of competitive advantage:

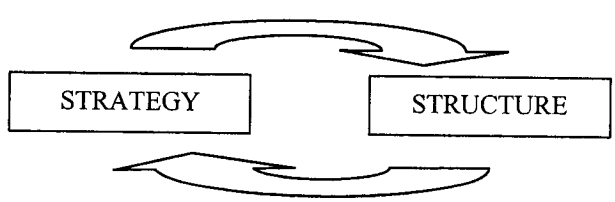
Edith Penrose's (1959) book, The Theory of the Growth of the Firm, is regarded by many strategy scholars as the basis for the Resource-Based View (RBV) of the firm (Cockburn, Henderson, and Stern, 2000). Penrose viewed the firm as a broader set of resources and viewed growth as the result of achieving the proper balance between exploitation of these resources and the development of new ones. Foundations of RBV include significant foundational contributions from Wernerfelt (1984) and Teece (1982), both of whom quoted Penrose's work. According to Cockburn, Henderson, and Stern (2000) the strategy process foundations of RBV were more influenced by Stinchombe (1965) and Nelson and Winter (1982).

RBV views the firm as a *bundle of resources* (Spanos and Lioukas 2001). These resources are further defined as competencies and capabilities (Rugman and Verbeke 2002). According to Rumelt (1984), the heterogeneous resources of

a firm generate isolating mechanisms which separate the firm from its competitors. Thus, superior returns are achievable to the degree to which the firm's competences and capabilities are specific (i.e imperfectly mobile), valuable to customers, non-substitutable and difficult to imitate (Rugman and Verbeke 2002).

The resource-based view represents an opposing viewpoint of strategy in that Porter viewed strategy as industry driven while the resource-based view contends that strategy is driven by past resource decisions which constitute the firm's uniqueness (Rumelt 1984). The differences between the viewpoints extend to the role of resources in the causal chain. Porter (1991) contends that the firm's assets (resources) are built from performing activities (i.e. strategy making and deployment) or by acquiring them from the environment. Therefore resources are not valuable in and of themselves but are the result of activities. The resource-based view conceptualizes resources as a basis for action (strategy-making), not the result of it. Thus, the two views are on opposite sides of the strategy-structure argument. Is strategy the result of firm structure or does strategy cause structure? Both are arguably true and one may imagine that strategy and structure exist in a continuous reciprocating relationship in which the direction of the relationship simply depends on the starting point of a proposition (Figure 2.02).

Figure 2.02: Strategy vs. structure



The design school perspective (structure precedes strategy) can be defended in the context of an SME environment. The argument is that since SMEs have very little influence over industry forces, industry forces can appropriately be looked upon as external structures. If the industry forces are viewed in this way then the SME is functioning in a strategic environment which is influenced by internal (RBV) and external (industry forces) structures. This situation would suggest that SMEs must apply the design school perspective in order to adapt. We believe this phenomenon exists in SMEs primarily because of resource scarcity and limited capital.

Like Porter's view, competitive advantage leading to superior performance is also embedded in the resource-based view of the firm. In the resource-based view Ricardian rents are produced by the uniqueness of the resource base, which generate differentiated levels of "efficiency" (Teece, Pisano, Shuen, 1997; Barney 1991).

Measures for the resource-based view were developed based on three dimensions reported in prior literature. These dimensions consist of organizational capabilities (Teece et al., 1997), marketing capabilities (Lado, Boyd and Wright 1992) and technological capabilities (Leonard-Barton 1995; and Lado et al 1992).

Organizational capabilities consist of managerial skills and competencies, knowledge and skills of employees, organizational structure and culture, efficient

coordinative mechanisms, strategic planning procedures and the ability to attract creative employees. Marketing capabilities include building of privileged relationships with customers and suppliers, market knowledge, control over distribution channels, and a strong "installed" customer base. Technical capabilities consist of efficient production, technological capabilities and infrastructure, and economies of scale and technical experience.

The scale of the resource-based view was developed and tested in prior literature (Spanos and Lioukas 2001). Tests for content validity, construct validity, and nomological validity were conducted and reported. To establish construct validity, tests were employed for unidimensionality, reliability, and convergent validity. As mentioned in section 2.2.1, the reasons for using this published scale include; 1) the firms surveyed were SMEs, 2) the study was recently published and 3) methodological robustness of the study. Reported cronbach's alpha values of the dimensions are 0.685 for organization/managerial, 0.764 for marketing dimension, and 0.893 for technical dimension of the construct. Reported measurement model fit statistics include a χ^2 (75) of 141.138, *p* value of 0.001, CFI of 0.922, and Robust CFI of 0.920.

2.2.3 Similarities of the two views:

Recent literature has recognized the complimentary nature of the competitive strategy and resource-based view of explaining firm performance (Conner 1991; Mahoney and Pandian 1992; Amit and Schoemaker, 1993; Mauri and Michaels, 1998). The most obvious similarity between Porter's view and the

resource-based view is that both are seen as driving strategic decisions in the firm. In this way both may be seen as "different sides of the same coin" (Wernerfelt 1984). Amit and Schoemaker (1993) illustrate this complimentary relationship by connecting the concept of "strategic industry factors" at the market level with "strategic assets" at the firm level. Amit and Schoemaker (1993) also point out that while industry analysis is critical in assessing external forces and barriers, it is insufficient in that it "treats the firm largely as a black box", deemphasizing the role of managerial discretion. According to this view both are essential to firms that want to maximize performance in that each, in and of itself, is incomplete.

In an empirical analysis of 264 companies, Mauri and Michaels (1998) found that industry level drivers that promote homogeneity coexist with firm level drivers that generate heterogeneity. The findings also suggested that firm level factors contributed more to performance while industry factors contributed more to technology and marketing.

According to Foss (1996) the resource-based view can be looked on as emphasizing the "strengths and weaknesses" component of SWOT analysis while competitive strategy (Porter) provides the "opportunities and threats" component. Barney (1991) and Foss (1997) propose that the two theories cover different domains of application within the context of SWOT. The resource-based view emphasizes developing resources while industry forces limit or change the significance of the resources.

Both views maintain that competitive advantage is possible and that superior performance results from an attractive strategic position. Porter's framework suggests monopolistic rents are driven by market position and the resource-based view suggests efficiency rents are driven by managerial competence in operations and resource allocation (Spanos and Lioukas 2001). Spanos and Lioukas (2001) also point out that comparing and contrasting the two perspectives is justifiable for three reasons; 1) the two perspectives both attempt to explain firm performance in the sense that the two views represent *"internal" and "external" determinants of competitive advantage*, 2) both seek to explain competitive advantage, and 3) both use the firm level of analysis. In our model, the resource-based view represents *internal factors* impacting firm activities leading to performance and industry forces represent *external factors* impacting firm activities which also lead to performance.

2.2.4 Sustainable competitive advantage:

Both the competitive strategy and the resource-based perspective of competitive advantage use the term "sustainable competitive advantage" as a means of qualifying the nature of a firm's advantage. The concept of sustainable competitive advantage has been debated in the literature and no attempt is made here to end that debate. However, we are of the view that all competitive advantage is temporary in nature, especially in the case of SMEs.

Collis (1994) argued that organizational capabilities will never identify the ultimate source of sustainable competitive advantage because of the infinite

regress problem. Every capability is vulnerable "to threats of erosion, substitution, and above all, being superseded by a higher-order capability of the learning to learn variety". He further suggests that "the source of sustainable competitive advantage is likely to be found in different places at different points in time in different industries". This sounds more like a moving target than an identifiable, "sustainable" condition. Perhaps the intended view is that competitive advantage is always temporary and that what is commonly referred to as "sustainable competitive advantage" is really defining firm's that have repeatedly, over some period of time, been able to repeatably create temporary competitive advantage. "Although extended periods of stability have existed in some industries, for example, technological regimes" (Anderson and Tushman 1990), such periods of stability have not been observed in the post-industrial era. Perhaps the only time sustainable competitive advantage can exist is in a perfectly static environment that has reached an unbalanced equilibrium. Such an environment was the case in some large industries prior to the post-industrial age.

In the case of SMEs, resource scarcity severely limits their ability to influence the external environment (industry effects) therefore creating a situation in which they must continually adapt to a dynamic environment. Such adaptation is characterized by efforts to mold the organization around its environment in such a way as to maximize profits therefore denying any possibility of creating a sustainable advantage over a competitor. We propose that resource scarce firms (SMEs) maximize profits through a process of adapting their current resource

base to their business environment. While larger, resource rich organizations maximize profits with less focus on adaptation to current resources since these can be more easily altered. The implication is that SMEs may have a temporary competitive advantage but since this is due to a dynamic process that is constantly in flux, it can not be called "sustainable". The only industrial organization alternative is to try to identify this "dynamic adaptation" as a sustainable competitive advantage in and of itself. This would be incorrect since in every case it is created by a unique combination of factors, internal and external to the organization, therefore it is without specification.

2.3 Environmental scanning:

Environmental scanning is an activity by which organizations collect information, either internal or external, that help determine future courses of action. Aguilar (1967) in his ground breaking study defined environmental scanning as:

"scanning for information about events and relationships in a company's outside environment, the knowledge of which would assist top management in its task of charting the company's future course of action".

Hambrick (1981) further defines environmental scanning as "the managerial activity of learning about events and trends in the organization's environment", thus extending the definition to include internal factors. Given these definitions, a few of the important characteristics of environmental scanning can be summarized as; 1) it is an activity, 2) it involves the use of internal and external

information sources, and 3) the information gathered through this activity is useful for managerial decision making.

According to Auster and Choo (1993) the acquisition and use of information is at the center of managerial work. In a survey of 207 CEO's they found that scanning increases with the level of uncertainty in the external environment, and that a mix of internal and external sources were used. The USSBA (1995) highlighted the importance of information in SMEs stating "because small firms have limited ability to absorb mistakes in underestimating the costs of switching technology, the availability of information is especially critical". Mintzberg (1973a) in describing a set of interlocking managerial roles concluded that "it is the informational roles that tie all managerial work together" and that because of the access to external and internal information, managers function as an "information processing system" that receives information, directs its flow, and takes action based on the information assimilated.

Environmental scanning has been studied from many different perspectives and has received considerable research effort over the last few decades. Fahey and King (1977) suggested classifying scanning models into three types: irregular, regular, and continuous. According to Fahey and King these three types of scanning represent a continuum from *reactive* to *proactive but limited*, to *proactive and broad*. The irregular model is considered to be *reactive*, the regular to be *proactive but limited*, and the continuous to be *proactive and broad*.

Fahey and Narayanan (1986) discussed two distinct approaches to environmental scanning. The first is a macro-approach "outside-in" and the second is a micro-approach or "inside-out". The "outside-in" approach takes a broad view of a firm's environment whereas the "inside-out" approach takes a narrow view constrained by the organization. Costa (95) discusses these approaches and categorizes the differences along five dimensions; focus and scope, goal, time horizon, frequency, and strengths.

Jain (1984) in a study of corporate environmental scanning suggested a stage model progressing from primitive scanning, to ad hoc scanning, reactive scanning, and finally proactive scanning. Primitive scanning is depicted by a situation in which the environment is assumed to be inevitable and random. In this stage managers do not make a concerted effort to collect information but are exposed to it "at random" and further make no attempt to discern any strategic value. Ad hoc scanning involves informal scanning activities in which management distinguishes some areas that merit careful attention. This stage most accurately resembles the informal scanning activities of smaller organizations. The third stage of the model, reactive scanning, involves recognizing the value of and collection of large amounts of information but manager's efforts to organize and utilize the collected information are sporadic and disorganized. This disorganization causes them to be surprised by competitor moves and react rather than lead based on their own analysis. In the most advanced and final stage, proactive scanning, the organization is focused and formal in their information collection and analysis allowing them to

proactively take action. Jain's stage model suggests that scanning activities evolve. In this we would agree to the extent that these stages would seem to parallel organizational size and the degree of formalized structure.

Lawrence and Lorsch (1967) were among the first to connect organizational performance to the ability of an organization to "obtain relevant information about its current and future environment". This is a significant statement in that it presumes that "current environment" is an antecedent of scanning. In our model we propose that the strategic context of the firm consisting of internal (resource-based view) and external (industry forces) factors are antecedents of environmental scanning activity. We propose that the organization's environment is a unique information set that constitutes what we may call the strategic context of the firm. We believe this strategic context consists of separate constructs with different dimensions with one important discriminating characteristic from the environmental scanning construct; the strategic context is not an activity. It exists for every firm whether or not it is utilized as an information resource.

The dimensions of environmental scanning most often used are technological, economic, political, and social (Aaker 1984; Johnson and Scholes 1993; Fahey and Narayanan, 1986). Other authors have used different dimensions to operationalize environmental scanning. Beal (2000), in a study of Midwestern manufacturing firms (USA) found four dimensions; competitors and customers, internal factors and resources, suppliers-labor-funds, and external socio-economic factors. Beal (2000) reported Cronbach's alpha values of 0.78 for

competitors and customer dimension, 0.81 for internal factors and resources dimension, 0.66 supplier, labor and funds dimension, and 0.79 for the socio-political dimension. We have selected Beal's scale for the following reasons; 1) the sample group is very similar to ours in that he sampled 500 mid-west (USA) SME manufacturing firms, 2) the scale is from a recent publication (Beal 2000), and 3) the robust methodology used in its development.

2.4 Strategy:

The concept of strategy has received significant treatment in research literature over the last several decades. In academic literature, strategy has been defined and viewed in many different ways. Particular to the interest of this research work are the concepts of strategic management, strategy-making and manufacturing strategy. Strategic management is a broad view of the strategy area which has typically concentrated on any business concept that affects firm performance (Hoskisson, Hitt, Wan, Yiu, 1999). Strategy-making is more concentrated on the underpinnings of strategy development and manufacturing strategy is a functional level strategy representing specific priorities at the operational level.

2.4.1 Strategic management:

Strategic management is concerned with identifying concepts that affect business performance. As such, strategic management views strategy in the broadest of perspectives. Over the last four decades the field of strategic

management has seen evolutions in thought swing from its roots in business policy to the recent rise of the resource-based view (RBV) of the firm (Hoskisson et al., 1999).

The early development in the field of strategic management began with work by Chandler (1962) in his book "Strategy and Structure". Chandler described strategy as "the determination of the long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out the goals" and structure as "the design of the organization through which the enterprise is administered". In Chandler's view changes in structure were the consequence of changes in strategy.

Other important work in the development of strategic management were put forth by Ansoff (1965) on strategic decisions and by Andrews (1971) on business policy. According to Rumelt, Schendel, and Teece (1991), the works by Chandler, Ansoff, and Andrews provide the foundation for the field of strategic management. They defined the importance of external opportunities and internal capabilities, the notion that structure follows strategy, and the practical distinction between formulation and implementation, as well as the role of managers (Hoskission et al., 1999).

In the 1980's the field began to be heavily influenced by economics, particularly industrial organization (IO) economics. Based on the structure-conduct-performance (SCP) paradigm from early work by Bain (1956, 1968) and Mason (1939) IO economics focused on the interaction of buyers, sellers, and suppliers in an economy wide context. The influence of the SCP paradigm has

been significant (Rumelt, Schendel, and Teece, 1994). Important contributions to SCP were made by Porter (1980, 1985) who introduced a framework based on industry level analysis and competitive advantage. According to Porter, the ability of a firm to create competitive advantage depends on how well the firm positions itself in an industry. Porter's industry forces model (1991) specifies various aspects of an industry's structure and is to this day a very useful view of forces inherent in any business environment (see prior discussion in section 2.2.1).

Further developments in the field of strategic management began to refocus on firm level influences. Transaction cost economics (Williamson 1975, 1985) and agency theory (Fama and Jensen, 1983) made important, though controversial contributions to the field. Transaction cost economics (TCE), based on the work of Coase (1937), sought to explain why organizations exist. According to TCE theory, organizations exist because the cost of managing economic exchanges between firms (transaction costs) is greater than the cost of managing exchanges within firms. Agency theory, by contrast, maintains that because of the separation of ownership and management there is a divergence of interests between shareholders (principles) and managers (agents). According to Eisenhardt (1989) since human beings are boundedly rational, self-interested, and opportunistic, managers will seek to maximize their own interest at the expense of the shareholders.

A more recent development in the field of strategic management is the resource-based view (RBV) of the firm. This development, discussed in section 2.2.2 focuses on internal firm resources and capabilities. In summary, the field of

strategic management has moved from being focused on firm level factors, to the industry, and back again over the last four decades.

One of the most unique and valuable resources the firm possesses may be its leadership. Strategic leadership research is based on prior work including Fayol's (1949) managerial actions (planning, organizing, coordinating, commanding, controlling), Selznick's (1957) suggestion that top management's job is to establish and convey "organizational meaning", and Mintzberg's (1973a) "The Nature of Managerial Work" which described managerial work in terms of three dimensions; interpersonal, informational, and decisional. Hambrick and Mason (1984) go further by suggesting that senior executives make strategic choices on the basis of their cognitions and values, arguing that organizations become a reflection of top management. In the case of SMEs which are characterized by a flat organizational design, the influence and impact of the top manager is easily understood. This has several implications for the strategy-making process within SMEs and the impact of the mental orientation of top management within the strategy development process.

2.4.2 Strategy-making:

Strategy-making, as reported by Miller (1987), converges around three multifaceted dimensions; rationality, assertiveness, and interaction. According to Miller, the rationality dimension is represented by two different schools of thought. The first is described as the synoptic (Frederickson, 1984; Lindblom, 1959), planning (Mintzberg, 1973b), or rational (Miller and Friesen, 1984).

Characteristic of this school are careful analysis, systematic scanning for problems and opportunities (Aguilar 1967; Andrews, 1980), and planning of unified strategies. The second school follows a bounded rationality model (March and Simon, 1958). This school of thought suggests that firms do little analysis and instead emphasize satisficing. Strategies are formulated by a disjointed process of intuition and spontaneity. This latter school is most appropriate to an organizational environment characterized by the informal processes present in many SMEs as pointed out in the work of Mintzberg (1994) in which strategy in small firms was the consequence of an adaptive "visionary" approach resulting in an informal or "realized" strategy.

The second dimension of strategy-making, interaction, involves bargaining, politicking, and consensus building in the decision making processes in large, decentralized companies. In smaller firms which are very centralized, little interaction occurs as decisions are made by a single decision-maker (Collins and Moore, 1970). Although there is little need for consensus building in small organizations which are characterized by little or no power sharing, it may be that interactions are motivated by the need for information. Information sources within organizational boundaries (internal factors) and outside the organization (external factors) are typically sought after (via informal environmental scanning) whether or not official power sharing is present.

The third dimension of strategy-making is assertiveness which refers to the accepted level of risk taking and the reactiveness or proactiveness of

decisions. The particular level of assertiveness varies based on firm complexity (Quinn 1980) and entrepreneurial presence (Mintzberg 1973b).

In an SME environment all of these dimensions of strategy-making are easily interpretable. Rationality is represented by the bounded rationality perspective in that the level of informal processes and spontaneity are high. Interaction is not with fellow decision-makers so much as it is with information resources including internal and external environment contextual factors. The level of assertiveness varies along individual preference dimensions exhibiting reactiveness or proactiveness modes of behavior based on a situational basis. The important connections between this view of strategy-making and our research model are the strategy decision-maker and the internal and external environment which heavily influences the resource allocation process. We see environmental scanning activities as the primary way in which information is informally collected and analyzed (rationality dimension), adaptive decision making as the decision making process (interaction dimension) and manufacturing strategy as representative of the level of risk taking (assertiveness dimension). These dimensions also parallel the Miles and Snow (1978) typology in that the bounded rationality perspective would produce a reactor type of strategy, characteristic of the small manufacturing company's desire to adapt to their environment (Miller 1987). As will be discussed in the following section, we believe that SMEs will switch strategies or even follow two divergent strategies at the same time. With regard to Miles and Snow's typology we believe that they

may follow a defender strategy with some customers while simultaneously pursuing a proactive strategy with another.

2.4.3 Adaptive decision making:

According to Mintzberg (1994), strategy in small firms is a consequence of an adaptive "visionary" approach resulting in an informal or "realized" strategy. Therefore the strategy-making process within SMEs *is* a "pattern of decisions" by top management. It is our contention that the tendency of top managers within SMEs is toward adaptation to the environment internally and externally in an attempt to survive, grow, and prosper.

The term adaptation is common in business research. The role of adaptation has been studied in several different business contexts including buyer-supplier behavior and relationships (Brennan and Turnbull, 1999; Canning and Hammer-Lloyd, 2002), supply chain (Quayle, 2003), decision support systems (Fazlollahi, Parikh, and Verma, 1997) firm economizing behavior (Cyert and Kumar, 1996), investor strategy (Marinov and Marinova, 1998), employee psychological adaptations (James, 1999), product adaptation (Leonidou, 1996), supplier-customer relationships (Canning and Hammer-Lloyd, 2001), and cultural adaptation (Fang, 2001).

What we observe in SMEs is a lack of comparability with several theories on strategy and competitive advantage. SMEs often defy classification according to popular competitive strategies or typologies. Small manufacturing companies may follow a low cost and differentiation strategy concurrently. This is driven by

the fact that most major customers have significant bargaining power over SMEs. Therefore, the SME will follow a low cost strategy with these customers while at the same time adopt niche strategies in other markets. In the Midwest manufacturing environment we believe that this is a common situation in which OEM business is based on low cost and after-market manufacturing is niche or differentiation driven.

Similarly, SMEs defy classification into typologies such as Miles and Snow (1978). They will follow a defender type of strategy with large customers and a prospector strategy with higher margin after-market or non-automotive business. This duplicity in strategy can be interpreted as a clear indication that SMEs are actually basing strategy on something other than the market based approaches inherent in popular theories and typologies. We believe that SME strategy is informal and adaptive in nature.

In a case study of 13 buyer-supplier relationships in the automotive and telecommunications industries, Brennan and Turnbull (1999) found confirmatory evidence to support their argument that the concepts of power and social exchange in relationships are important drivers of adaptive behavior. More specifically they found that in cases where a small supplier interacts with a large customer (OEM), the power in-balance leads to a desire on the part of the smaller supplier to respond to requests of the larger customer and a tendency of the larger customer to underestimate the effort required within the smaller organization to respond. This is true in the case of SMEs in general and

manufacturing SMEs specifically. Given this finding, it would also make sense that SMEs tend to adapt to larger suppliers in a similar way.

With respect to decision making processes that produce adaptations, Brennan and Turnbull (1999) made two significant observations in relation to our research effort. First of all they found that in some cases adaptations took place without any conscious decision having been made, while other times they were the result of formal data gathering, analysis, and decision. Secondly they found that often many small adaptations over a period of time can cause "substantial adaptation" resulting in a new strategy emerging from a pattern of decisions (Mintzberg 1994). These ad-hoc decisions are made at the senior level in small companies because there are fewer decision making levels and a given adaptation is comparatively more important in smaller organizations. The decision making processes and the corresponding adaptation types described by Brennan and Turnbull (1999) are represented in Figure 2.03 below:

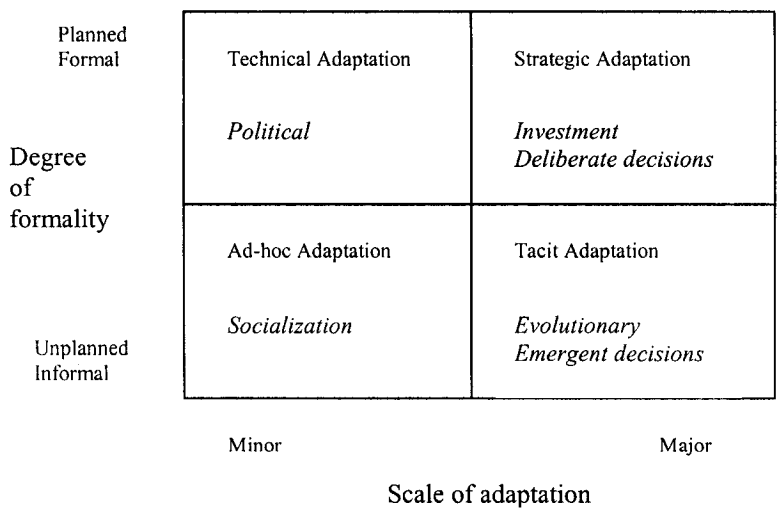


Figure 2.03: Adaptation process: Scale and formality (Brennan and Turnbull, 1999)

Since small organizations lack the managerial depth to support formal processes they are more likely to employ ad-hoc or tacit adaptations that result in evolutionary strategy development. We propose that this adaptive tendency in SMEs is related to practically all decision areas of the business, not just those investigated in prior research.

Sharfman and Dean (1997) suggest that the core of all organizational adaptation is the decision making process. They further suggest that adaptation is "a series of choices about how to respond to perceived threats and opportunities". In a case study of 25 companies they confirmed earlier work (Mintzberg and McHugh, 1985) finding that top management flexibility in decision making was a key component of an organization's ability to adapt. We believe that the primary motivation, whether conscious or unconscious, in SME decision making, is adaptation.

This concept of adaptation relates very well to that discussed by McCarthy and Tan (2000) in an article applying fitness landscape theory to manufacturing environments. By adopting a "complex systems" approach (Casti, 1998), they viewed manufacturing organizations as a system which evolves over time by adopting characteristics in order to survive. Biologists have long used fitness landscape theory to explain the mechanisms by which organisms adapt to conflicting constraints and the complex interactions of the environment. Kauffman (1995, 1993) used the concept of a fitness landscape to investigate the process of self-organizing and natural selection. This view pictures a biological landscape where organisms adapt and search for genotypes which are "fitness" peaks on a

rugged, multi-peaked, mountainous, "fitness landscape". The similarity with modern manufacturing business environments in the post industrial era, which are characterized by intense competition and rapid change, is inescapable. According to Mcarthy and Tan (2000), fitness landscape theory could help manufacturing organizations obtain new insights about the interrelation between internal characteristics and the external environment. In other words, the adaptive processes are used, consciously or unconsciously, to increase performance and survivability in today's complex business environment.

The fitness points are locations of increased performance and survivability while the lower points represent non-competitiveness and the threat of extinction. While global optimums are rarely identified, local optimums, or fitness points, are sought after by natural selection and survival of the fittest. When an organism finds a local maximum that will increase performance or the likelihood of survival, it moves to that location. Once there, the search for a more optimum location continues, moving the organism about the landscape. This is representative of strategy-making through adaptive decision making in a SME. The SME constantly scans the environment for a more preferable position and makes decisions based on a desire to adapt to avoid extinction or improve its position on the landscape. We believe that the primary motivator in SME decision patterns is toward adaptation.

Therefore we propose that *adaptive decision making* is the basis for strategy development in SMEs. Adaptive decision making reflects our belief that the underlying mechanism driving decisions in small companies is a desire to

adapt to their environment in a manageable way. It is our contention that adaptive decision making occurs in SMEs among top managers by using information collected through scanning of the environment to make decisions which, in turn, produce strategy (emphasis or lack of emphasis on strategic imperatives). Therefore we propose that environmental scanning is positively related to adaptive decision making and that adaptive decision making is positively related to manufacturing strategy and performance.

Since adaptive decision making does not exist in the literature we developed a list of potential items representative of such a construct based on interviews with small manufacturing company executives. The construct was then refined using Q-sort methodology in a pilot study before inclusion in the large scale survey instrument.

2.4.4 Manufacturing strategy:

Manufacturing strategy dates back to early work by Skinner (1969) that prescribed in detail the importance of connecting manufacturing to overall business strategy by arguing that manufacturing can be a competitive weapon if managed in support of the firm's resources. Skinner also perceived linkages between manufacturing strategy and the business environment, competitive strategy, and performance. The work of Skinner has been confirmed by other research (Anderson, Cleveland, and Schroeder, 1989; Leong, Snyder, and Ward, 1990; Ward and Duray, 2000; Hayes and Upton 1998). Recent empirical studies have continued to confirm these linkages (Ward and Duray 2000). Linkages

between manufacturing strategy and other important constructs have been theoretically argued or empirically investigated in the literature by several authors (Hill, 1994; Vickery, Droge, and Markland, 1993; Miller and Roth, 1994; Williams, D'Souza, Rosenfeldt, and Kassaee, 1995; Ward and Duray, 2000).

Manufacturing strategy has been defined by Slack, Chambers, Harland, Harrision, and Johnson (1998) as:

"the total pattern of decisions and actions which set the role, objectives and activities of manufacturing operations so that they contribute to and support the organization's business strategy"

This view of strategy is in agreement with Mintzberg's and Lampel's (1999) argument that strategy can be thought of as "everything a company does or consists of". Others have characterized strategy as some form of order emerging from the chaos of an organization's actions, rather than any plans that have been formulated (Brown and Eisenhardt, 1999). This perspective is particularly consistent with views of strategy development in SMEs, where strategy more likely forms from an emergent process (Barnes 2000). Manufacturing strategy can be thought of as "the pattern of decisions actually made...." (Hayes and Wheelwright, 1984). In an SME environment, which is characterized by resource scarcity, including planning resources, the nature of these decisions is largely informal (Barnes 2002).

Gupta and Lonial (1998) tested linkages between business strategy, manufacturing strategy, and organizational performance. The connection between manufacturing strategy and performance is important in that ultimately

the goal of every business is to be profitable and thereby guarantee its continuation. In this research we connect manufacturing strategy to organizational performance in an attempt to confirm this prior research stream.

Other important linkages were explored by Swamidass and Newell (1987) who empirically explored environmental dynamism, manufacturing strategy, and performance. The connection with the business environment as an antecedent of manufacturing strategy is easy to understand since strategy represents an allocation of resources. In a business environment several factors determine the priorities for making such resource assignments. Environmental factors should impact these allocations. In the scarce resource environment of SMEs this connection could be particularly strong since recovering from misallocations can be devastating in a smaller organization (USSBA, 1995). Ward, Bickford, and Leong (1995) also connected the business environment to the manufacturing strategy dimensions of quality and delivery and to higher organizational performance. In our model environmental scanning activities are linked to the informal process of manufacturing strategy development and adaptive decision making. In agreement with prior literature discussed above, we view manufacturing strategy in SMEs as the culmination of a pattern of informal decisions. It seems reasonable therefore, that manufacturing strategy, when viewed from this perspective, is influenced by information available for decision making (environmental scanning) and the mental focus of the decision-maker.

Measures for the manufacturing strategy construct were adopted from prior work by Youndt, Snell, Dean, and Lepak (1996) consistent with those found

throughout literature (Leong et al. 1990; Marucheck, Pannesi, and Anderson, 1990; Schroeder et al., 1986; Skinner, 1969; Upton, 1995; Wheelwright, 1981). The 31 item scale includes operationally defined competitive priorities in manufacturing, including cost, quality, flexibility, and delivery. The dimensionality of measures was checked by principle components factor analysis and the two-stage rule was used to assign items to factors (Nunally, 1978). The scale produced four stable factors each with an eigenvalue greater than 1.00 and Cronbach's alpha values greater than 0.70.

2.5 Firm Performance:

The performance construct is arguably one of the most important constructs in strategy and organizational research for the simple reason that almost every model attempts to relate the constructs of interest to performance. Indeed one must inquire as to the value of any particular course of action if it does not impact performance. According to Venkatraman and Ramanujam (1986) "performance improvement is at the heart of strategy research" as "most strategic theories either implicitly or explicitly underscore performance implications". Therefore performance can be viewed as the time test of any strategy (Schendel and Hofer, 1979).

The quality of the performance measures used in SME research is more problematic because of the lack of standardized accounting and reporting methods and the variety of entity types (corporation, partnership, individual) used in smaller companies. The use of metrics such as return on equity (ROE) has

questionable value in SME research because of the fact that the equity portion of any small company balance sheet is often distorted by several factors present in smaller organizations. Some entity types common in SMEs do not even require the formulation or reporting of the balance sheet from which ROE is calculated. Even if these measures were reported in a standardized format the interpretation of them would be extremely difficult given the various tax strategies followed by small organizations under US tax laws.

Two major drawbacks of accounting data are non-homogeneity and non-availability of data (Bracker and Pearson 1986). Non-homogeneity results from the use of varying accounting conventions such as depreciation and stock valuation. In the case of SMEs which are not publicly traded, there is simply no data available. It is obvious that some type of financial measures are necessary in performance measurement. However, the over reliance on financial measures is at best problematic in SME research. In a comprehensive review of 51 published articles, Murphy, Trailer, and Hill (1996) found little consistency in performance measurement. Sixty percent of the studies reviewed used only one or two dimensions of performance, and generally used the selected dimension without justification.

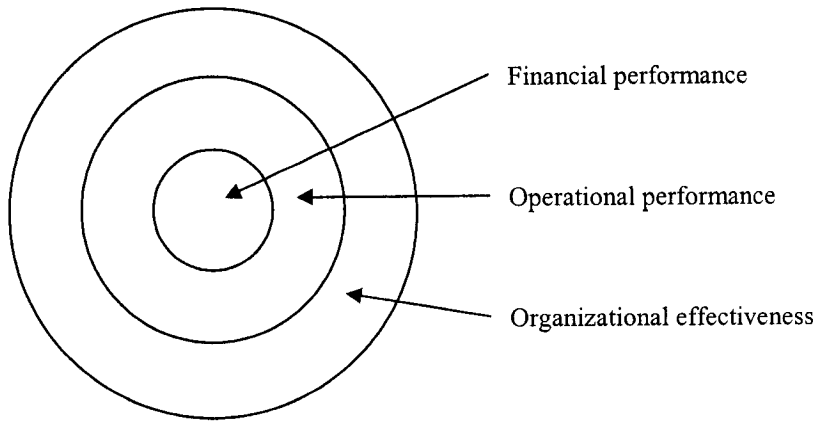
Organizational theorists have measured organizational effectiveness using three different approaches. The goal-based approach suggests that performance be evaluated based on goals the organization sets for itself (Etzioni 1964). According to Murphy et al. (1996), the drawback of this approach is that many organizations have varied and sometimes contradictory goals which make cross-

firm comparisons difficult. The systems approach overcomes this disadvantage by the use of generic performance aspects (Georgopolous and Tannenbaum, 1957; Yuchtman and Seashore, 1967; Steers, 1975). According to Murphy et al. (1996) both of these approaches fail to consider differences between stakeholder groups and their perspectives on performance. The constituency approach accounts for these differences by examining the extent to which the agenda of various stakeholder groups are satisfied (Thompson, 1967; Pfeffer and Salancik, 1978; Connolly, Conlon, and Deutsch, 1980; Zammuto 1984).

Venkatraman and Ramanujam (1986) integrated these three dimensions in a multiple hierarchial construct using financial performance, operational performance and organizational effectiveness (constituency performance level) as dimensions of the organizational performance domain. According to Venkatraman and Ramanujam, business performance is "a subset of the overall concept of organizational effectiveness" (see figure 2.04). At the center of this conceptualization of organizational effectiveness is financial performance. The next ring is operational performance representing financial performance plus operational performance. The outside ring is organizational effectiveness representing financial performance plus operational performance plus organizational effectiveness (stakeholder or constituency group satisfaction). The representation by Venkatraman and Ramanujam implies that these rings have a dependent relationship in that one causes or builds upon the other. The implication is that organizational effectiveness (stakeholder satisfaction) impacts

operational and financial performance and that operational performance impacts financial performance.

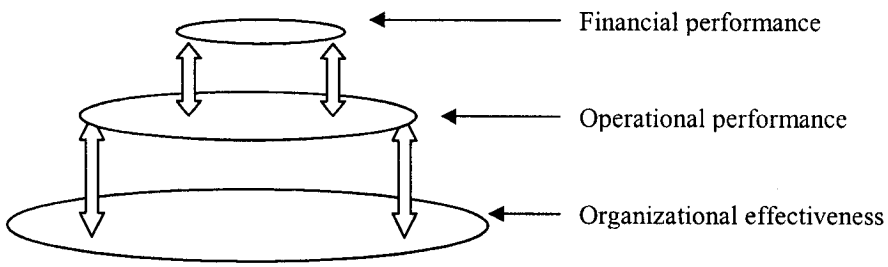
Figure 2.04: Organizational effectiveness



There are a few observations worth noting with regard to this interpretation of the model. First of all, the relationships are presumed to be unidirectional in that financial performance does not impact operational performance or stakeholder satisfaction. Logic would say that this is not true. Favorable financial results often lead to additional investment thereby improving operational performance. And improved financial results would almost certainly improve stakeholder satisfaction, among at least some constituency group. Another observation is that since financial performance among SMEs has been problematic or unstable in empirical research, it seems that the dependent relationship for smaller organizations may not hold up. Finally, we observe that Venkatraman and Ramanujam referred to the rings as three different levels of conception and did not discuss the model in terms of dependent relationships. Another way to view this model is as three disks, which are independent yet

interact within the scope of each dimension (see Figure 2.05). This view may be more accurate since it reflects the interactions between financial, operational, and stakeholder groups which we intuitively know exist.

Figure 2.05: Organizational effectiveness view



We propose that the relationship among financial performance, operational performance and organizational effectiveness (constituency group satisfaction) may very well be independent in SMEs. One can imagine several situations in which this could be the case. For instance, an SME could follow an aggressive tax strategy in its financial management, which would have a tendency to suppress (lower) financial reporting results, while at the same time raise operational performance (through investment of tax savings) and constituency group satisfaction. It may be that these three dimensions are more or less broad in scope and distinctively measure performance along three different perspectives, not necessarily dependent on one another.

Several authors have argued for multi-dimensional measures of performance (Kaplan 1983; Gupta 1987; Venkatraman and Ramanujam, 1986; Randolph, Sapienza, and Watson, 1991). In this research we measure performance based on the domains proposed by Venkatraman and Ramanujam

(1986). As to whether or not these measures should be subjective or objective is the subject of some debate. Swamidass and Newell (1987), among others, have taken note of the difficulty in obtaining objective financial measures although they are preferred. There are some drawbacks to objective measures in that it is difficult to compare performance across business units with different product lines, technologies, and competitive priorities (Bozarth and Edwards, 1997).

In the study of small organizations, objective measures of performance are usually not available. Therefore the majority of research investigating the performance of SMEs, utilize subjective or perception-based measures. Dess and Robinson (1984) examined the usefulness of subjective performance measures obtained from top management in a case study of twenty-six manufacturing organizations. They hypothesized that there would be a strong positive correlation between objective and subjective measures of return on assets, sales growth, and other global measures of performance. Their findings indicated a strong correlation between objective and subjective measures of return on assets (r=0.611), sales growth (r=0.694), and overall performance (r=0.733). In another study, Venkatraman and Ramanujam (1987) report "managers tend to be less biased in their assessments of their organizational performance than researchers have tended to give them credit for". In this study, we use perception based measures for financial, operational, and constituency (stakeholder) performance.

2.5.1 Financial performance:

The financial performance measures used in this research are based on a literature survey of 51 articles by Murphy et al. (1996). All of the articles were empirical, composed of small businesses, and included performance as a dependent variable. According to Murphy et al. (1996), the three most frequently reported performance dimensions were efficiency, growth, and profit.

The efficiency dimension included return on investment, return on equity, return on assets, return on net worth, and gross revenues per employee. Return on assets, or return on investment, was utilized in 22 out of 40 articles reporting this dimension. We believe return on assets is the best measure for small organizations since it is easy to understand and calculate. The growth dimensions included change in sales, change in employees, market share growth, change in income margin, change in CEO/owner compensation, and change in labor expense to revenue. Of these the most frequently used in literature was change in sales with 23 out of 35 articles using this dimension. We therefore selected change in sales as a second item for financial performance. The profit dimension included return on sales, net profit margin, gross profit margin, net profit level, net profits from operations, pretax profit, and client's estimate of incremental profits. Of these, net profit margin (return on sales) was the most prevalent being used in 19 out of the 40 articles reporting this dimension. Therefore we selected profitability to be used in our measure of financial performance. Our financial performance dimension therefore consists of

three perception-based measures; return on assets, change in sales (sales growth), and profitability.

2.5.2 Operational performance:

Operational performance in manufacturing organizations is the same as manufacturing performance. Prior research has identified several competitive priorities for manufacturing plants. Previous measures of operational performance have included cost as a percentage of sales, conformance quality, on-time deliveries, cycle time, volume flexibility, product flexibility and length of fixed production schedule (Skinner, 1969; Wheelright, 1978; Schmenner, 1981; Hayes and Wheelwright, 1984; Hill, 1989; Krajewski and Ritzman, 1990; Ferdows and De Meyer, 1990; Hill, 1994; Miller and Roth, 1994). Recent literature has added the rate of new product introduction to this list (Vickery, Droge, and Markland, 1997). The rate of new product introduction does not apply in many SMEs since most small organizations make products according to customer specifications and do not develop their own products. Therefore, the dimensions of operational performance in an SME environment would include cost, quality, delivery, and flexibility. These dimensions reflect the performance of the organization along the strategic imperatives discussed in section 2.4.4 under manufacturing strategy. The similarity is no accident, in fact the literature often makes little distinction between the strategic imperatives and the corresponding measurement of how well an organization is achieving outcomes consistent with the organization's objectives. The most significant difference in measuring

manufacturing strategy and measuring manufacturing performance (operational performance) is not the items, but how the question is asked. In strategy we ask about the degree to which various imperatives are emphasized while in performance we ask how they perform in comparison to competitors. So why measure both? There is an important distinction to be made between what objectives an organization sets for itself (strategic imperatives) and the degree to which they are capable of achieving the desired outcomes (performance along those objectives).

In a study of 164 manufacturing plants Schroeder, Bates, and Junttila (2002) used manufacturing cost as a percent of sales to measure the cost dimension, scrap rate to measure the quality dimension, percentage of deliveries customers receive on time to measure the delivery dimension, and length of fixed production schedule to measure the flexibility dimension. The survey design allowed for multiple respondents from a single plant and the data collected were actual values (not perceptual) reported from either the plant accountant, quality manager, or inventory/purchasing manager. While the operationalization of manufacturing performance used in their study was consistent with prior literature, there are too many inconsistencies with the present study in regard to survey design to warrant usage.

A more appropriate scale for this study is reported by Ahmad and Schroeder (2003). Ahmad and Schroeder (2003) used the unit cost of manufacturing to measure the cost dimension, quality of product conformance to measure the quality dimension, on-time delivery performance to measure the

delivery dimension and flexibility to change volume to measure the flexibility dimension. Respondents were asked to indicate their opinion about how they faired in comparison to their competitors on the four dimensions. This perception-based measure used a five point lickert scale (1=poor or low end of industry …5=superior or better than average).

2.5.3 Constituency performance:

Utilizing the Venkatraman and Ramanujam (1986) framework, constituency performance consists of the satisfaction level of different constituency groups connected to the business. The reason that businesses exist is to provide some benefit to the human element that comes into contact with the organization. Without this important connection there would be no reason for a business to exist.

A significant part of the human connection to a business is represented by owners, customers, employees, and debt holders. We believe that the current and future relevance of the business is reliant on the satisfaction of these four groups, and perhaps others. For this reason, we include constituency performance as a third dimension of our organizational performance construct. Beyond justifying the continued existence of a business we believe that the satisfaction of these groups may have significant impact on several factors that impact the level of performance directly or indirectly. Therefore, it is perfectly logical that the satisfaction of constituency groups is not only desirable, but a necessity. We measure constituency performance of the organization by asking

the respondent to rate the level of satisfaction of these groups on a lickert scale of 1 (low) to 5 (high).

2.6 Linkages in the proposed framework and model

Many of the linkages between constructs in the current research model have been confirmed in prior research efforts. Among these are the connection between external factors (industry forces) and performance (Porter, 1991; Dess and Davis, 1984; Miller, 1988; Spanos and Lioukas, 2001), internal factors and performance (Wernerfelt, 1984; Teece, 1982; Rumelt, 1984; Rugman and Verbeke, 2002), environmental scanning and manufacturing strategy, (Andrews, 1980; Miller, 1987; Bourgeois, 1995) and manufacturing strategy and performance (Skinner 1969; Anderson et al, 1989; Hayes and Upton, 1998; Leong et al 1990; Brown and Eisenhardt, 1999). The linkages between industry forces, internal resources and capabilities, and environmental scanning, as well as, the linkages between environmental scanning, manufacturing strategy, and our measures for adaptive decision making and performance have not been covered in prior literature. The following paragraphs discuss the theoretical arguments for the linkages between these constructs.

Table 2.01 illustrates the connections in our framework between external factors, internal factors, environmental scanning, adaptive decision making, manufacturing strategy, and performance. The table shows the direction and nature of the relationships between the constructs of interest.

Table 2.01: Construct relationships

Antecedent	*Construct of interest*	*Relationship*
External factors	Environmental scanning	Positive
Internal factors	Environmental scanning	Positive
Environmental scanning	Adaptive decision making	Positive
Adaptive decision making	Manufacturing strategy	Positive
Adaptive decision making	Performance	Positive

2.6.1 External and internal factors connection to environmental scanning:

Prior literature has incorporated similar factors (internal and/or external) in the environmental scanning construct itself by incorporating them as dimensions. Our constructs for internal and external factors have been developed from prior literature on industry forces and the resource-based view of competitive advantage and are considered antecedents of environmental scanning (see section 2.2.1 and 2.2.2). We would argue that there is a significance difference between environmental scanning, which is an activity, and our operationalization of internal and external factors which are not. In this research, Internal and external factors are sets of business environmental conditions (contextual factors), that exist whether or not one uses them as information sources through scanning activities. These conditions, or contextual factors, have an impact on the organization whether or not environmental scanning is done. We believe that this is an important distinction and we also believe they are different from the "sources of information" referred to in prior research (Auster and Choo, 1993). Therefore our use of internal resources and capabilities and industry forces as antecedents of environmental scanning is unique in the literature thus far.

While prior research has not separated these factors from the scanning activity, there have been references that clearly indicate an antecedent relationship. Aguilar (1967) defined environmental scanning as "scanning for information about the events and relationships in a company's outside environment". The reference to "the company's outside environment" indicates that the external factors that impact the business are separate from the scanning activities covered by "scanning for information". Hambrick (1981) further defined environmental scanning as "the managerial activity of learning about events and trends in the organization's environment". This definition refers to internal factors by using the term "organization's environment". The quote also refers to scanning as an "activity" which indicates the direction of the relationship in our proposed research framework.

2.6.2 Adaptive decision making construct connections:

We define adaptive decision making as

"*a conscious or unconscious tendency to place a high priority on adaptation to ones environment throughout the decision making process*".

In our view, such a tendency will impact the decision outcomes since adaptation is the first objective, with all other factors filtered through this adaptive lens of the decision maker. We further contend that the primary objective among decision makers in SMEs is to find a way to adapt to their environment in a way which will insure the continued survival of the firm and maximize performance metrics of interest to the owners. From this perspective adaptive decision making is at the center of the strategy-making process within SMEs.

2.6.3 Environmental scanning to adaptive decision making:

While there is a multitude of support in prior literature for the relationship between information sources and information uses in decision making we will use just two references to justify our linkage between environmental scanning and adaptive decision making. According to Hambrick (1981) environmental scanning is "the first step in a chain of perceptions and actions leading to the organization's adaptation to its environment". This statement indicates that adaptation to an environment requires information. "Perceptions" refers to the interpretation, or filtering of the information based on our individual biases and values. "Actions" refers to the fact the information requires a response. We may assert that one uses information for decision making, even if the decision is to not do anything with the information. What is the difference between not making a decision and making a decision to not make a decision? From a definitional perspective we may argue that in order to make a decision there must be a decision to be made. In other words, making a decision requires information. In a business strategy-making context, information is the mortar from which strategy is formed through some decision making process. Therefore the fact that information is required before a decision is made is true by definition.

According to Bourgeois (1995) "environmental scanning is the first step in the development of strategy and it provides the information needed *for decision making*". This statement brings environmental scanning and decision making into a clear business context whereby information gathered through environmental scanning is "needed for decision making". In SMEs, we believe that this decision

making process is particularly focused on adaptation to the business environment. Regardless of the orientation or "perceptions" of the decision maker, the information comes first and is required for the decision making process. Therefore we link environmental scanning to adaptive decision making.

2.6.4 Adaptive decision making to manufacturing strategy:

Slack et al. (1998) define manufacturing strategy as "the total pattern of decisions and actions which set the role, objectives and activities of manufacturing operations so that they contribute to and support the organization's business strategy". This definition clearly connects manufacturing strategy to decision processes. The connection is once again a natural one that is somewhat self-defined by the constructs themselves.

Furthermore, Mintzberg (1994) contends that strategy in small firms is a consequence of an adaptive "visionary" approach resulting in an informal or "realized" strategy. This quote clearly indicates the direction of the relationship between these two constructs. The decision making process comes before "realized" strategy. Therefore we connect adaptive decision making to manufacturing strategy.

2.6.5 Adaptive decision making to performance:

The connection between adaptive decision making and performance is similar to the connection between strategy and performance in prior literature. Small organizations develop strategy via an informal, "pattern of decisions" (Hayes and Wheelwright, 1984) resulting in a "realized strategy" (Mintzberg,

1994). Therefore there is little distinction between decision making and strategy in small organizations. The linkages between strategy and performance which are covered extensively in prior literature (see section 2.4.4) justifies linking adaptive decision making to performance in SMEs.

2.7 Hypotheses development

Based on the foregoing review and theoretical arguments, several hypotheses in support of our research model are proposed. The following nine hypotheses represent the direction of the relationship between constructs as well the nature of the proposed relationship. All hypotheses with the exception of H1a are presumed to be positive.

H1: As the intensity of industry forces (external factors) increase, the level of environmental scanning activities will increase.

Prior research has found that environmental scanning activities increase as uncertainty increases (Auster and Choo 1993). Industry forces (external factors) represent several unknowns involving competitors, suppliers, and threat of substitute products. It is reasonable to assume that in smaller organizations, based on the complexity of the external environment, firms would increase their information gathering activities as the level of complexity increases. For this reason we propose that the relationship between external factors and environmental scanning will be positive.

H1a: As the intensity of industry forces (external factors) increase, the level of organizational performance will decrease.

Given an increase in factors such as those represented by Porters (1991) five-forces model (external factors) we would expect a dampening impact on organizational performance. As the bargaining power of customers increase, the organization is at a pricing disadvantage. Likewise, as the bargaining power of suppliers increases the organization is at a cost disadvantage. In a similar way increases in the threat of substitute products, *lowering* of barriers to entry, and increased levels of competition will adversely impact performance. Therefore we propose that external factors will have a direct negative impact on performance.

H2: As the level of company resources and capabilities (internal factors) increases, the level of environmental scanning activities will increase.

Prior research has identified the importance of monitoring internal sources of information (Mintzberg 1973a, Hambrick 1981). In smaller organizations, information gathering is ad hoc (Brennan and Turnbull, 1999) but no less valuable than in larger organizations. It is reasonable to assume that as internal resources are perceived as more valuable to an organization, that information gathering about the status of these resources would increase. Highly valued resources are so valued because of their perceived importance to the firm's

future. Therefore we propose that internal factors will have a direct positive impact on environmental scanning.

H2a: As the level of company resources and capabilities (internal factors) increase, the level of organizational performance will increase.

Internal resources are the firm specific capabilities and competencies possessed by a firm. Higher levels of organizational, marketing, and technological capabilities will positively impact performance. In a similar way, higher levels of competencies such as production efficiency, technical experience, and infrastructure should make a firm more competitive, consequently positively impacting performance. Therefore we propose internal factors will have a direct positive impact on performance.

H3: As the level of environmental scanning activities increase, the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) will increase.

As a manufacturing firm becomes aware of deficiencies through environmental scanning an attempt will be made to correct them by adjusting the level of emphasis the firm places on strategic imperatives such as cost, quality, delivery, and flexibility. Higher levels of scanning would logically produce more frequent adjustments resulting in higher levels of emphasis on the manufacturing

strategic imperatives. Thus, higher levels of environmental scanning would lead to higher scoring on the manufacturing strategy construct. Therefore, we propose that environmental scanning will have a direct positive effect on manufacturing strategy.

H4: As the level of environmental scanning activities increase, the level of emphasis placed on adaptation in decision making (ADM) will increase.

Informal environmental scanning is the information portal in SMEs. As useful information is gathered from the business's environment it is only natural to assume that this information will be utilized in decision making processes. Increasing the level of environmental scanning allows the decision maker to make more frequent adaptations through the decision making process. Hence, as environmental scanning increases, the use of that information in adaptive decision making will also increase. Therefore we propose that environmental scanning will have a direct positive effect on adaptive decision making.

H5: As the level of emphasis placed on adaptation in decision making (ADM) increases, the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) will increase.

The strategy-making process in SMEs is primarily the consequence of a pattern of decisions (Mintzberg 1994). As such the activity of decision making is

synonymous with strategy-making. Given this relationship, strategy can be viewed as a culmination of prior decisions. As decision making increases the frequency of adjustments to strategic imperatives increases, thereby increasing the level of manufacturing strategy response levels. Therefore, we expect adaptive decision making to have a direct positive effect on manufacturing strategy.

H6: As the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) increase, the level of organizational performance will increase.

Manufacturing strategy in this study is represented by the level of emphasis on manufacturing strategic imperatives. The imperatives were defined in prior literature based on their positive relationship with operational performance. As a manufacturing organization increases the level of emphasis on cost, quality, delivery, and flexibility, operational performance on these same measures should improve. Since operational performance in this research is a dimension of organizational performance, increases in emphasis would result in improved organizational performance. Therefore manufacturing strategy will have a direct positive impact on performance.

H7: As the level of emphasis placed on adaptation in decision making (ADM) increases, the level of organizational performance will increase.

Adaptive decision making consists of a specific focus on adaptation during the decision making process. The more effectively the organization adapts to its environment the more *effective* the organization should be. Increased levels of adaptation through decision making will increase organizational effectiveness and will thereby positively increase performance. Therefore adaptive decision making will have a direct positive relationship to organizational performance.

Chapter 3

Instrument Development

Several measures used in this study were developed in prior research. The measure for industry forces (Dess and Davis, 1985; Miller, 1988), internal capabilities and competencies (Spanos and Lioukas, 2001), environmental scanning (Beal, 2000), and manufacturing strategy (Youndt et al., 1996) were developed and reported in previous literature. The measurement scales for adaptive decision making and the multi-dimensional measure of constituency performance have been developed for this research. Two of the three dimensions used in our performance measurement were reported in prior literature but were not used together. These dimensions include financial performance (Murphy et al. 1996) and operational performance (Ahmad and Schroeder, 2003). In this chapter the methodology used for instrument development is explained and the results of the procedures are reported.

The Q-sort method (Davis 1986, 1989) was used to develop the measurement scales for three constructs; adaptive decision making, manufacturing strategy, and organizational performance. Although the manufacturing strategy scale was developed and reported in prior literature, the scale was included in the Q-sort because of potential confusion between the

manufacturing strategy items and the operational performance items. The items used to measure manufacturing strategy were developed from prior work by Youndt et al. (1996) and included items that measured the *emphasis* the respondent placed on four manufacturing strategic imperatives including flexibility, quality, delivery, and cost. These items are similar to the operational performance dimension of the performance construct used in this study. The primary difference is how the question is worded. With the operational performance measurement items, the respondent was asked to *rate their performance* along the four strategic imperatives in comparison to their competition. With the manufacturing strategy measurement items the respondent was asked to rate the *degree of emphasis* placed on the four manufacturing strategic imperatives. Therefore, the possibility exists that a respondent may not adequately differentiate the items representing these two constructs affecting the discriminant validity of the scales.

Scale development was achieved in two steps. First, the items were generated from interviews with industry experts in the target sample group or adopted from prior literature. The list of items was then reviewed by industry and academics in a pre-test of the survey instrument which included reading of the questionnaire to provide feedback on the clarity of questions, instructions, length of the survey, and general understandability of the questionnaire. The feedback from this step was used to modify the presentation of the questions and the instructions to improve the overall clarity and understandability of the survey.

The items developed for the study according to this procedure resulted in 10 items for the adaptive decision making construct, 15 items for the manufacturing strategy construct, and 14 items for the performance construct.

The second step involved sorting the items into categories by experts in the manufacturing industry that are representative of the sample group. Two judges were used in each round of sorting. The judges were asked to put the individual items, which were displayed on separate cards, into envelopes of the category to which they belonged. A "not available" envelope was used to allow the judges to throw out any items they felt did not belong to any category. The objective of the procedure is to assess the convergent and discriminant validity of scales by examining how the judges sort the items into construct categories. This assessment is done by analyzing the inter-judge agreement on items classified as belonging to the same construct. The procedure identifies items that do not belong in the item pools as well as bringing out weaknesses in the original definitions of the constructs. After each round items are dropped, added, or replaced until the inter-judge agreement approaches 80%.

Items for manufacturing strategy were adopted entirely from Youndt et al. (1996), and the items for adaptive decision making were generated from interviews with small manufacturing company CEO's, owners and top managers. The organizational performance construct, as operationalized for this research, consists of three dimensions including financial performance, operational performance, and constituency performance. The financial items were based on Murphy et al. (1996) and the operational performance items were based on prior

work by Ahmad and Schroeder (2003). The constituency dimension was developed from suggestions by Venkatraman and Ramunajam (1986) in which organizational stakeholder satisfaction represents one dimension in a three dimensional view of performance including financial performance, operational performance, and organizational performance.

3.1 Scale development procedure using Q-sort methodology:

The procedure involves using representatives from the sample group including CEO's, owners, and top managers of SME manufacturing companies to sort the items generated in step one into construct categories based on similarities and/or differences among the items. Based on this categorization by the judges the items could then be examined and ambiguous and inappropriately worded items can be reworded or eliminated. The goal of this stage is to pre-assess the construct validity of the scales being developed. Davis (1986,1989) used this procedure to assess the coverage of the domains of his constructs.

The first step in sorting was to print out each question individually on a standard size card. The cards were then shuffled prior to presentation to the judges. Each judge was provided with four envelopes, one for each construct and one labeled "not available" so that items were not forced into categories to which the judges did not feel they belonged. Each of the three sorting rounds used a different set of judges to insure the independence of each sort.

After each round the results were analyzed by first categorizing the sort of each judge in a matrix that compared the theoretical item categories with the

actual classification made by the judge. Next the results of both judges are summed in a matrix comparing the theoretical and actual classifications. This matrix is referred to as the combined judge raw score for each round. After computing the combined raw score the inter-judge agreement scores were calculated. This matrix also compared the theoretical and actual classifications using only those items which both judges agreed belong to a particular category. The inter-judge agreement percent is then calculated as the ratio of agreements divided by the total number of items. As a final check, the inter-judge agreement, or Cohen's kappa, is calculated to assess the reliability of each sorting round. The calculation of Cohen's kappa (Cohen, 1960) is shown in figure 3.01.

Figure 3.01: Cohen's kappa

$$k = \frac{N_i X_{ii} - \sum_i (X_{i+} X_{+i})}{N_i^2 - \sum_i (X_{i+} X_{+i})}$$

Where: k = the kappa ratio
N_i = the number of items classified
X_{ii} = the number correctly classified by both judges
$\sum_i (X_{i+} X_{+i})$ = the sum of the accepted items by both judges with the uniquely rejected items for each individual judge.

Cohen suggested comparing the actual agreement with the chance of agreement that would occur if all rows and columns are independent. The difference between the actual and chance agreements is the percent agreement above that which is due to chance. The ratio of these is denoted by the Greek letter kappa and is referred to as Cohen's kappa.

There are three assumptions in Cohen's kappa; 1) the units are independent, 2) the categories of the nominal scale are independent, mutually exclusive, and 3) the judges operate independently. While no general agreement exists with respect to the interpretation of kappa values, several studies have considered values above 0.65 to be acceptable (Todd and Benbasat, 1989). Landis and Koch (1977) provided guidelines for interpreting kappa by associating different values to the degree of agreement beyond chance (see table 3.01).

Table 3.01: Cohen's kappa guidelines

Value of Kappa	Degree of agreement beyond chance
0.76 – 1.00	Excellent
0.40 – 0.75	Fair to good
0.39 or less	Poor

The results of all three sorting rounds is summarized in table 3.02 below

Table 3.02: Q-sort results summary			
Measure	*Round 1*	*Round 2*	*Round 3*
Combined judge raw scores	72%	79%	88%
Inter-judge agreement	56%	69%	79%
Cohen's Kappa	.547	.679	.785
Combine judge raw score summary			
Manufacturing strategy	71%	73%	92%
Adaptive decision making	83%	90%	91%
Performance	65%	78%	83%
Inter-judge agreement score summary			
Manufacturing strategy	56%	56%	56%
Adaptive decision making	60%	90%	100%
Performance	50%	64%	86%

3.2 Results of first sorting round:

The first round consisted of 39 items for the three constructs. The combined judge raw score average was 72% as 56 of 78 items were correctly classified (table 3.03).

Table 3.03 : Combined Judge Scores R1		Actual Classification					
		1	2	3	NA	Total	%
Theoretical Classification	1	24	2	7	1	34	71
	2	0	15	1	2	18	83
	3	6	3	17	0	26	65
	Total items: 78			Hits: 56		Hit%: 72	

Constructs:
1. Manufacturing strategy
2. Adaptive decision making
3. Performance

In round one, the combined judge raw scores were 71% for manufacturing strategy as 24 of 34 items assigned to this category were in agreement with the theoretical assignments. Likewise the scores for adaptive decision making was 83% and performance was 65%. As indicated by the table there is evidence of some confusion with the manufacturing strategy and performance constructs as anticipated. The first step in the analysis is to examine off-diagonal items to look for clusters. This examination reveals two clusters around manufacturing strategy and performance. On the manufacturing strategy items 7 out of the 10 or (70%) of the misclassified items are in the performance area. Also, with performance 6 of the 9 misclassified items (66%) were place in manufacturing strategy. It is obvious that the largest difficulty for the judges was the classification of manufacturing strategy items and the operational performance dimension items of the organizational performance construct.

The results for the adaptive decision making construct show that 15 out of 18 items (83%) were correctly classified indicating relatively good distinction of these items from the other two constructs. The combined judge raw score is very useful in detecting patterns of misclassification so the survey instrument can be improved. However, it does not tell the whole story, as one can see from observing the inter-judge agreement scores for round one.

The inter-judge agreement score dropped to only 56% (table 3.04) as items that were not classified the same by both judges were thrown out.

Table 3.04: Inter-judge Agreement Scores – Round 1		***Actual Classification***			
		1	**2**	**3**	**%**
Theoretical Classification	**1**	9			56%
	2		6		60%
	3			7	50%
Total items: 39		**Total Hits: 22**		**Average Percent: 56%**	

Constructs:

1. Manufacturing strategy
2. Adaptive decision making
3. Performance

This table shows that only 9 of 16 (56%) items for manufacturing strategy were correctly classified by both judges. Likewise 6 out of 10 (60%) adaptive decision making items were correctly classified and only 7 of 14 (50%) organizational performance items were correctly classified. With only 22 correct classifications on 39 items round one shows weakness in the wording or selection of items for the manufacturing strategy and operational performance construct. Cohen's kappa for this round was calculated at .547, below the acceptable range according to Landis and Koch (1977).

Table 3.05: Accept/Reject Table Round 1		Judge 1				
		Accept	Reject	Total	P1+	30
Judge 2	Accept	22	8	30	P+1	26
	Reject	4	5	9	Sum	56
	Total	26	13			

Figure 3.02: Cohen's kappa for R1

$$k = \frac{N_i X_{ii} - \sum_i (X_{i+} X_{+i})}{N_i^2 - \sum_i (X_{i+} X_{+i})} = \frac{(39)(22) - 56}{(39^2) - 56} = 0.547$$

To further identify the cause of the misclassifications in round one, the individual judge classifications for each item were investigated. This revealed that both judges had difficulty associating the operational performance items with performance. Of the four items used for operational performance only one, unit manufacturing cost, was associated with performance by judge number 1. Judge number two failed to classify any of the four operational performance items with the organizational performance construct. To correct this problem the questions were reworded to better distinguish the items from the manufacturing strategy items by using the word performs as opposed to degree of emphasis in the item question.

3.3 Results of second sorting round:

Again, two judges were used for the second sorting round. The results of the combined judge raw scores showed improvement over round one. An average of 79% of all 39 items were correctly classified by the two judges with 22

of the 30 manufacturing items (73%) correctly classified, 19 of 21 (90%) of the adaptive decision making items correctly classified, and 21 of 27 (78%) of the organizational performance items correctly classified (table 3.06).

Table 3.06 : Combined Judge Scores R2		Actual Classification					
		1	2	3	NA	Total	%
Theoretical Classification	1	22	0	7	1	30	73
	2	0	19	1	1	21	90
	3	4	0	21	2	27	78
	Total items: 78			Hits: 62		Hit%: 79	

Constructs:

1. Manufacturing strategy
2. Adaptive decision making
3. Performance

The combined judge raw scores showed improvement in almost every category. However, examination of the off-diagonal classifications continued to reveal clusters around the manufacturing strategy and performance construct. In analyzing the individual judge classifications it was revealed that there remained a problem with the operational performance dimension of the performance construct and manufacturing strategy. The rewording improved the results from round one with two of the four operational items correctly classified by at least one judge. The inter-judge agreement scores for round two are presented in table 3.07.

Table 3.07: Inter-judge Agreement Scores – Round 2		Actual Classification			
		1	2	3	%
Theoretical Classification	1	9			56%
	2		9		90%
	3			7	64%
Total items: 39		Total Hits: 27		Average Percent: 69%	

Constructs:

1. Manufacturing strategy
2. Adaptive decision making
3. Performance

The inter-judge agreement scores improved in round two with a total agreement on 27 of the 39 items (69%) classified correctly by both judges. Table 3.07 shows improvement from round one with increases in agreement on the adaptive decision making and performance constructs. The total agreement of 69% remains below the target agreement of 80%. Cohen's kappa is calculated at .679 (figure 3.03) showing only moderate inter-judge agreement (table 3.08).

Table 3.08: Accept/Reject Table Round 2		***Judge 1***				
		Accept	Reject	Total	P1+	33
Judge 2	Accept	27	6	33	P+1	29
	Reject	2	4	6	Sum	62
	Total	29	10			

Figure 3.03: Cohen's kappa for R2

$$k = \frac{N_i X_{ii} - \sum_i (X_{i+} X_{+i})}{N_i^2 - \sum_i (X_{i+} X_{+i})} = \frac{(39)(27) - 62}{(39^2) - 62} = 0.679$$

While there were significant improvements over round one the scores remain too low to establish an acceptable level of confidence in the discriminant validity of the manufacturing strategy and performance constructs. Interviews with the judges revealed that some of the problem may be related to how the terms were defined in the instructions for sorting as well as the clarity of wording for the flexibility item used to measure the operational performance dimension of performance. These changes were made for round three.

3.4 Results of third sorting round:

The results of sorting round three are summarized in tables 3.09, 3.10, and 3.11 below. The combined judge agreement scores averaged 88% for all three constructs with 24 of 26 items (92%) correctly classified for manufacturing strategy, 20 of 22 items (91%) correctly classified for adaptive decision making and 25 of 30 items (83%) correctly classified for the performance construct (see table 3.09).

Table 3.09 : Combined Judge Scores R3		***Actual Classification***					
		1	**2**	**3**	**NA**	**Total**	**%**
Theoretical Classification	**1**	24	0	2	0	26	92
	2	2	20	0	0	22	91
	3	3	0	25	2	30	83
	Total items: 78			**Hits: 69**		**Hit%: 88**	

Constructs:

1. Manufacturing strategy
2. Adaptive decision making
3. Performance

The combined judge score of 88% show that a high percentage of items were correctly classified by at least one of the two judges. The best indication of discriminant validity is demonstrated by the inter-judge agreement which shows the items that both judges classified in the same category. Table 3.10 shows that both judges classified 9 of the 16 manufacturing items correctly, 10 out of 10 adaptive decision making items correctly, and 12 of 14 performance items correctly. The average agreement score of 79% for all three constructs indicates a high percentage of agreement between the two judges.

Table 3.10: Inter-judge Agreement Scores - Round 3		Actual Classification			
		1	2	3	%
Theoretical Classification	1	9			56%
	2		10		100%
	3			12	86%
Total items: 39		**Total Hits: 31**		**Average Percent: 79%**	

Constructs:

1. Manufacturing strategy
2. Adaptive decision making
3. Performance

Cohen's kappa calculation was .785 (figure 3.04) indicating excellent agreement between the judges (table 3.11). With excellent agreement between the judges our scales are considered robust enough to proceed with the large scale survey.

Table 3.11: Accept/Reject Table Round 3		*Judge 1*				
		Accept	Reject	Total	P1+	37
Judge 2	Accept	31	6	37	P+1	32
	Reject	1	1	6	Sum	69
	Total	32	7			

Figure 3.04 Cohen's kappa for R4

$$k = \frac{N_i X_{ii} - \sum_i (X_{i+} X_{+i})}{N_i^2 - \sum_i (X_{i+} X_{+i})} = \frac{(39)(31) - 69}{(39^2) - 69} = 0.785$$

Chapter 4

Exploratory and Confirmatory Factor Analysis of Scales

The potential respondents to the large-scale survey included small and medium sized manufacturing companies, defined by the USSBA as firms with less than 500 employees. In an effort to identify such a group the manufacturing associations in the states of Michigan, Indiana, and Ohio were contacted and asked to participate in the survey.

In the regional economy consisting of Ohio, Michigan, and Indiana manufacturing employment contributes approximately 1.5 million jobs and 70 billion in payroll (USSBA, 2000). Thus, the tri-state region represents 22 percent of SME manufacturing jobs and 31 percent of SME manufacturing payroll in the US. Therefore, the tri-state region is a significant part of the total SME manufacturing base in the US and would serve well as a proxy for US Manufacturing SMEs.

After analyzing the research proposal, all three states agreed to sponsor the survey. The respective associations included Michigan Manufacturer's Association (MMA), Indiana Manufacturer's Association (IMA), and the Ohio Manufacturer's Association (OMA). We are indebted to the time, effort, cooperation and money expended by these associations in the mailing and

promotion of the survey (Appendix A) among their members who satisfied the response group criteria.

Each state produced a list of potential respondents based on the survey criteria. The two criteria were that the respondent have less than 500 employees and be a manufacturer. A survey cover letter was developed to promote the importance of the survey to the potential respondents (Appendix B). The draft was then mailed to the respective associations for additional editing. The same cover letter was used by all three states with slight modifications by each state. The cover letter, which was signed by the director of each state association, was then mailed along with the survey to the potential respondents in their state. The total number of potential respondents for each state was 1,481 in the state of Michigan, 934 in Indiana, and 1,550 for the state of Ohio for a total of 3,965 potential respondents.

In the state of Michigan we mailed a total of 1,481 surveys of which 12 were returned undeliverable for a net of 1,469 mailings. We received a total of 174 responses with 3 being unusable based on the number of employees criteria. The net response was 171 giving a response rate of 11.64%. The responses came from two mailings; the first generating 107 responses and the second generating an additional 67. The follow-up mailing was done in an attempt to improve the response rate. Companies that responded to the first mailing were not included in the second mailing.

In the state of Indiana we mailed a total of 934 surveys of which 2 were returned undeliverable for a net of 932 mailings. We received a total of 198

responses giving a response rate of 21.24%. The responses came from two mailings; the first generating 129 responses and the second generating an additional 69. The follow-up mailing was done in an attempt to improve the response rate. Companies that responded to the first mailing were not included in the second mailing.

In the state of Ohio we mailed a total of 1,550 surveys of which 3 were returned undeliverable for a net of 1547 mailings. We received a total of 180 responses from the first mailing therefore no follow-up mailing was made. Of the 180 responses 2 were unusable because they exceeded the number of employee criteria giving a net response of 178 or 11.51%.

Table 4.01 below breaks down the responses to the survey including the percentage of the total that is represented by each state.

Table 4.01: Survey response summary

State	Valid Responses	Response Rate	Percentage of Total
Michigan	171	11.64%	31.3%
Indiana	198	21.24%	36.2%
Ohio	178	11.51%	32.5%
TOTAL	547	13.74%	100.0%

A wide variety of manufacturer's responded to the survey including companies involved in the manufacturer of automotive or recreational vehicle parts, specialty products, tool and die, food, wood, furniture and numerous other manufacturing types. Over ninety-four percent (94.5%) of the respondents were CEOs or top managers (532 valid cases out of 547) and almost seventy percent (69.6%) represented family businesses (533 valid cases out of 547).

The data set was analyzed for missing data patterns, maximum and minimum response values, and excluded case percentages for each survey item (Appendix C). Before any analysis was done a random sample of 27 (5% sample) surveys were selected and audited for data entry errors. Every data field was audited for the selected sample of surveys and no discrepancies were found. The statistics for each survey item was analyzed including maximum and minimum values, the mean, standard deviation and skewness. All cases were analyzed to check the number of missing and valid cases for each item as well as to make sure that the recorded response was within the appropriate range (1 to 5).

Certain survey questions had significantly higher levels of missing data but no item had more than 13.2% missing and no patterns were detected. The missing data were well below the cutoff of 15% recommended by Mertler and Vannatta (2002) therefore no cases were dropped from the analysis. Case summary data including valid and missing cases are provided in Appendix "D". The two items with the highest percent missing data included items adpt8 and p2or4, which had 11.3% and 13.2% missing data respectively. Both of these questions asked for information regarding the relationship between the company and debt holders (i.e. banks). Given that some percentage of SMEs do not have any debt, the higher missing data could be expected on these items. Since no missing data patterns were detected the data is considered to be missing completely at random (MCAR). Mean substitution was used to replace missing data in all subsequent analysis. According to Mertler and Vannatta (2002),

replacement of less than 15% of data will have little effect on the outcome of analysis. Response and Non-response bias was not evaluated since data necessary for evaluation was not available from the state manufacturing associations.

To satisfy the assumptions of the multivariate procedures used for confirmatory analysis, we evaluated the linearity and normality of the data prior to mean substitution. Scatter plots were utilized to evaluate linearity and histograms and normal Q-Q plots (sample in Appendix D) were used to evaluate univariate normality. Based on these evaluations the data is considered linear and univariate normal. Therefore, for analysis purposes we believe the data approximates multivariate normality.

The 547 responses from the large-scale survey were split into two data sets for analysis purposes. The first set was utilized for exploratory factor analysis of the scales developed in this study including the adaptive decision making construct and the multi-dimensional performance construct. The second data set was utilized for confirmatory factor analysis of the two new scales developed in this research, confirmatory analysis of previously published scales, and for model testing. The split was based on random selection and resulted in two sets of data with 273 and 274 cases respectively. The first data set (273 cases) consists of 91 Michigan (33.3%), 94 Indiana (34.5%), and 88 Ohio (32.2%) cases.

In this chapter data reduction factor analysis technique is used to explore the adaptive decision making and multi-dimensional performance scales and

structural equation modeling (SEM) is used to confirm all new and previously published scales. Data reduction factor analysis will be used for the new scales since structural equation modeling requires a priori specification of the dimensions of a construct. Data reduction factor analysis is better suited for determining initial factor structures in situations where prior research does not provide us with the theoretical basis for specifying the dimensions of a new construct (such as the adaptive decision making scale).

Section 4.1 discusses the item refinement and purification techniques used in our exploratory factor analysis and section 4.2 follows with the results of exploratory factor analysis. Section 4.3 discusses the structural equation modeling (SEM) procedure and the model fit statistics reported for the confirmatory models. Section 4.4 concludes the chapter with the results of confirmatory factor analysis of the new scales and the previously reported scales used in our survey.

The previously used scales that will be confirmed include industry forces (Dess and Davis, 1984; Miller, 1988), internal resources and capabilities (Spanos and Lioukas, 2001), environmental scanning (Beal, 2000), and manufacturing strategy (Youndt, Snell, Dean, and Lepak, 1996).

4.1 Item Refinement

Item refinement for exploratory factor analysis of the new scales used the following criteria: simplicity of factor structure, purification, reliability, convergent validity and discriminant validity. The items resulting from application of the Q-

sort methodology (Chapter 3) for the adaptive decision making and performance constructs were submitted to exploratory factor analysis. Factor analysis is a data reduction technique used to determine the number of latent variables (dimensions) represented by a set of items proposed for each construct. Data reduction was accomplished using SPSS 10.0 software using mean substitution for missing data, principal components extraction method, and varimax factor rotation (except where otherwise indicated). The cutoff for the number of factors to extract was Kaiser's eigenvalues greater than one (1.0) (Nunally, 1983). Certain exceptions to this rule were made based on analysis of the Scree plot for factors close to the target value of one (1.0). Items that did not load at 0.60 or greater and items with cross-loadings greater than 0.40 were eliminated from further analysis. Any exceptions to these rules were made based on the suggestion by Dillon, Kumar, and Mulani (1987) that the importance of an item to the research objective be taken into consideration before dropping items based on its loading value alone. In an effort to make the factor interpretation process more manageable loadings below 0.40 were not reported. Tinsley and Tinsley guidelines were followed to evaluate factor stability based the recommended minimum ratio of 5 to 10 times more responses than items.

4.1.1 Purification of scales

Scales explored through data reduction factor analysis were purified based on Churchill (1979) recommendation that the corrected-item to total correlation (CITC) be examined to make certain that all items are contributing to each dimension of a construct. This was accomplished by comparing the change

in Cronbach's alpha that resulted from dropping each individual item with the alpha coefficient for the group of items (Flynn, Schroeder, and Sakakibara, 1995). Items that did not contribute to alpha were evaluated before dropping based on the significance between the dropped score and the overall score and the items importance to the research effort. Caution was used in eliminating items. However, if an items CITC value was less than 0.40 it was eliminated except if the items value to the research effort was considered highly valuable in which case the cutoff was 0.35. Reliability was evaluated using Cronbach's alpha and the average amount of variance extracted. The cutoff for variance extracted for any construct follows Baggozi and Yi (1992) recommendation of 0.50. The higher the average amount of variance extracted the more representative the items are of the construct.

Validity is the extent to which the scale is measuring the construct that it is intended to measure. The Q-sort pilot procedure provided reasonable assurance that the construct being measured was represented by the list of items (questions) used in the survey instrument. Discriminant validity was assessed by evaluation of the cross loadings produced by the factor analysis procedure. Convergent validity was assessed by evaluation of the items loading on each factor and the factor structure itself.

4.2 Results of the exploratory factor analysis

The methodology in 4.1 was utilized in the exploratory factor analysis (EFA) of the adaptive decision making and performance constructs proposed in our model. Section 4.2.1 reports the results of EFA for adaptive decision making and section 4.2.2 reports the results of EFA for the multi-dimensional performance construct used in our survey. Each of the following sections makes use of tables to summarize the analysis results. The first table in each section shows the items and the survey coding for all items representing the construct. The second table(s) shows the rotated factor solution indicating any dropped items. The third table reports CITC values, reliability coefficient, and variance extracted for each dimension. The final set of two tables show the correlation matrices for the items for each factor and the correlations between factors for the construct (oblimin rotation) or transformation matrix (varimax rotation). The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) coefficient was used to quantify the degree of inter-correlations among the variables and the appropriateness of using factor analysis. KMO is less sensitive to sample size than other measures of sampling adequacy such as the Bartlett test of sphericity (Hair, Anderson, Tatham, and Black, 1995). The index for KMO is from 0 to 1 with the value of 1 representing perfect predictability without error from the other variables. The interpretation of KMO values in table 4.02 below was adopted from Hair et al. (1995).

Table 4.02: KMO value interpretations

KMO value	sampling adequacy
.90 or above	marvelous
.80 or above	meritorious
.70 or above	middling
.60 or above	mediocre
.50 or above	miserable
less than .50	unacceptable

4.2.1 Adaptive Decision Making

Table 4.03 shows the items representative of the adaptive decision making construct used in the survey. Exploratory factor analysis was done using SPSS 10.0 with principal components analysis, varimax rotation, and an eigenvalue cutoff of 1.0. The ratio of respondents to items for the adaptive decision making construct was 273/10, or 27.3, exceeding the recommended ratio range of 5 to 10.

The initial solution revealed three factors (table 4.04) with a KMO value (Kaiser-Meyer-Olkin measure of sampling adequacy) value of 0.782 and three extracted factors with eigenvalues of 3.716, 1.722, and 1.084 respectively explaining 65.224% of total variance.

Table 4.03: Items and coding for adaptive decision making construct

CODE	ITEM **Indicate the degree of emphasis which your manufacturing plant places on the following activities/priorities…**
ADPT1	Adapt to competitor pricing
ADPT2	Adapt to market forces in industry

CODE	ITEM **Indicate the degree of emphasis which your manufacturing plant places on the following activities/priorities…**
ADPT3	Adapt our resources to customer needs and preferences
ADPT4	Adapt our capabilities to the current business environment
ADPT5	Adapt our product pricing to our suppliers pricing
ADPT6	Adapt to restraints of our cash flow
ADPT7	Adapt to restraints of capital availability
ADPT8	Adapt to debt holder's (i.e. bank's) requirements
ADPT9	Adapt to economic conditions
ADPT10	Adapt to social and political conditions

The three factors include items adpt6, adpt7 and adpt8 (factor 1), adpt3 and adpt4 (factor 2), and adpt1 and adpt5 (factor 3). Item adpt2 cross-loaded on factors 2 and 3 and adpt9 cross-loaded on factors 1 and 2. Item 10 did not load on any factor significantly and was dropped since it was not considered critical to the research. Adpt2 and adpt9 were kept for further analysis.

Table 4.04: Factor loadings for adaptive decision making construct

Items	Factor 1	Factor 2	Factor 3
Adpt1			.853
Adpt2		.596	.556
Adpt3		.771	
Adpt4		.803	
Adpt5			.709
Adpt6	.857		
Adpt7	.899		
Adpt8	.843		
Adpt9	.524	.544	
Adpt10*	**.482**		

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
* dropped from analysis

The revised analysis using varimax rotation produced three factors with eigenvalues of 3.423 (F1), 1.721 (F2), and 1.084 (F3) respectively explaining 69.2% of the variance (see table 4.05).

Table 4.05: Factor loadings for adaptive decision making construct after dropping adpt10 from the analysis.

Items	Factor 1	Factor 2	Factor 3
Adpt1			.860
Adpt2		.600	.551
Adpt3		.775	
Adpt4		.810	
Adpt5			.714
Adpt6	.874		
Adpt7	.903		
Adpt8	.845		
Adpt9*	**.492**	**.558**	

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization

* dropped from analysis

Analysis of the output resulted in dropping item 9 from the analysis since it was not pertinent to understanding or naming the factors and because of the significant cross-loading between factor 1 and 2. Table 4.06 shows the analysis result after dropping adpt9.

Table 4.06: Factor loadings for adaptive decision making construct after dropping item adpt9.

Items	Financial adaptation (Factor 1)	Customer adaptation (Factor 2)	Market / Pricing adaptation (Factor 3)
Adpt1			.868
Adpt2			.583
Adpt3		.829	
Adpt4		.804	

Items	Financial adaptation (Factor 1)	Customer adaptation (Factor 2)	Market / Pricing adaptation (Factor 3)
Adpt5			.702
Adpt6	.883		
Adpt7	.908		
Adpt8	.849		

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization

Item 2 fits well with item 1 and 5 from a factor interpretation perspective although significant cross-loading with factor 2 did occur (.559). The resulting scale consists of three variables named financial adaptation (items adpt6-8), customer needs and preferences adaptation (items adpt3 and adpt4), and market / pricing adaptation (items adpt1, adpt2, and adpt5). The scale accounts for 71.71% of the variance and the over all reliability as assessed by Cronbach's alpha values are .8870, .6251, and .6412 respectively. The corrected item total correlation, alpha values, and variance explained for each factor are presented in table 4.07 below.

Table 4.07: CITC, reliability and extracted variance for the adaptive decision making scale

Unobserved Variable	Items	CITC	Reliability	Variance Extracted
Financial adaptation	Adpt6	.7948	α = .8870	36.9% of 71.7% total
	Adpt7	.8347		
	Adpt8	.7287		
Customer adaptation	Adpt3	.4601	α = .6251	21.5% of 71.7% total
	Adpt4	.4601		
Market / pricing adaptation	Adpt1	.5733	α = .6412	13.3% of 71.7% total
	Adpt2	.4489		
	Adpt5	.3552		

The correlation matrix between all items used in the final scale is presented in table 4.08 and the component transformation matrix is presented in table 4.09 (below).

Table 4.08: Correlation matrix for all 8 items used in the scale

	Adpt1	Adpt2	Adpt3	Adpt4	Adpt5	Adpt6	Adpt7	Adpt8
Adpt1	1.000	.514	.167	.187	.391	.184	.122	.162
Adpt2	.514	1.000	.392	.393	.217	.095	.110	.105
Adpt3	.167	.392	1.000	.460	.190	.161	.110	.129
Adpt4	.187	.393	.460	1.000	.184	.261	.250	.216
Adpt5	.391	.217	.190	.184	1.000	.223	.234	.217
Adpt6	.184	.095	.161	.261	.223	1.000	.784	.669
Adpt7	.122	.110	.110	.250	.234	.784	1.000	.722
Adpt8	.162	.105	.129	.216	.217	.669	.722	1.000

Pearson Correlations

To further test for convergent validity the lowest correlation among scale items in the matrix (.217 between adpt2 and adpt5) was tested using Spearman's rho and Kendall's tau_b to see if the correlation is significantly different from zero. Both tests indicate that the correlation is significant at the 0.01 level (2-tailed).

Table 4.09: Component (factor) transformation matrix for the adaptive decision making scale

Component	1	2	3
1	.754	.470	.460
2	-.657	.563	.501
3	-.024	-.680	.733

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.2.2 Performance

Table 4.10 shows the items representative of the performance construct used in the survey. Exploratory factor analysis was done using SPSS 10.0 with principal components analysis, varimax rotation, and an eigenvalue cutoff of 1.0. The ratio of respondents to items for the adaptive decision making construct was 273/11, or 24.8, exceeding the recommended ratio range of 5 to 10.

Table 4.10: Items and coding for performance construct

CODE	ITEM **For each of the following measures please indicate how you believe your firm performs in comparison to your competitors.**
P2fina	Average return on assets over the last three years
P2fins	Average percent change in sales over the last three years
P2finp	Average before tax profit over the last three years
P2op1	Unit cost of manufacturing
P2op2	Quality of product (meets customer specification)
P2op3	On-time delivery performance
P2op4	Your ability to quickly change production volumes
P2or1	Customer satisfaction
P2or2	Employee satisfaction
P2or3	Ownership satisfaction
P2or4	Your bank or financial institution satisfaction

The initial solution revealed only two factors. However, analysis of the output revealed that the third factor just missed the eigenvalue cutoff of 1.0. Examination of the Scree plot and the EFA output revealed that the third factor had an eigenvalue of .936 and captured 19.9% of the variance. The decision to include the third factor was based on this information and the fact that the original research assumption was that three distinct factors were represented by the

items for this construct. Table 4.11 below shows the initial three-factor solution with KMO value of 0.846, and three extracted factors with eigenvalues of 4.366, 1.704, and 0.936 respectively explaining 63.69% of total variance. The three factors include items p2op2, p2op3, p2op4 and p2or1 (factor 1), p2fina, p2fins, and p2finp (factor 2), and p2or2, p2or3, and p2or4 (factor 3). Item p2op1 (unit cost of manufacturing) exhibited weak loadings and cross-loaded on factors 2 and 3. This item loaded with the financial performance items, which is logical since manufacturing cost is usually captured in overall financial results in smaller organizations because they typically do not have sophisticated cost accounting systems. Since p2op1 was deemed as captured by the overall financial measures and is not considered critical to the research effort it was dropped from further analysis.

Table 4.11: Factor loadings for the performance construct

Items	Factor 1	Factor 2	Factor 3
P2fina		.757	
P2fins		.777	
P2finp		.824	
P2op1*		**.496**	**.441**
P2op2	.805		
P2op3	.782		
P2op4	.626		
P2or1	.771		
P2or2			.717
P2or3			.793
P2or4			.722

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization

*dropped from the analysis

The revised analysis using varimax rotation produced a KMO value of .835 with three factors accounting for 66.65% of the variance. The eigenvalues for the factors were 4.113 (F1), 1.618 (F2), and 0.935 (F3) see table 4.12 below.

Table 4.12: Factor loadings for the performance construct after dropping P2op1 from the analysis.

Items	Operational performance (Factor 1)	Financial performance (Factor 2)	Constituency performance (Factor 3)
P2fina		.769	
P2fins		.780	
P2finp		.829	
P2op2	.801		
P2op3	.775		
P2op4	.635		
P2or1	.773		
P2or2			.717
P2or3			.797
P2or4			.759

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization

The resulting scale has three unobserved variables with a total of 10 items explaining 66.65% of the variance. The interpretation of the factors is in accordance with the anticipated loading of all items with the exception of p2or1 (customer satisfaction). However, upon examination of the other items that loaded on the first extracted component it seems logical that customer satisfaction would load with other operational items. In our original assumptions we anticipated that p2or1 would load with constituency performance items p2or1 through p2or4. Interpretation of the factors is straightforward in that factor one (p2op2, p2op3, p2op4, and p2or1) is operational performance, factor two (p2fina,

p2fins, and p2finp) is financial performance, and factor 3 (p2or2, p2or3, and p2or4) is constituency performance.

The over all reliability as assessed by Cronbach's alpha values are .7814 for factor 1 (operational performance), .7835 for factor 2 (financial performance), and .7778 for the third factor (constituency performance). The corrected item total correlation, alpha values, and variance explained for each factor are presented in table 4.13 below.

Table 4.13: CITC, reliability and extracted variance for the performance scale

Unobserved Variable	Items	CITC	Reliability	Variance Extracted
Operational performance	P2op2	.5753	α = .7814	41.1% of 66.7% total
	P2op3	.6634		
	P2op4	.5514		
	P2or1	.5921		
Financial performance	P2fina	.6528	α = .7835	16.2% of 66.7% total
	P2fins	.5142		
	P2finp	.7098		
Constituency performance	P2or2	.5729	α = .7778	9.4% of 66.7% total
	P2or3	.6891		
	P2or4	.5906		

The correlation matrix between all items used in the final scale is presented in table 4.14 and the factor component transformation matrix (three factor solution) is presented in table 4.15.

To further test for convergent validity the lowest correlation among scale items in the matrix (.231 between p2fins and p2op2) was tested using Spearman's rho and Kendall's tau_b to see if the correlation is significantly

different from zero. Both tests indicate that the correlation is significant at the 0.01 level (2-tailed).

Table 4.14: Correlation matrix for all 10 items used in the performance scale

	p2fina	p2fins	p2finp	p2op2	p2op3	p2op4	p2or1	p2or2	p2or3	p2or4)
p2fina	1.000									
p2fins	.425	1.000								
p2finp	.687	.505	1.000							
p2op2	.173	.111	.169	1.000						
p2op3	.264	.198	.248	.511	1.000					
p2op4	.279	.204	.236	.369	.537	1.000				
P2or1	.249	.175	.185	.514	.501	.411	1.000			
P2or2	.292	.251	.270	.315	.372	.416	.432	1.000		
P2or3	.460	.292	.500	.240	.312	.331	.269	.576	1.000	
P2or4	.435	.251	.434	.158	.312	.323	.231	.421	.555	1.000

Table 4.15: Component (factor) transformation matrix for the performance scale

Component	1	2	3
1	.605	.530	.595
2	.745	-.641	-.186
3	.283	.556	-.782

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

In summary, the exploratory factor analysis of adaptive decision making and the performance constructs produced two scales for further testing. The adaptive decision making construct consists of three dimensions with a total of eight items (two items discarded). The multi-dimensional performance construct exploratory analysis resulted in a scale consisting of 3 dimensions with a total of

10 items (one item discarded). Both scales are deemed acceptable for confirmatory analysis with the split half of the data set.

4.3 Confirmatory factor analysis methodology

Structural equation modeling (SEM) was used for confirmatory factor analysis to test the unidimensionality of each construct. SEM has been used extensively in psychology and social science research (Anderson and Gerbring, 1988) and is regarded as a comprehensive method for simultaneously evaluating and modifying theoretical models (Bentler, 1983). Confirmatory factor analysis (CFA) is a form of latent variable SEM (Maruyama, 1998). In SEM CFA we test the relationship between scores on the survey instrument (observed indicator variables) and the latent variables they are hypothesized to measure (Byrne, 2001). SEM goes beyond simple correlation analysis by simultaneously exploring the relationships in a single model that accounts for interaction among variables.

SEM has several notable advantages over traditional multivariate procedures (Fornell, 1982). First of all, SEM takes a confirmatory approach by requiring that the relationships among variables be specified *a priori*. Secondly, SEM provides explicit estimation of errors unlike traditional multivariate approaches (such as data reduction factor analysis used in the previous section) which are incapable of either assessing or correcting for correlated error terms. SEM also simultaneously estimates the strength of the various hypothesized relationships between observed variables (indicators) and latent variables resulting in rigorous hypotheses testing (Joreskog and Sorbom, 1989).

An SEM measurement model is a form of CFA and is identical to the CFA model except that a second order construct (latent construct) is added to the model. In SEM CFA the first order latent variables are allowed to freely co-vary with each other while in a measurement model they are modeled to a second order construct (figure 4.01). Since the measurement model gives us the regression weights between the first order latent variables and the second order construct we will use the measurement model form to test all constructs in this chapter. Using the measurement model form we will model all constructs from the item level (survey scores) instead on using composite variables (averaging survey scores for each latent variable).

A measurement model consists of observed indicators (survey scores), latent variables (first order), and a single latent construct (second order). For example, in this research the internal capabilities and resources construct (figure 4.03) is represented by three dimensions (latent variables) which themselves consist of multiple observed variables (survey scores). In total, the internal capabilities and resources measurement model consists of fifteen items (observed indicators) modeled to three first order latent variables (unobserved variables) which are in turn modeled to a single second order latent construct (internal capabilities and resources). The measurement models for each construct will later be combined in a structural model (causal model linking constructs) in chapter five to assess the hypothesized relationships in our research framework (figure 2.01).

All SEM analysis was conducted using AMOS 4.0 structural equation modeling (SEM) software developed by James Arbuckle (Arbuckle, 1999). In the following sections all six measurement scales (four from prior research and two new scales) are validated using SEM. Confirmation of all scales will be accomplished using the second split half of the sample data consisting of 274 cases from the three participating states. In this split half there are 80 Michigan (29.2%), 104 Indiana (38.0%), and 90 Ohio (32.8%) cases.

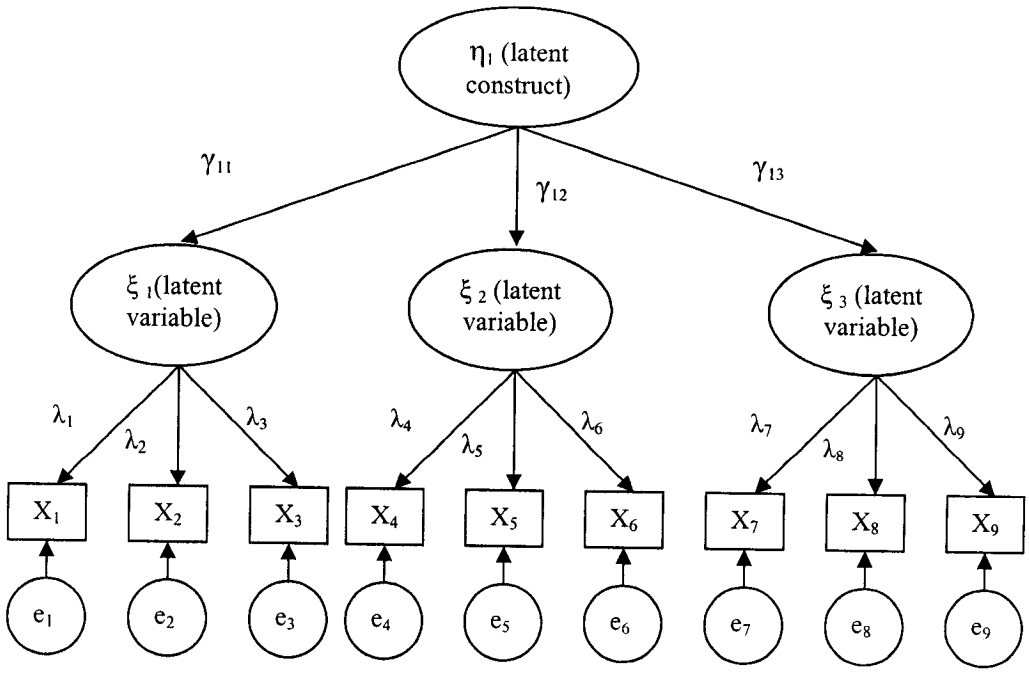
Following is a mathematical representation of structural equation modeling (SEM) in matrix form (Maruyama, 1998).

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

Where: β (beta) is a weight matrix of partial regression coefficients interrelating endogenous variables.
η (eta) is a vector of latent endogenous variables.
Γ (gamma) is the weight of partial regression coefficients relating exogenous to endogenous variables.
ξ (xi) is a vector of latent exogenous variables
ζ (zeta) is a vector of residuals for latent endogenous variables.

This basic form of the measurement model is shown in figure 4.02. Notice that in the measurement model X_n represents the observed variables (survey scores), λ_n (lamda) represents the regression weights between the observed variables and the first order latent variables, ξ_n (xi) represents the first order latent variables, γ_n (small cap gamma) represents the regression weights between the first order latent variable (exogenous latent variable) and the second order latent variable (endogenous latent construct), and η_1 represents the latent construct.

Figure 4.01: SEM measurement model form



where: λ_n is the regression weights of the various observed variables on unobserved factors
X_n is the observed variables (indicators)
e_n is the error (unexplained variance)

4.3.1 Evaluation of SEM measurement models

In SEM, model fit is estimated using either absolute, relative, or adjusted fit indexes (Marsh, Balla, and McDonald, 1988). Absolute indexes do not impose any baseline (comparison to alternate models) for a particular data set. These indexes measure whether or not the residual (unexplained) variance is appreciable. Absolute indexes include Chi-square (χ^2), Chi-square per degree of freedom (χ^2/df), root mean square residual (RMR), and goodness of fit index

(GFI). The Chi-square and Chi-square per degree of freedom look at the absolute size of residuals. While Chi-square is perhaps the most popular index to evaluate goodness of fit, it is sensitive to sample size and departures from multivariate normality. Researchers suggest that Chi-square must be interpreted with caution (Joreskog and Sorbom, 1989). RMR is the square root of the mean squared difference between the elements of the predicted and observed matrices and has a value between 0 and 1. Lower values indicate better fit with 0.10 or lower indicating good fit (Chau, 1997). GFI assesses the relative amount of the variances and co-variances accounted for by the model.

Relative fit indexes compare the test model to other possible models (independence or null) with the same data. Examples of relative fit indexes reported in AMOS 4.0 include NFI, TLI, IFI and BFI or RNI. Adjusted fit indexes combine model fit and parsimony into a single index. Examples of adjusted fit indexes reported in AMOS 4.0 include PGFI, PNFI, and TLI. For additional information and detailed formulation of the indexes see Maruyama (1998).

At the present time, there is no agreement in the literature on a single optimal test or even a set of optimal tests to evaluate models (see Maruyama, 1998). However, many researchers interpret these index scores in the range of 0.80 – 0.89 as representing reasonable fit and 0.90 and higher as good fit (Joreskog and Sorbom, 1989). In this chapter we will provide several fit indexes including χ^2, χ^2/df, RMR, AGI, AGFI, and TLI for each measurement model.

A final statistic, the T coefficient, is reported to validate the existence of a single second-order construct. SEM CFA alone does not explicitly reveal or

provide evidence of a second-order construct (Doll et al., 1995). The T coefficient is calculated by dividing the Chi-square value of the CFA model by the Chi-square of the measurement model yielding a value between 0 and 1. The T coefficient estimates the amount of variance of the first-order factors (ξ_n) that is explained by the single second-order factor (η_n). A T coefficient higher than 0.80 indicates the existence of a single second-order construct since most of the variance shared by the first-order latent variables is explained.

4.4 Confirmation of measurement scales

Although the previously published scales seem appropriate for use in this study (chapter 2 and 3), sound methodological practice requires that the scales be confirmed on our data set as no two response groups are the same. The following section covers confirmation of the newly developed scales as well as those borrowed from prior literature. The scales in order of presentation and testing include industry forces (Dess and Davis, 1984; Miller, 1988), internal resources and capabilities (Spanos and Lioukas, 2001), environmental scanning (Beal, 2000), manufacturing strategy (Youndt, Snell, Dean, and Lepak, 1996), adaptive decision making, and multi-dimensional performance.

4.4.1 Industry Forces scale (external factors construct) CFA

The industry forces construct used in the study consisted of four items that load on one first order latent variable called competitive rivalry and four individually scored items representing barriers to entry, threat of substitute products, bargaining power of suppliers and bargaining power of buyers. The

individually scored items and the first order latent variable competitive rivalry load on the second order latent variable (industry forces). For a detailed review of the scale see chapter two.

The barriers-to-entry item was reverse scaled in the survey to avoid confusing the respondents. The original item efif1 was re-scaled in the data set as efif1a to account for the survey reverse scaling. Table 4.16 presents the items and coding associated with the survey.

Table 4.16: Industry forces items

CODE	ITEM **How would you evaluate the intensity of competition your firm is facing in the following areas with respect to...**
Efcr1	Product characteristics
Efcr2	Promotional strategies among competitors
Efcr3	Access to distribution channels
Efcr4	Service strategies to customers
	Individually scored ITEMs **How would you evaluate the...**
Efif1a	Barriers to entry
Efif2	Threat of substitute products
Efif3	Bargaining power of buyers
Efif4	Bargaining power of suppliers

The initial model resulted in a Chi-square (χ^2) value of 18.258 with 19 degrees of freedom giving a Chi-square per degree of freedom (χ^2/df) ratio of 0.961. The first order standardized regression loadings for the single first order latent variable Competitive Rivalry were 0.72, 0.65, 0.63, and 0.69 respectively. The second order standardized loadings were 0.96 for the Competitive Rivalry variable and -0.05, 0.28, 0.43, and 0.00 for the individually scored items. The T

coefficient comparing the CFA model to the measurement model cannot be calculated for a model with a single first order construct.

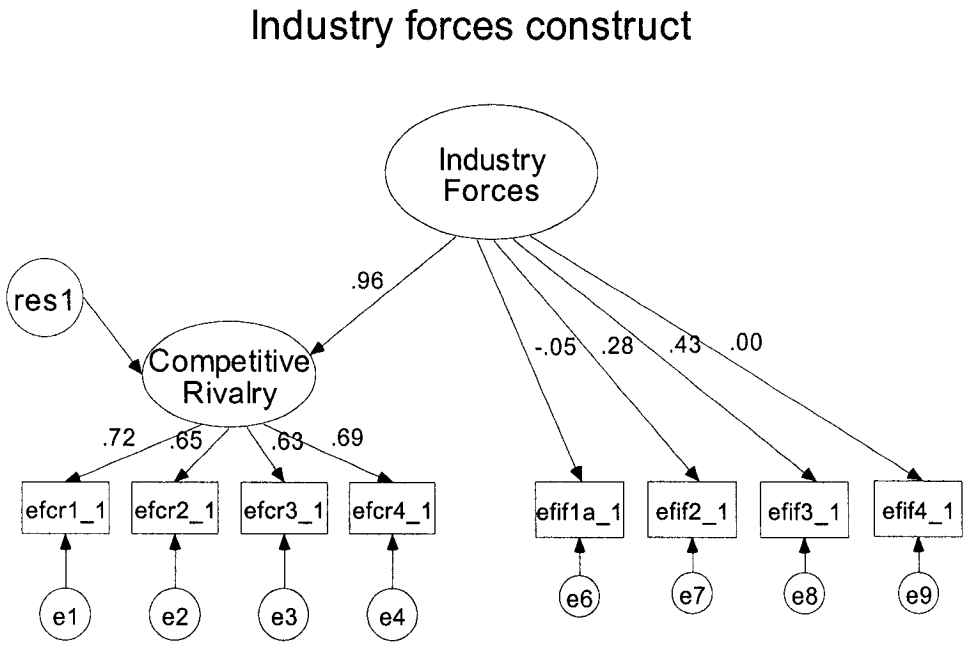
Among the individually scored items, barriers to entry (efif1a) loaded insignificantly at –0.05 (t value = -0.652) as did the bargaining power of suppliers (efif4) item at 0.00 (t value = 0.027). These items loaded as expected given our sample group. As discussed in chapter two barriers to entry are very low in smaller organizations and furthermore, small organizations have virtually no bargaining power with suppliers since their suppliers are typically much larger than they are. Therefore it is not surprising that the model indicates that these two items have virtually no impact on the perceived industry forces among our sample group. Threat of substitute products loaded at 0.28, which is significant at the 0.06 level (t value = 1.878) and bargaining power of buyers loaded at 0.43, which is significant at the 0.05 level (t value = 1.982). Overall model fit indexes are shown in table 4.17 below.

Table 4.17: Model fit indexes for the Industry Forces measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.984	0.970	0.033	1.004
Independence model	0.698	0.612	0.207	0.000

The high GFI, AGFI, and TLI (>0.90) and the low RMR value of 0.033 (<.10) indicate good model fit to the data. The model is presented in figure 4.02 below.

Figure 4.02: Industry forces measurement model (standardized regression weights)



The over all reliability of the first order competitive rivalry variable as assessed by Cronbach's alpha value is .7678 with all items contributing to alpha. The corrected item to total correlation, alpha values, and alpha it item deleted values for competitive rivalry is presented in table 4.18 below. The Pearson correlations among the individually scored items is presented in table 4.19. As suggested by prior research (Beal, 2000) these correlations are very low.

Table 4.18: CITC, reliability and alpha if item deleted values for the competitive rivalry scale

Unobserved Variable	Items	CITC	Reliability	Alpha if item deleted
Competitive rivalry	Efcr1	.5978	α = .7678	.6968
	Efcr2	.5499		.7230
	Efcr3	.5450		.7246
	Efcr4	.5811		.7056

Table 4.19: Pearson correlations among industry factor items

ITEMS	Efif2	Efif3	Efif4	Efif1
Efif2	1.000			
Efif3	0.105	1.000		
Efif4	0.010	-0.029	1.000	
Efif1	-0.129	0.049	0.134	1.000

This scale tested as expected based on prior literature and is deemed confirmed for use with our data set. The Industry Forces second order construct consists of one first order variable with four dimensions and 4 individually scored items.

4.4.2 Internal resources and capabilities (Internal Factors) CFA

The resources and capabilities scale used in the study consists of 3 unobserved latent variables including organizational and managerial capabilities (Ifo1 through Ifo7), technical capabilities (Ift1 through Ift4), and marketing capabilities (Ifm1 through Igm4) for a total of 15 items. For a detailed review of

the scale see chapter two. Table 4.20 presents the items and coding for internal resources and capabilities scale associated with the survey.

Table 4.20: Internal resources and capabilities items

CODE	ITEM **Please indicate for each of the following, your firm's strength relative to your competitors..**
Ifo1	Managerial competencies
Ifo2	Knowledge and skills of employees
Ifo3	Firm climate (quality of work environment)
Ifo4	Efficient organizational structure
Ifo5	Coordination between employees
Ifo6	Strategic planning activities
Ifo7	Ability to attract creative employees
Ifm1	Market knowledge
Ifm2	Control and access to distribution channels
Ifm3	Advantageous relationships with customers
Ifm4	Current customer base
Ift1	Efficient and effective production department
Ift2	Economies of scale
Ift3	Technical experience
Ift4	Technical capabilities and equipment

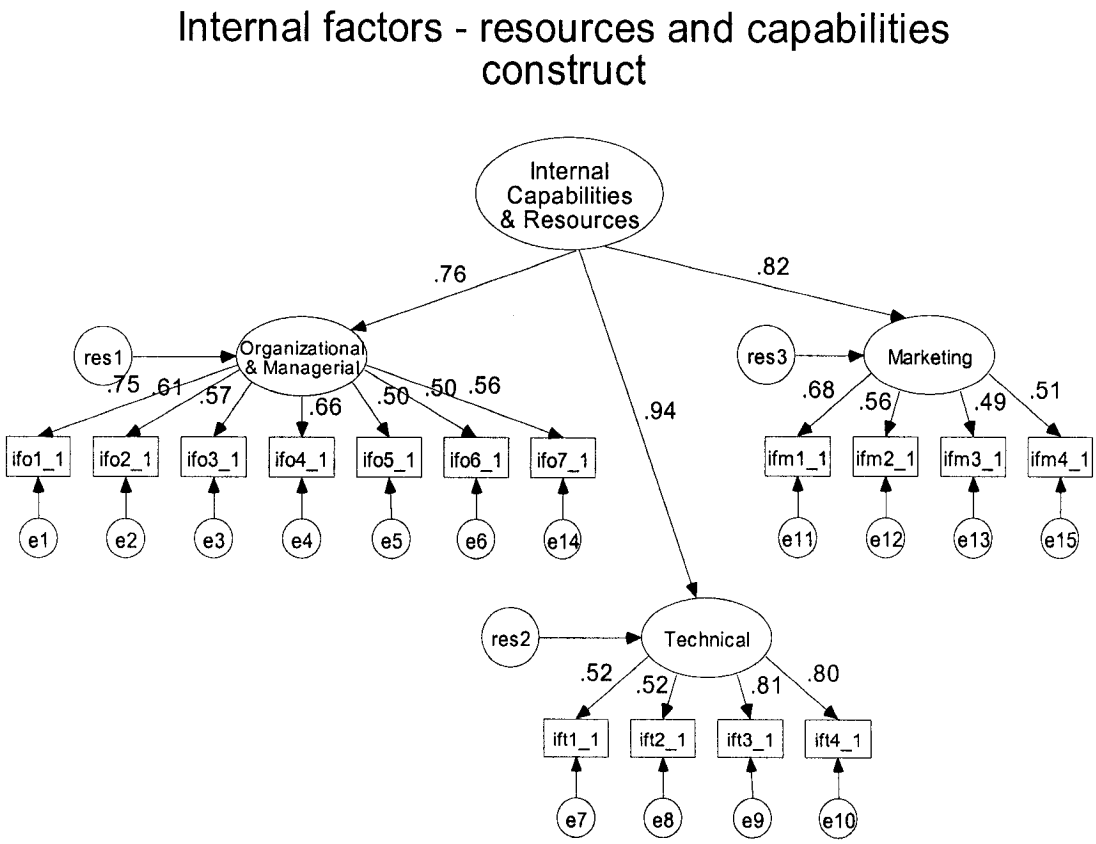
The confirmatory analysis of the scale was accomplished using AMOS 4.0 software (Arbuckle, 1999). The initial model resulted in a χ^2 value of 264.255 with 87 degrees of freedom giving a χ^2/df ratio of 3.037. The second order standardized regression loadings were 0.76 for the organizational and managerial latent variable, 0.94 for the technical capabilities latent variable, and 0.82 for the marketing capabilities latent variable. The T coefficient comparing the CFA model to the measurement model of 1.00 (264.255/264.255) strongly argues for the existence of a single second-order latent variable. Model fit indexes are presented in table 4.21.

Table 4.21: Model fit indexes for the Internal Resources and Capabilities measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.885	0.841	0.044	0.826
Independence model	0.422	0.340	0.193	0.000

The high GFI, AGFI, and TLI (>0.80) indicate reasonable model fit and the low RMR value of 0.041 (<.10) indicates good fit to the data. The model is presented in figure 4.03 below.

Figure 4.03: SEM measurement model for Internal Resources and Capabilities construct (standardized regression weights)



First order loadings for the organization and managerial capabilities latent variable were 0.75 (ifo1), 0.61 (ifo2), 0.57 (ifo3), 0.66 (ifo4), 0.50 (ifo5), 0.50

(ifo6) and 0.56 (ifo7). First order loadings for the technical capabilities latent variable were 0.52 (ift1), 0.52 (ift2), 0.81 (ift3), and 0.80 (ift4). First order loadings for the marketing capabilities latent variable were 0.68 (ifm1), 0.56 (ifm2), 0.49 (ifm3), and 0.51 (ifm4). All first and second order standardized regression loadings were significant at the 0.01 level.

The overall reliability as assessed by Cronbach's alpha values are .8097 for the organizational and managerial capabilities variable, .7906 for the technical capabilities variable, and .6970 for the marketing capabilities variable. The corrected item to total correlation, alpha values, and alpha if item is deleted for each factor are presented in table 6.0 below. As table 4.22 below shows, all items contribute to alpha.

Table 4.22: CITC, reliability and alpha if item deleted values for the internal resources and capabilities scale

Unobserved Variable	Items	CITC	Reliability	If item deleted
Organizational and managerial capabilities	Ifo1	.6078	α = .8097	.7737
	Ifo2	.5436		.7852
	Ifo3	.5709		.7801
	Ifo4	.5534		.7832
	Ifo5	.4957		.7933
	Ifo6	.5219		.7900
	Ifo7	.5314		.7871
Technical capabilities	Ift1	.5302	α = .7906	.7716
	Ift2	.5280		.7743
	Ift3	.6578		.7086
	Ift4	.6875		.6921
Marketing capabilities	Ifm1	.4871	α = .6970	.6296
	Ifm2	.4916		.6283
	Ifm3	.4433		.6556
	Ifm4	..5073		.6162

The final scale consists of three variables with a total of 15 items. The organizational and managerial capabilities variable consists of 7 items, technical capabilities includes 4 items and marketing capabilities 4 items. The Internal Resources and Capabilities tested as expected therefore confirming prior literature.

4.4.3 Environmental scanning activities CFA

The environmental scanning activity scale used in the study consists of 4 unobserved variables including competitors and customers (escc1 through escc7), internal factors and resources (esifr1, esifr2, and esifr3), suppliers, labor and funds (esslf1, esslf2, and esslf3), and external socio-economic (essp1, essp2, and essp3) for a total of 16 items. For a detailed review of the scale see chapter 2. The following table (table 4.23) presents the items and coding for internal resources and capabilities associated with the survey.

Table 4.23: Environmental scanning items

CODE	ITEM Please indicate the degree to which your firm seeks out (by a formal or informal information collection system) the following typed of information about its operating environment...
Escc1	Competitors prices
Escc2	Competitor's introduction of new products
Escc3	Competitor's advertising/promotion programs
Escc4	New product characteristics
Escc5	Customers' buying habits
Escc6	Customers' product preferences
Escc7	Customers' demands and desires
Esifr1	Your company's sales capabilities and resources
Esifr2	Your company's financial capabilities and resources
Esifr3	Your company's management capabilities and resources
Esslf1	Availability of external financing

CODE	ITEM Please indicate the degree to which your firm seeks out (by a formal or informal information collection system) the following typed of information about its operating environment...
Esslf2	Availability of labor
Esslf3	New manufacturing technologies
Essp1	Local/national/global social conditions
Essp2	Local/national/global political conditions
Essp3	Local/national/global economic conditions

The initial confirmatory analysis revealed high error term correlations between items essc5, essc6, and escc7. These three items were customer's buying habits (escc5), customer's product preferences (escc6), and customer's demands and desires (escc7). It is understandable why these items would come out with highly correlated error terms in our sample group. SMEs usually do not produce their own product therefore they would not measure customer demands or desires for products since they typically produce for another company. This explains why an SME would not necessarily be able to differentiate between these three items, which are very distinct in larger organizations. Therefore items escc5 and escc7 were dropped from the analysis and escc6 was retained.

After dropping escc5 and escc7, confirmatory analysis of the environmental scanning scale resulted in a χ^2 value of 255.225 with 73 degrees of freedom giving a χ^2/df ratio of 3.496. The second order standardized regression loadings were 0.48 for the customers and competitors dimension, 0.94 for the internal factors and resources dimension, 0.79 for supply of labor and funds variable, and 0.52 for the social political dimension. The T coefficient comparing the CFA model to the measurement model of 0.98 (250.032/255.225)

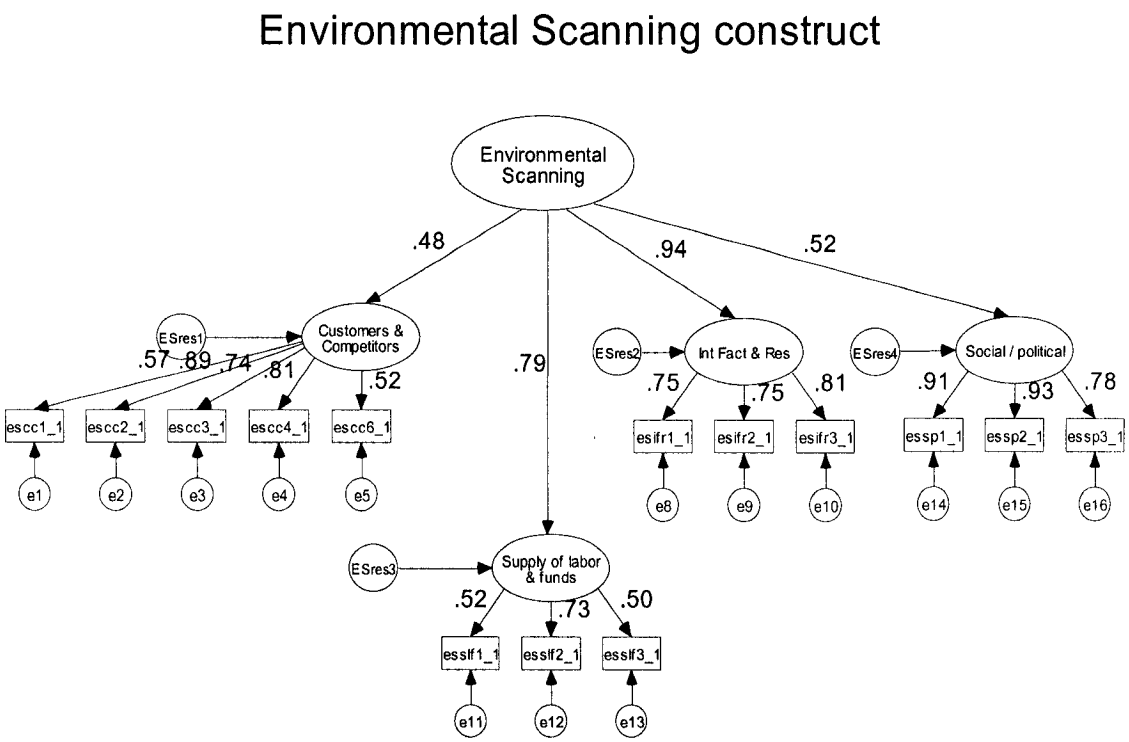
strongly indicates the existence of a single second-order factor. Overall model fit indexes are shown in table 4.24.

Table 4.24: Model fit indexes for the Environmental Scanning measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.879	0.826	0.087	0.876
Independence model	0.384	0.289	0.324	0.000

The high GFI, AGFI, and TLI (>0.80) and the RMR value of 0.087 (<.10) indicate reasonable model fit to the data. The model is presented in figure 4.04 below.

Figure 4.04: SEM Measurement model Environmental Scanning construct (standardized regression weights)



First order loadings for the customers and competitors dimension were 0.57 (escc1), 0.89 (escc2), 0.74 (escc3), 0.81 (escc4), and 0.52 (escc6). First order loadings for the internal factors and resources dimension were 0.75 (esifr1), 0.75 (esifr2), and 0.81 (esifr3). The first order loadings for the supply of labor and funds dimension were 0.52 (esslf1), 0.73 (esslf2), and 0.50 (esslf3). And the first order loadings for the social / political dimension were 0.91 (essp1), 0.93 (essp2), and 0.78 (essp3). All first and second order standardized regression loadings were significant at the 0.01 level. The over all reliability as assessed by Cronbach's alpha values are .8516 for the competitors and customers dimension, .8112 for the internal factors and resources dimension, .6030 for the supply of labor and funds dimension, and .8735 for the social / political dimension. The corrected item to total correlation, alpha values, and alpha if item deleted values for each dimension is presented in table 4.25 below.

Table 4.25: CITC, reliability and alpha if item deleted values for the environmental scanning scale

Unobserved Variable	Items	CITC	Reliability	Alpha if item deleted
Customers and competitors	Escc1	.6123	α = .8516	.8342
	Escc2	.7998		.7819
	Escc3	.6853		.8153
	Escc4	.7181		.8069
	Escc6	.5065		.8579
Internal factors and resources	Esifr1	.6560	α = .8112	.7468
	Esifr2	.6547		.7560
	Esifr3	.6831		.7229
Supply of labor and funds	Esslf1	.4141	α = .6030	.5152
	Esslf2	.5171		.3750
	Esslf3	.3315		.6118
Social / Political	Essp1	.7687	α = .8735	.8109
	Essp2	.8232		.7603
	Essp3	.6837		.8851

As is indicated by the table there are three instances were an item, if deleted, would increase the scale alpha values. This is true with items escc6, esslf3, and essp3. These items were not deleted since we are merely confirming the scale for use on our dataset. Minor changes in alpha values can be expected when applying a scale to different datasets.

The final scale consists of four unobserved variables and 14 items. The observed items for customers and competitors has 5 items, internal factors and resources has 3 items, supply of labor and funds has 3 items and the social-political dimension has 3 items. Overall the scale produced with our data set is consistent with that published in prior literature and is confirmed for structural model testing.

4.4.4 Manufacturing strategy CFA

The manufacturing strategy scale used in the study consists of 4 unobserved variables including the manufacturing strategic imperative dimensions of flexibility (msflex1 through msflex4), quality (msqlty1 through msqlty5), delivery (msdel1 and msdel2), and cost (mscost1 through mscost4) for a total of 15 items. For a detailed review of the scale see chapter two. Table 4.26 presents the items and coding for manufacturing strategy associated with the survey.

Table 4.26: Manufacturing strategy items

Code	ITEM Indicate the degree of emphasis which your manufacturing plant places on the following activities..
Msflex1	Lead-time reduction
Msflex2	Set-up time reduction
Msflex3	Ability to change priorities of jobs on the shop floor
Msflex4	Ability to change machine assignments on the shop floor
Msqlty1	Statistical process control
Msqlty2	Real-time process control
Msqlty3	Updating process equipment
Msqlty4	Developing new processes for new production programs
Msqlty5	Developing new processes for old production programs
Msdel1	Provide fast deliveries
Msdel2	Meet delivery promises
Mscost1	Reduce inventory
Mscost2	Increase capacity utilization
Mscost3	Increase equipment utilization
Mscost4	Reduce production costs

The initial confirmatory analysis resulted in high error correlations among two of the items for quality (msqlty1 and msqlty2) and flexibility (msflex3 and msflex4). Upon closer examination of the survey questions it is probable that the respondents in our sample group did not distinguish between the questions, resulting in the highly correlated error terms. The two quality items required the respondent to make a distinction between statistical process control (msqlty1) and real-time process control systems (msqlty2). It is reasonable to assume that SMEs may not make as clear a distinction between these items as would a larger organization. It is our belief that statistical process control is more likely adopted and understood by SME manufacturing companies therefore msqlty2 was dropped from the analysis.

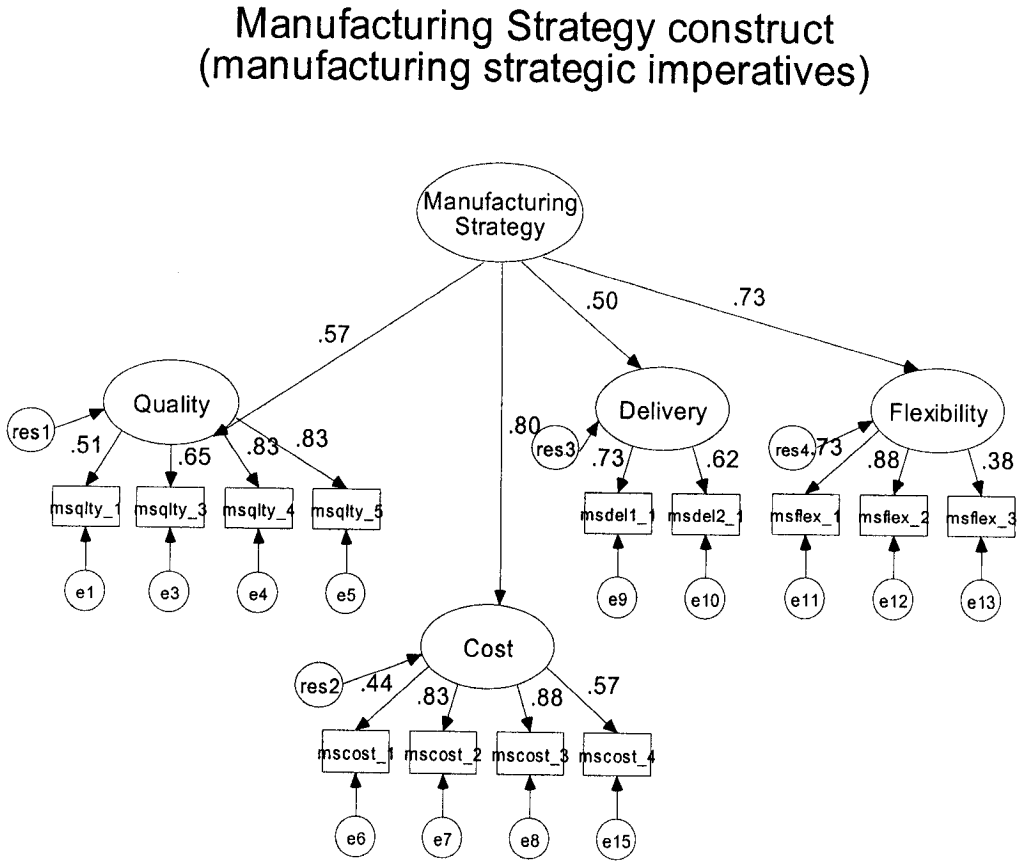
In the case of the flexibility dimension items msflex3 and msflex4 the respondent had to distinguish between the "ability to change priorities of jobs on the shop floor" and "ability to change machine assignments of jobs on the shop floor". Once again, SME manufacturing companies may have a more difficult time making a clear distinction among these two items compared to larger organizations since both of these items involve flexibility in scheduling jobs on the shop floor. It is our belief that SME manufacturing companies are more likely to have to change priorities of jobs whether or not the change involves a change in machine assignments. Therefore msflex4 was dropped from the analysis.

After dropping items msqlty2 and msflex4 confirmatory analysis of the manufacturing strategy scale resulted in a χ^2 value of 196.904 with 61 degrees of freedom giving a χ^2/df ratio of 3.228. The second order standardized regression loadings were 0.57 for the quality dimension, 0.80 for the cost dimension, 0.50 for the delivery dimension, and 0.73 for the flexibility dimension. The T coefficient comparing the CFA model to the measurement model of 0.96 (189.726/196.904) strongly indicates the existence of a single second-order factor.

First order loadings for the quality dimension was 0.51 (msqlty1), 0.65 (msqlty3), 0.83 (msqlty4), and 0.83 (msqlty5) For the cost dimension the first order loadings were 0.44 (mscost1), 0.83 (mscost2), 0.88 (mscost 3), and 0.57 (mscost4). The first order loadings for the delivery dimension were 0.73 (msdel1) and 0.62 (msdel2). For the flexibility dimension the loadings were 0.73 (msflex1), 0.88 (msflex2), and 0.38 (msflex3). All first and second order standardized

regression loadings were significant at the 0.01 level. The model is presented in figure 4.05 below.

Figure 4.05: SEM measurement model of the Manufacturing Strategy scale (standardized regression weights)



Overall model fit indexes are shown in table 4.27 below.

Table 4.27: Model fit indexes for the Manufacturing Strategy measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.899	0.849	0.064	0.859
Independence model	0.451	0.360	0.245	0.000

The high GFI, AGFI, and TLI (>0.80) and the RMR value of 0.064 (<.10) indicate reasonable model fit to the data. The over all reliability as assessed by Cronbach's alpha values are .8203 for the quality dimension, .7436 for the cost dimension, .7757 for the delivery dimension, and .7457 for the flexibility dimension. The corrected item total to correlation, alpha values, and alpha if item deleted values are presented in table 4.28 below. Once again there are a few instances in which dropping an item would increase the alpha value (items msqlty1 and mscost1) however, since we are merely confirming these scales for use on our data we will not delete these items.

Table 4.28: CITC, reliability and alpha if item deleted values for the manufacturing strategy scale

Unobserved Variable	Items	CITC	Reliability	Alpha if item deleted
Quality	Msqlty1	.5163	α = .8203	.8451
	Msqlty3	.6665		.7639
	Msqlty4	.7443		.7295
	Msqlty5	.6811		.7576
Cost	Mscost1	.3312	α = .7436	.8052
	Mscost2	.6049		.6444
	Mscost3	.7090		.5847
	Mscost4	.5522		.6810
Delivery	Msdel1	.6366	α = .7757	N/a
	Msdel2	.6366		N/a
Flexibility	Msflex1	.5783	α = .7457	.6544
	Msflex2	.6322		.5880
	Msflex3	.5169		.7240

The Manufacturing Strategy scale consisting of four dimensions and a total of 13 items is confirmed for use in testing of our structural model.

4.4.5 Adaptive decision making CFA

Exploratory factor analysis of the adaptive decision making scale (section 4.2) resulted in the elimination of items adpt9 and adpt10. The remaining 8 items loaded on 3 variables we named financial constraints (adpt6, adpt7, adpt8), customer needs and preferences (adpt4, adpt4), and market / pricing adaptation (adpt1, adpt2, and adpt5). The remaining items are detailed in table 4.29 below.

Table 4.29: Items and coding for adaptive decision making construct

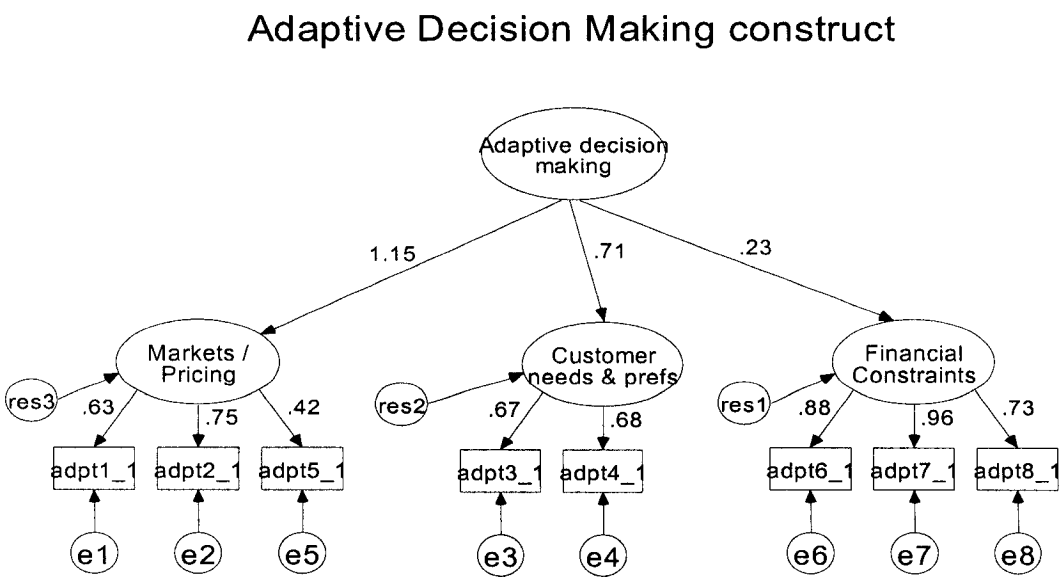
CODE	ITEM **Indicate the degree of emphasis which your manufacturing plant places on the following activities/priorities…**
ADPT1	Adapt to competitor pricing
ADPT2	Adapt to market forces in industry
ADPT3	Adapt our resources to customer needs and preferences
ADPT4	Adapt our capabilities to the current business environment
ADPT5	Adapt our product pricing to our suppliers pricing
ADPT6	Adapt to restraints of our cash flow
ADPT7	Adapt to restraints of capital availability
ADPT8	Adapt to debt holder's (i.e. bank's) requirements

Confirmatory analysis of the adaptive decision making scale resulted in a χ^2 value of 58.212 with 17 degrees of freedom giving a χ^2/df ratio of 3.424. The second order standardized regression loadings were 0.23 for the financial constraints dimension, 0.71 for the customer needs and preferences dimension, and 1.15 for the marketing / pricing adaptation dimension. The T coefficient comparing the CFA model to the measurement model of 1.00 (58.212/58.212) strongly indicates the existence of a single second-order factor.

The first order standardized regression weights for the financial constraints dimension were 0.88 (adpt6), 0.96 (adpt7), and 0.73 (adpt8). The first

order regression weights for the customer needs and preferences dimension were 0.67 (adpt3) and 0.68 (adpt4). And the markets / pricing adaptation dimension had first order standardized regression weights of 0.63 (adpt1), 0.75 (adpt2), and 0.42 (adpt5). All first order standardized regression loadings were significant at the 0.01 level. The model is presented in figure 4.06 below.

Figure 4.06: SEM measurement model of Adaptive Decision Making construct (standardized regression weights)



Overall model fit indexes are shown in table 4.30. The high GFI and TLI (>0.90) and the low RMR value of 0.060 (<.10) indicate good model fit to the data.

Table 4.30: Model fit indexes for the Adaptive Decision Making measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.950	0.894	0.060	0.918
Independence model	0.549	0.420	0.278	0.000

The over all reliability as assessed by Cronbach's alpha values are .8867 for the financial adaptation dimension, .6259 for the customer adaptation dimension, and .6181 for the market / pricing adaptation dimension. The corrected item to total correlations, alpha values, and alpha if item deleted values are presented in table 4.31 below. Once again there are a few situations in which deleting an item would result in increasing the overall reliability (adpt8 and adpt5). These items were not deleted since they are considered important to the overall research effort and because the change in alpha is relatively insignificant.

Table 4.31: CITC, reliability and alpha if item deleted values for the adaptive decision making scale

Unobserved Variable	Items	CITC	Reliability	Alpha if item deleted
Financial adaptation	Adpt6	.7978	α = .8867	.8232
	Adpt7	.8530		.7774
	Adpt8	.6979		.9167
Customer adaptation	Adpt3	.4567	α = .6259	N/a
	Adpt4	.4567		N/a
Market / pricing adaptation	Adpt1	.5241	α = .6181	.3634
	Adpt2	.4340		.5270
	Adpt5	.3499		.6335

The Adaptive Decision Making scale consisting of 8 items loading on three dimensions is confirmed for use in the structural model.

4.4.6 Performance CFA

Exploratory factor analysis of this scale (section 4.2) resulted in dropping one item (p2op1) from further analysis. The remaining 10 items represent three variables named financial performance, operational performance, and constituency performance. The remaining 10 items are detailed in table 4.32 below.

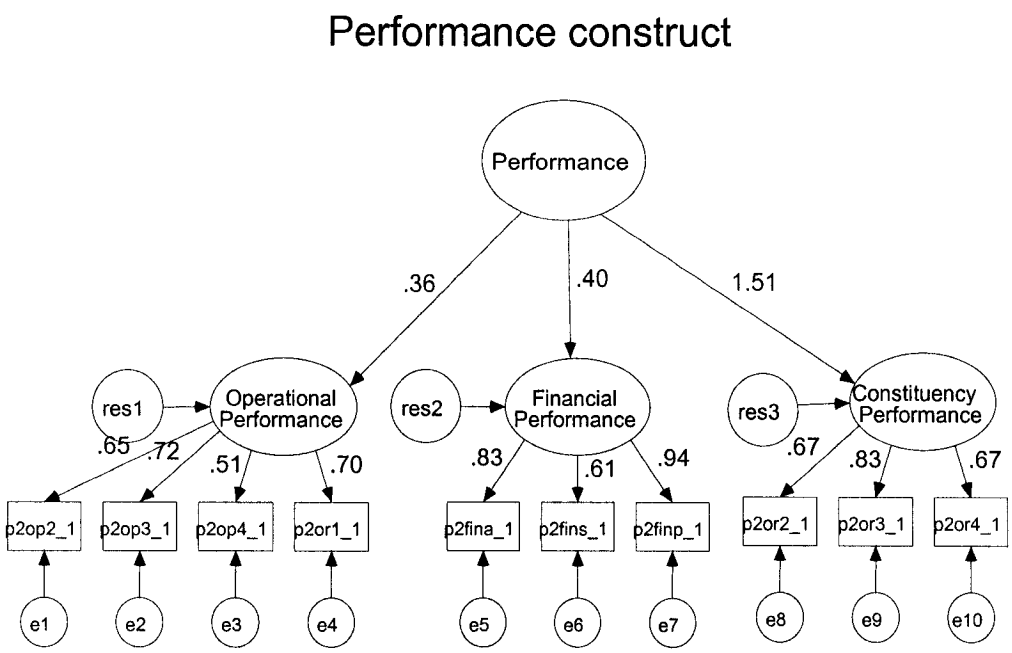
Table 4.32: Items and coding for performance construct

CODE	ITEM **For each of the following measures please indicate how you believe your firm performs in comparison to your competitors.**
P2fina	Average return on assets over the last three years
P2fins	Average percent change in sales over the last three years
P2finp	Average before tax profit over the last three years
P2op2	Quality of product (meets customer specification)
P2op3	On-time delivery performance
P2op4	Your ability to quickly change production volumes
P2or1	Customer satisfaction
P2or2	Employee satisfaction
P2or3	Ownership satisfaction
P2or4	Your bank or financial institution satisfaction

Confirmatory analysis of the performance scale resulted in a χ^2 value of 100.264 with 32 degrees of freedom giving a χ^2/df ratio of 3.133. The second order standardized regression weights of 0.40 for the financial performance dimension, 0.36 for the operational performance dimension, and 1.51 for the constituency performance dimension. The T coefficient comparing the CFA model to the measurement model of 1.00 (100.264/100.264) strongly indicates

the existence of a single second-order factor. The model is presented in figure 4.07 below.

Figure 4.07: Measurement model of performance construct (standardized regression weights)



The first order standardized regression weights for the financial performance dimension were 0.83 (p2fina), 0.61 (p2fins), and 0.94 (p2finp). For the operational performance dimension the first order loadings were 0.70 (p2or1), 0.65 (p2op2), 0.72 (p2op3), and 0.51 (p2op4). Lastly, the constituency performance dimension had first order standardized regression weights of 0.67 (p2or2), 0.83 (p2or3), and 0.67 (p2or4). All first and second order loadings were significant at the .01 level of significance. Overall model fit indexes for the

confirmatory analysis are shown in table 4.33 below. The high GFI, AGFI, and TLI (>0.90) and the low RMR value of 0.039 (<.10) indicate good model fit to the data.

Table 4.33: Model fit indexes for the Performance measurement model

Model	GFI	AGFI	RMR	TLI
Default model	0.937	0.892	0.039	0.905
Independence model	0.486	0.371	0.235	0.000

The over all reliability as assessed by Cronbach's alpha values are .7319 for the operational performance dimension, .8329 for the financial performance dimension, and .7544 for the constituency performance dimension. The corrected item to total correlations, alpha values, and alpha if item deleted values are presented in table 4.34 below.

Table 4.34: CITC, reliability and alpha if item deleted values for the performance scale

Unobserved Variable	Items	CITC	Reliability	Alpha if item deleted
Operational performance	P2op2	.5123	α = .7319	.6776
	P2op3	.6186		.6108
	P2op4	.4183		.7333
	P2or1	.5649		.6566
Financial performance	P2fina	.7344	α = .8329	.7268
	P2fins	.5746		.8774
	P2finp	.7808		.6771
Constituency performance	P2or2	.5766	α = .7544	.6956
	P2or3	.6737		.5650
	P2or4	.5345		.7261

Once again in the case of item p2op4 and p2fins the reliability would increase if the items were deleted. These items were not deleted since they are important to the research effort and the change in reliability in insignificant. The Performance construct is confirmed for use in the structural model.

In summary, all six scales including a total of 68 items covering 22 variables and 6 constructs are confirmed for use in structural model testing. A listing of all constructs, variables, and items is in table 4.35.

Table 4.35: Confirmed scales for use in structural model testing

Construct	Variable	Items
Industry Forces	Competitive rivalry	efcr1, efcr2, efcr3, efcr4
	Barriers to entry	efif1a
	Threat of substitute products	efif2
	Bargaining power of buyers	efif3
	Bargaining power of suppliers	efif4
Internal Resources and Capabilities	Organizational and managerial competencies and capabilities	ifo1, ifo2, ifo3, ifo4, ifo5, ifo6, ifo7
	Technical capabilities and competencies	ift1, ift2, ift3, ift4
	Marketing capabilities and competencies	ifm1, ifm2, ifm3, ifm4
Environmental Scanning	Customers and competitors	escc1, escc2, escc3, escc4, escc6
	Internal factors and resources	esifr1, esifr2, esifr3
	Supplies of labor and funds	esslf1, esslf2, esslf3
	Social and political environment	essp1, essp2, essp3
Manufacturing Strategy	Quality	msqlty1, msqlty3, msqlty4, msqlty5
	Cost	mscost1, mscost2, mscost3, mscost4
	Delivery	msdel1, msdel2
	Flexibility	msflex1, msflex2, msflex3
Adaptive Decision Making	Financial constraints	adpt6, adpt7, adpt8
	Customer needs and preferences	adpt3, adpt4
	Market / pricing adaptation	adpt1, adpt2, adpt5
Performance	Financial performance	P2fina, p2fins, p2finp
	Operational performance	P2or1, p2op2, p2op3, p2op4
	Constituency performance	P2or2, p2or3, p2or4

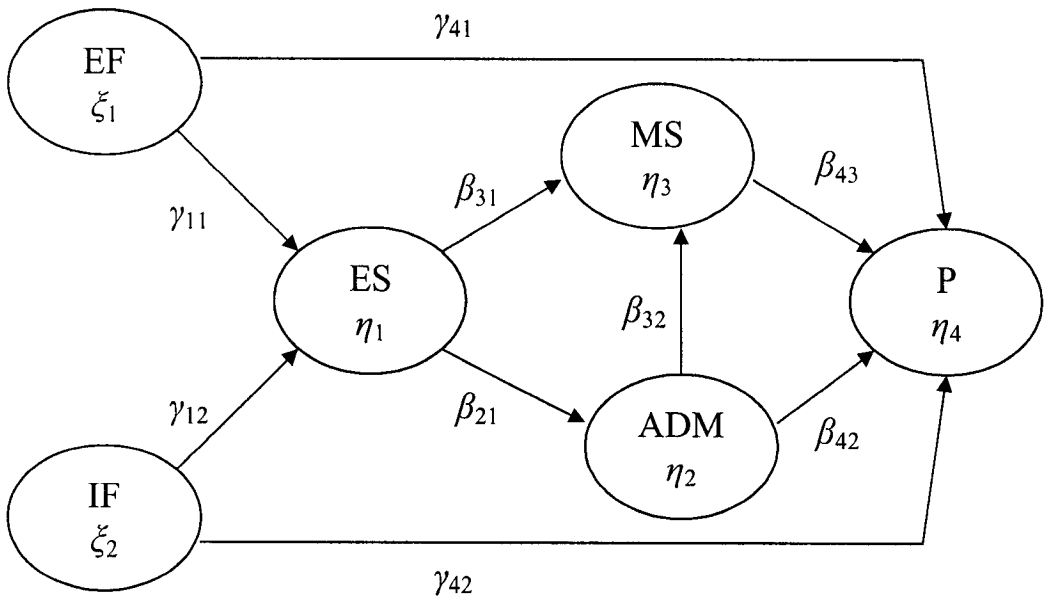
Chapter 5

Structural model testing and discussion

5.1 Structural Model testing

Hypotheses testing of the research framework presented in chapter two (figure 2.01) was conducted using structural equation modeling (SEM). The mathematical presentation of the structural model is presented in figure 5.01.

Figure 5.01: Mathematical presentation of the hypothesized structural model



Where: EF: External Factors (industry forces construct)
IF: Internal Factors (internal capabilities and resources construct)
ES: Environmental Scanning construct
ADM: Adaptive Decision Making construct
MS: Manufacturing Strategy construct
P: Performance construct

There are six variables in the research framework. The exogenous variables include: Industry Forces (EF-external factors) – ξ_1, and Internal Resources and Capabilities (IF-internal factors) – ξ_2, The endogenous variables include: Environmental scanning (ES) - η_1, Adaptive Decision Making (ADM) – η_2, Manufacturing Strategy (MS) - η_3, and Performance (P) – η_4. Given the structural model form

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

η is a (4 x 1) vector of latent endogenous variables, β is a (4 x 4) matrix of coefficients relating the four endogenous variables to one another, Γ is a (4 x 2) vector of coefficients relating two exogenous variables to four endogenous variables, ξ is a (2 x 1) vector of exogenous variables, and ζ is a (4 x 1) vector of residuals in the structural equations (see chapter four for a detailed explanation of the formula).

The nine hypotheses presented in chapter two represent the causal relationships in the structural model. Hypothesis 1 is represented in figure 6.01 by the relationship γ_{11} (EF→ES), Hypothesis 1a is represented by the relationship γ_{41} (EF→P), hypothesis 2 is represented by the relationship γ_{12} (IF→ES), and hypothesis 2a is represented by the relationship γ_{42} (IF→P). The endogenous hypotheses include hypothesis 3 represented by the relationship β_{31} (ES→MS), hypothesis 4 is represented by β_{21} (ES→ADM), hypothesis 5 is represented by

β_{32} (ADM→MS), hypothesis six is represented by the relationship β_{43} (MS→P), and hypothesis seven is represented by the relationship β_{42} (ADM→P). These causal paths of our hypothesized relationships are represented by the following structural equations

Hypothesis 1 and 2 are estimated by $\eta_1 = \gamma_{11}\xi_1 + \gamma_{12}\xi_2 + \zeta_1$

Hypothesis 4 is estimated by $\eta_2 = \beta_{21}\eta_1 + \zeta_2$

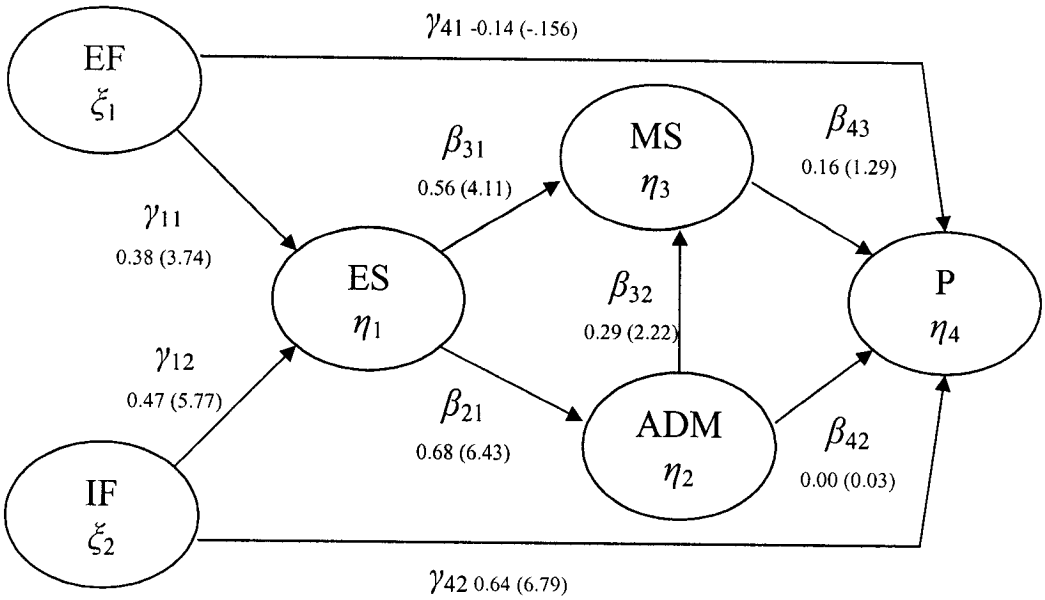
Hypothesis 5 and 6 are estimated by $\eta_3 = \beta_{31}\eta_1 + \beta_{32}\eta_2 + \zeta_3$

Hypothesis 1a, 2a, 6, and 7 are estimated by $\eta_4 = \beta_{43}\eta_3 + \beta_{42}\eta_2 + \gamma_{41}\xi_1 + \gamma_{42}\xi_2 + \zeta_3$

Model fit will be assessed using the same indexes as reported in chapter 4 for the measurement models. If the model fit indexes indicate reasonable fit to the data, the magnitude of the standardized regression weights, the gamma (γ) and beta (β) coefficients and the significance of the t-values of the coefficients will be used to test the hypotheses. Using a one-tailed test, t-values greater than 2.33 are significant at the 0.01 level, t-values greater than 1.65 are significant at the 0.05 level, and t-values greater than 1.28 are significant at the 0.10 level.

Results of hypotheses testing of the research framework using SEM is presented in figure 5.02. As shown in the figure, several of the relationships were as hypothesized (H1, H2, H2a, H3, H4, H5), while others were only partially supported (H1a), or not supported (H6, H7) by our data. The t-values and standardized regression weights for the various hypotheses are shown in the table.

Figure 5.02: Structural model presentation



Where: EF: External Factors (industry forces construct)
IF: Internal Factors (internal resources and capabilities connstruct)
ES: Environmental Scanning construct
ADM: Adaptive Decision Making construct
MS: Manufacturing Strategy construct
P: Performance construct

The model had a χ^2 value of 418.60 with 200 degrees of freedom giving a $\chi 2/df$ of 2.093 indicating that the unexplained variance is not appreciable. Model fit indexes for the structural model are shown in table 5.01 below. The GFI, AGFI, and TLI indexes are in the range 0.80 - 0.90 indicating reasonable model fit and the RMR value of 0.041 indicates good fit of the model to the data.

Table 5.01: Model fit indexes for the structural model

Model	GFI	AGFI	RMR	TLI
Default model	0.878	0.846	0.041	0.823
Independence model	0.501	0.454	0.109	0.000

To further insure discriminant validity in the structural model each pair of constructs was tested using constrained and unconstrained models. The models of construct pairs are constrained by adding one degree of freedom. Comparison of the chi-square values of the constrained and unconstrained models with one degree of freedom difference allows us to test for discriminant validity. If the differences (change) in the chi-square values of the constrained and unconstrained models are significant (*p*-value less than 0.01), discriminant validity is justified. Table 5.02 shows the values for all construct pairs in the structural model.

Table 5.02: Discriminant validity test of latent constructs

Construct pair	Constrained	Unconstrained	Difference	*p*-value
External Factors and Environmental Scanning	59.08	48.05	11.03	.000
Internal Factors and Environmental Scanning	52.94	15.64	37.30	.000
Environmental Scanning and Adaptive Decision Making	78.09	59.06	19.03	.000
Environmental Scanning and Manufacturing Strategy	55.79	46.20	9.59	.002
Adaptive Decision Making and Manufacturing Strategy	73.28	70.11	**3.17**	**.080**
Manufacturing Strategy and Performance	81.85	64.12	14.73	.000
Adaptive Decision Making and Performance	48.79	31.82	16.97	.000

As is indicated in the table, the relationship between Adaptive Decision Making and Manufacturing Strategy failed to show discriminant validity in this

test. These results indicate that there is not sufficient discriminant validity in the structural model between Adaptive Decision Making (ADM) and Manufacturing Strategy (MS). All other construct pairs had significant *p*-values.

5.2 Results of hypotheses testing:

The following paragraphs summarize the hypotheses included in our model. Of the nine hypotheses six were supported, one was partially supported, and two were not supported by the data. Table 5.03 summarizes the gamma (γ) and beta (β) coefficients and t-values.

Table 5.03: Hypothesized relationships and their respective standardized regression weights and t values

Hypotheses	Relationship	t-value	Standardized Direct effects
H1	Industry forces → Environmental scanning	3.74	0.376
H1a	Industry forces → Performance	-.156	-0.140
H2	Internal cap. & res. → Environmental scanning	5.77	0.470
H2a	Internal cap. & res. → performance	6.79	0.643
H3	Environmental scanning → Manufacturing strategy	4.11	0.559
H4	Environmental scanning → Adaptive decision making	6.43	0.677
H5	Adaptive decision making → Manufacturing strategy	2.22	0.288
H6	Manufacturing strategy → Performance	1.29	0.162
H7	Adaptive decision making → Performance	0.03	0.004

Hypothesis 1:

H1: As the intensity of industry forces (external factors) increases, the level of environmental scanning activities will increase.

As hypothesized by our model the relationship between Industry Forces and Environmental Scanning was positive (0.376) and significant (t-value of

3.74). Therefore hypothesis one is supported. This confirms our interpretation of prior literature and theory development of hypothesis 1 (Chapter 2). This also supports our understanding of the definition of environmental scanning put forth by Aguilar (1967) which referred to "scanning for information about the events and relationships in a company's outside environment". Based on this statement, we argued that external factors were part of a set of business environmental conditions (contextual factors) that existed whether or not a company engaged in scanning. We further argued that these contextual factors (external and internal) were antecedents to environmental scanning activities. In our model, external factors, operationalized using Porters (1991) industry forces model, has been shown to be an antecedent of the environmental scanning construct put forth by Beal (2000). In the context of a smaller organization the implication is that as the intensity of industry forces increases the scanning of information about them increases. The model also confirms the independent association between industry forces and strategic business activities in which managers may, or may not, engage in based on choice. In other words, industry forces exist, independent of whether, or how, the information about them are accessed or utilized for strategy making by managers.

Hypothesis 1a:

H1a: As the intensity of industry forces (external factors) increases, the level of organizational performance will decrease.

In the case of the relationship between Industry Forces and Performance (H1a), the relationship was negative as hypothesized yet insignificant with a direct effect of –0.140 and t-value of –0.156. Therefore we find only partial support for hypothesis 1a in that the direction of the relationship is as predicted but insignificant. Partial support for this hypothesis confirms the nature of the relationship between industry forces and performance as negative. As the intensity of industry forces increased we expected a negative impact on performance. However, since the relationship is insignificant, we do not find conclusive support for this hypothesis.

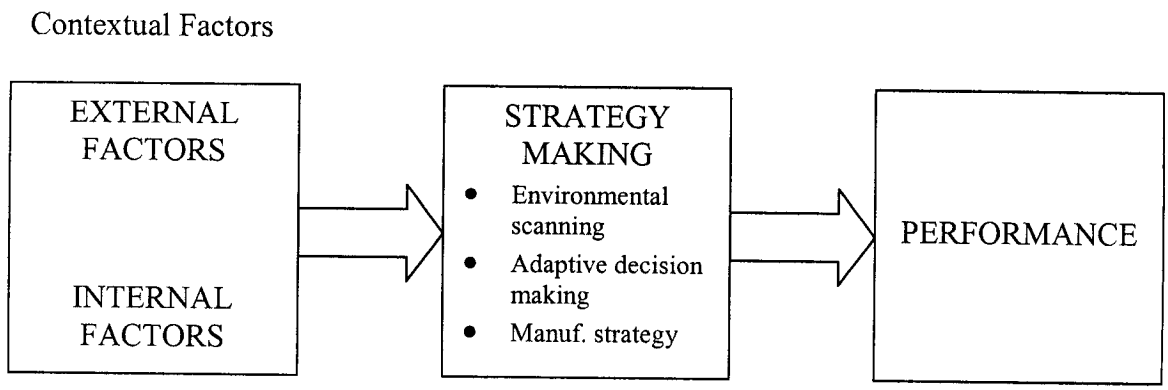
Hypothesis 2:

H2: As the level of company resources and capabilities (internal factors) increases, the level of environmental scanning activities will increase.

Our second hypothesis of a positive relationship between Internal Resources and Capabilities and Environmental Scanning (H2) was as hypothesized with a positive direct effect of 0.470 (t-value = 5.77). Therefore hypothesis two is supported by the analysis. This confirms our theory development (chapter two), which argued that as resources and capabilities are perceived as valuable to an organization, that information gathering about the status of these resources would increase. Support for this hypothesis also is confirmation of the antecedent relationship between our contextual factors (internal and external) and environmental scanning activities. Even though internal capabilities and resources are the result of past managerial decisions,

this relationship shows that once a capability or resource is developed it becomes part of the strategic contextual factors which exist independent of future managerial actions or strategic information gathering through environmental scanning. In other words, the resources and capabilities that exist within a company, may, or may not be utilized strategically, and in this sense they are independent of the scanning activity. Support for this hypothesis and hypothesis 1 indicates that the overall conception of our model (figure 5.03) was supported which positioned internal and external factors (contextual factors) as the basis for strategy making and the resulting level of performance.

Figure 5.03: Hypothesized relationship of contextual factors to strategy making constructs.



Support for hypothesis 1 and 2 supports recent literature on the complimentary nature of the resource-based (Wernerfelt, 1984; Teece, 1982) and competitive strategy (1991) views and their impact on firm performance (Conner, 1991; Mahoney and Pandian, 1992; Mauri and Michaels, 1998). The fact that both are antecedents of environmental scanning activity is consistent with work by Wernerfelt (1984) in which the two views are seen as "different

sides of the same coin". It also supports work by Amit and Schoemaker (1993) which argued that while industry forces was critical in assessing external forces and barriers, that it was insufficient in that it treated the firm as a black box and therefore ignored the role of managerial action. According to Amit and Schoemaker (1993) both are essential to firms that want to maximize performance.

Hypothesis 2a:

H2a: As the level of company resources and capabilities (internal factors) increases, the level of organizational performance will increase.

The relationship between Internal Resources and Capabilities (internal factors) and Performance was also significant with a t-value of 6.79 and a direct effect of 0.643. We find strong support for hypothesis 2a. This confirms prior work on the dimensions of the Internal Resources and Capabilities scale (Teece et al., 1997; Lado et al., 1992; Leonard-Barton, 1995; Spanos and Lioukas, 2001). It also supports the performance impacts of past resource decisions put forth by Rumelt (1984) and Rugman and Verbeke, 2002). In our model, the direct effect of Internal Resources and Capabilities on Performance was confirmed.

Hypothesis 3:

H3: As the level of environmental scanning activities increase, the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) will increase.

Our third hypothesis of the relationship between Environmental Scanning and Manufacturing Strategy was also highly significant with a t-value of 4.11 and a direct effect of 0.559. Therefore hypothesis three is supported. This supports prior literature and our contention that as a firm becomes aware of deficiencies through environmental scanning that an attempt will be made to correct for them by adjusting the level of emphasis the firm places on strategic imperatives. Increased levels of scanning result in increasing emphasis on the manufacturing strategic imperatives in our model.

Hypothesis 4:

H4: As the level of environmental scanning activities increases, the level of emphasis placed on adaptation in decision making (ADM) will increase.

The relationship between Environmental Scanning and Adaptive Decision Making was positive and significant with a t-value of 6.43 and a direct effect of 0.677. Therefore we find strong support for hypothesis four. Support for this hypothesis indicates that the role of Adaptive Decision Making is independent of environmental scanning. It supports our argument that while environmental scanning is an information portal into the organization, Adaptive Decision Making is the selective and adaptive use of strategic information. This linkage supports the causal relationship between information sources and uses proposed by Hambrick (1981) is defining environmental scanning as "the first step in a chain of perceptions and actions leading to the organization's adaptation to its environment" and Bourgeois (1995) statement that "environmental scanning is

the first step in the development of strategy and it provides the information needed for decision making".

Hypothesis 5:

H5: As the level of emphasis placed on adaptation in decision making (ADM) increases, the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) will increase.

Our fifth hypothesis of the positive relationship between Adaptive Decision Making and Manufacturing Strategy was also confirmed with a t-value of 2.22 (p=.027) and a direct effect of 0.288. Therefore hypothesis five is supported. Support for this hypothesis is consistent with the definition of manufacturing strategy put forth by Slack et al. (1998) in which manufacturing strategy was clearly connected to decision making processes by defining it as "the total pattern of decisions and action". Also it is consistent with Mintzberg's (1994) contention that strategy in small firms is a consequence of "an adaptive visionary approach resulting in an informal or realized strategy". In our model Adaptive Decision Making was proposed to mediate between Environmental Scanning and Manufacturing Strategy.

Hypothesis 6:

H6: As the level of emphasis on manufacturing strategic imperatives (manufacturing strategy) increase, the level of organizational performance will increase.

The sixth hypothesis of the relationship between Manufacturing Strategy and Performance did not come out as hypothesized. While the direction of the relationship was positive it was insignificant with a t-value of 1.29 and a direct effect of 0.162. Therefore hypothesis six is not supported. Lack of support for this hypothesis is contrary to the majority of the literature on manufacturing strategy. Without exception almost all prior literature (Skinner, 1969; Anderson et al., 1989; Leong et al., 1990; Ward and Duray, 2000; Hayes and Upton, 1998) supports the positive relationship between manufacturing strategy and performance. Further discussion of the possible causes for this inconsistency are discussed in the next chapter.

Hypothesis 7:

H7: As the level of emphasis placed on adaptation in decision making (ADM) increases, the level of organizational performance will increase.

The relationship between Adaptive Decision Making and Performance was also not supported by the model. The results of analysis indicate a t-value of 0.03 and a direct effect of Adaptive Decision Making on Performance of 0.004. Our contention that increased levels of adaptability through decision making would increase organizational effectiveness and thereby increase organizational performance was not supported. The lack of support for this hypothesis is also discussed in the next chapter.

In summary, table 5.04 shows the direct and in-direct effects in the structural model. Direct effects are represented by the gamma and beta

coefficients in the model which connect one latent variable to another latent variable. Indirect effects measure the effect on a given latent variable from all latent variables in a path. In SEM analysis of the in-direct effects can provide valuable information of the relationships represented by the model. As is

Table 5.04: Total effects table (standardized regression weights)

Hypotheses	Relationship	t-value	Direct effect	In-direct effect	Total effect
H1	Industry forces → Environmental scanning	3.74	0.376		0.376
H1a	Industry forces → Performance	-.156	-0.140	0.048	-0.092
	Industry forces → Adaptive decision making			0.255	0.255
	Industry forces → Manufacturing strategy			0.284	0.284
H2	Internal cap. & res. → Environmental scanning	5.77	0.470		0.470
H2a	Internal cap. & res. → Performance	6.79	0.643	0.059	0.702
	Internal cap. & res. → Adaptive decision making			0.318	0.318
	Internal cap. & res. → Manufacturing strategy			0.354	0.354
H3	Environmental scanning → Manufacturing strategy	4.11	0.559	0.195	0.754
H4	Environmental scanning → Adaptive decision making	6.43	0.677		0.677
	Environmental scanning → Performance			0.125	0.125
H5	Adaptive decision making → Manufacturing strategy	2.22	0.288		0.288
H6	Manufacturing strategy → Performance	1.29	0.162		0.162
H7	Adaptive decision making → Performance	0.03	0.004	0.047	0.051

indicated in table 5.04, the relationship between Industry Forces and Performance (H1a) was negative and insignificant. However, the indirect effect between these two constructs is positive (0.048). This may indicate that some of

the negative effects of Industry Forces on Performance is somewhat mitigated by the intervening strategy making constructs representing managerial action.

Another interesting point that can be drawn from the table is that the vast majority of the total effect (0.702) that Internal Resources and Capabilities has on Performance is a direct effect of 0.643. This indicates that the intervening constructs do not contribute significantly to the effect that Internal Resources and Capabilities has on Performance (in-direct effect of 0.059).

In the case of Environmental Scanning, we see that the direct effect on Manufacturing Strategy is 0.559 and the indirect effect on Manufacturing Strategy is 0.195 resulting in a total effect of 0.754. In this case Adaptive Decision Making (ADM) is the only intervening variable so the indirect effect is entirely due to the contribution of ADM to the total effect.

The most surprising result from the model testing is the insignificance of the relationship between Manufacturing Strategy and Performance as there is a considerable amount of research that has consistently identified this relationship as positive and significant. Possible reasons as to why this benchmark relationship did not come out as hypothesized will be further explored in the next chapter along with the presentation of an alternate model, conclusions, and future research.

Chapter 6

Alternate model presentation, conclusion, and future research

The most surprising result from the model testing is the lack of support for the relationship between Manufacturing Strategy and Performance as there is a considerable body of literature that supports the relationship between strategy and performance (Skinner, 1969; Anderson, Cleveland, and Schroeder, 1989; Leong, Snyder, and Ward, 1990; Ward and Duray, 2000; Hayes and Upton 1998) as well as manufacturing strategy and performance (Swamidass and Newell, 1987; Gupta and Lonial, 1998; Ward, Bickford, and Leong, 1995). Such a departure from prior literature warrants further analysis as to its cause. Potential causes for the lack of support for this relationship will be investigated in the next section.

6.1 Alternate model development and presentation:

There may be several possible reasons why the structural model produced an insignificant relationship between Manufacturing Strategy and Performance. A few of these are explored here.

One possibility is that the design of the model and the modeling methodology itself could be masking the relationship. To investigate this

possibility we used the second split half of the data and linear regression to explore the relationship between each performance construct dimension and the four manufacturing strategy variables. We were attempting to find the direction and significance of the relationships. Table 6.01 below summarizes the analysis results.

Table 6.01: Regression analysis results

Model 1: Financial performance: Y = 1.947 + .141x1 - .038 x2 + .259x3 - .096x4

Model 2: Operational performance: Y = 2.244 + .296x1 + .010x2 + .149x3 + .035x4

Model 3: Constituency performance: Y = 2.029 + .183x1 - .016x2 + .195x3 - .010x4

Model 4: Performance (composite): Y = 2.139 + .256x1 - .024x2 + .273x3 - .042x4

(x1 = delivery, x2 = cost, x3 = quality, x4 = flexibility)

Model	t-value of constant	t-value of x1	t-value of x2	t-value of x3	t-value of x4
1	4.701	2.158	-0.498	3.818	-1.316
2	9.365	4.721	0.130	2.281	0.497
3	5.569	2.805	-0.212	2.880	-0.142
4	8.297	4.068	-0.323	4.170	-0.605

Model number four used a composite performance variable computed by averaging financial, operational, and constituency variable values at the case level. As can be seen from this analysis the relationship is actually positive and significant between the performance dimensions and the manufacturing strategy dimensions of quality and delivery. This consistency with the quality and delivery dimensions of manufacturing strategy is important given that the financial dimension of our performance construct was directly borrowed from prior literature (Murphy et al., 1996). Table 6.02 below gives the R-square, Anova F

value, and the significance for each model. Given these results we need to look at the model itself for possible reasons for the inconsistency.

Table 6.02: Regression analysis summary

Model	R Square	Anova F	Significance
1	.072	5.216	.000
2	.140	10.959	.000
3	.075	5.440	.000
4	.138	10.722	.000

In our hypothesized model, Manufacturing Strategy and the Adaptive Decision Making are positioned in the model in such a way that their impact on performance is limited to the amount of unexplained variance from the preceding constructs. Therefore in our model, it may be that the exogenous constructs (external and internal factors) explain most of the variance in Performance resulting in insignificant direct effects from Manufacturing Strategy and Adaptive Decision Making.

An example of this effect from the model structure that could obscure the significance of the relationship of Manufacturing Strategy and Adaptive Decision Making on Performance is the direct effect of Internal Resources and Capabilities on Performance. The direct effect of Internal Resources and Capabilities on Performance is very high 0.643 with a t-value of 6.797.

From a theoretical perspective while prior literature has established the relationship between internal resources and capabilities and performance (RBV). The performance impact of internal capabilities and resources has been

theorized primarily as an in-direct effect which is influenced by managerial action (Spanos and Lioukas, 2001). In other words internal capabilities and resources are a basis for action or strategy making (Rumelt, 1984) and therefore require managerial intervention to exploit. On the other hand we could ague that our hypothesized model found such a significant relationship between Internal Resources and Capabilities and Performance that the other constructs in the model are marginalized to the point of being of no consequence in manufacturing SMEs. This interpretation would have to be rejected on the basis that it would also be contradictory to the volume of strategy research in small organizations in which the relationship between manufacturing strategy and performance has been proposed and confirmed.

In order to further explore the impact of the relationship between Internal Resources and Capabilities and Performance on the significance of the relationships between Manufacturing Strategy, Adaptive Decision Making, and Performance, we removed the direct effect (IF→ P) from the structural model to observe the impact. The resulting model showed improvement in the significance of the relationship between Performance and both Manufacturing Strategy and Adaptive Decision Making.

The Manufacturing Strategy to Performance t-value increased significantly to 2.186 (from 1.29) and Adaptive Decision Making to Performance t-value also increased significantly to 0.97 (from 0.03). While still marginal, these values are a significant improvement over the original model. Another significant consequence of removing the direct effect from Internal Resources and Capabilities and

Performance in the model was that the relationship between Industry Forces and Performance became significant (t = -2.692) as predicted in the original hypothesis (H1a).

Another potential problem with the model may be that Adaptive Decision Making and Manufacturing Strategy are measuring the same phenomena. In consideration of this possibility we re-visited our prior theory development in chapter two. While we considered both of these constructs to be part of strategy making, the rationalization for them being two separate constructs hinged on the statement that small organizations develop strategy via an "informal pattern of decisions" (Hayes and Wheelwright, 1984) resulting in a "realized strategy (Mintzberg, 1994). In the context of this statement we further noted in section 2.6.5 that "there is little distinction between decision making and strategy in small organizations".

Further confirmation of this was found in the results of discriminant validity testing of the structural model latent variables in chapter five (table 5.02). The relationship between Adaptive Decision Making and Manufacturing Strategy failed the χ^2 difference test performed between the constrained and unconstrained models of construct pairs indicating a discriminant validity problem.

If it is true that both of these constructs are a type of strategy they may be measuring the same phenomena. If they are measuring the same phenomena, then both constructs may be dimensions of some larger construct. To investigate this possibility we looked at Pearson correlations of the variables that make up

Manufacturing Strategy and Adaptive Decision Making. As can be seen in Table 6.03 (bold), the correlations between this set of variables are highly significant. In fact eleven of the twelve cross-construct correlations are significant at the 0.01 level (2-tailed).

Based on the assumption that Adaptive Decision Making and Manufacturing Strategy were measuring the same larger strategy construct we

Table 6.03: Pearson correlations of manufacturing strategy and adaptive decision making variables

Correlations	Delivery	Cost	Quality	Flexibility	Financial Const.	Customers needs/pref	Market/ Pricing
Delivery							
· **Pearson**							
· **Sig.**							
Cost							
· **Pearson**	0.324**						
· **Sig.**	0.000						
Quality							
· **Pearson**	0.152*	0.492**					
· **Sig.**	0.012	0.000					
Flexibility							
· **Pearson**	0.415**	0.524**	0.322**				
· **Sig.**	0.000	0.000	0.000				
Financial const.							
· **Pearson**	**0.024**	**0.350****	**0.165****	**0.259****			
· **Sig.**	**0.691**	**0.000**	**0.006**	**0.000**			
Customers needs/pref							
· **Pearson**	**0.392****	**0.326****	**0.235****	**0.285****	0.108		
· **Sig.**	**0.000**	**0.000**	**0.000**	**0.000**	0.074		
Market/pricing							
· **Pearson**	**0.172****	**0.294****	**0.182****	**0.254****	0.262**	0.473**	
· **Sig.**	**0.004**	**0.000**	**0.002**	**0.000**	0.000	0.000	

**** Correlation is significant at the 0.01 level (2-tailed)**
*** Correlation is significant at the 0.05 level (2-tailed)**

tested a second order measurement model using Adaptive Decision Making and Manufacturing Strategy as dimensions. The resulting two dimensional construct we refer to as Adaptive Manufacturing Strategy is presented in figure 6.01.

The measurement model had a Chi-square value of 70.106 with 13 degrees of freedom. The second order standardized regression weights were 0.84 for manufacturing strategy and 0.78 for adaptive decision making. The standardized regression weights for the manufacturing strategy variable were 0.47 for delivery, 0.79 for cost, 0.67 for flexibility, and 0.54 for quality. For the adaptive decision making variable the standardized regression weights were 0.35 for financial adaptation, 0.67 for customer needs and preferences, and 0.66 for market/pricing adaptation. The standardized regression weights of the variables indicate that all variables are contributing to the second order construct. Model fit was reasonable with a GFI of 0.931, AGFI of 0.851 and an RMR value of 0.036.

Figure 6.01: Second order measurement model of the adaptive manufacturing strategy construct (standardized regression weights)
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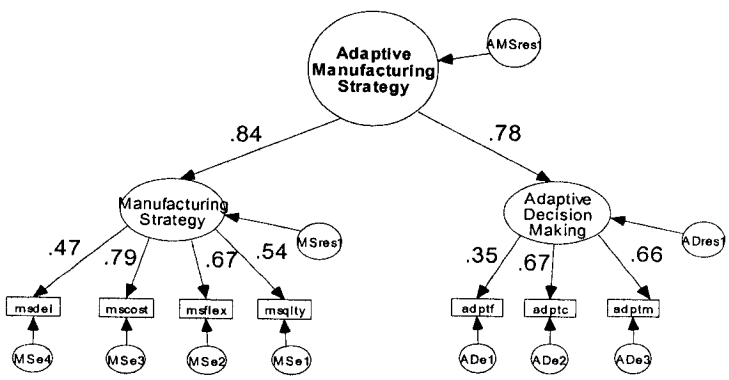
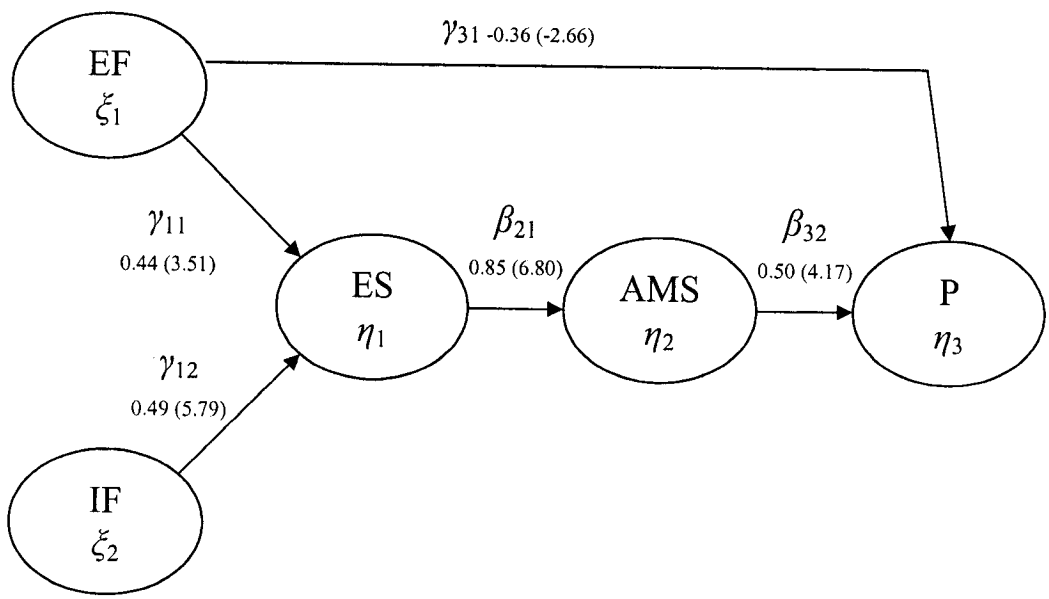


Given the positive results of measurement model testing we then tested it in the structural model as an alternative to the hypothesized model. The alternate model is shown with standardized regression weights in figure 6.02 below. The proposed alternate model had a χ^2 value of 495.19 with 204 degrees of freedom giving a χ^2/df of 2.427 indicating that the unexplained variance is not appreciable. The model fit indexes were GFI = 0.863, AGFI = .830 and a RMR of .045 indicating reasonable fit to the data.

Figure 6.02: Alternative structural model (standardized regression weights)



Standardized regression weights of the direct effects of the various relationships in the alternate model are summarized in table 6.04 along with the significance of each relationship (t-value).

Table 6.04: Alternate model hypothesized relationships, direct effects and t-values.

Hypothesis	Relationship	Direct effect	t-value
H1	Industry Forces → Environmental Scanning	0.44	3.51
H1a	Industry Forces → Performance	-0.36	-2.66
H2	Internal Res. & Cap. → Environmental Scanning	0.49	5.79
H3	Environmental Scanning → Adaptive Manufacturing Strategy	0.85	6.80
H4	Adaptive Manufacturing Strategy → Performance	0.50	4.17

The indirect and total effects in the alternate model are summarized in table 6.05 below. By analyzing this table we note that the direct effect of Industry Forces on Performance is negative, consistent with theory that predicts that as Industry Forces increase, Performance will suffer. However, the negative effect is somewhat mitigated by managerial action (positive in-direct effect of 0.19) so as to reduce the negative impact on Performance. This means that managerial action is important in reducing the performance impacts of a highly competitive business environment.

Table 6.05: Alternate model direct, in-direct and total effects (all regression weights are standardized)

Relationship	Direct effects	In-direct effects	Total effects
Industry forces → Environmental scanning	0.44		0.44
Industry forces → Adaptive manufacturing strategy		0.37	0.37
Industry forces → Performance	-0.36	0.19	-.017
Internal cap. & res. → Environmental scanning	0.49		0.49
Internal cap. & res. → Adaptive manufacturing strategy		0.42	0.42
Environmental scanning → Adaptive manufacturing strategy	0.85		0.85
Environmental scanning → Performance		0.41	0.41
Adaptive manufacturing strategy → Performance	0.50		0.50

6.2 Conclusions

This research has investigated the role of Adaptive Decision Making and its potential role in strategy making in small and medium-sized manufacturing companies. The following paragraphs highlight some of the contributions of this research effort.

The first contribution is our proposed model itself, which tested the strategy making processes within SME manufacturing companies. We hypothesized that strategy making in these companies begins with the evaluation or scanning of factors that are both external and internal to the organization for relevant information to use as a basis for action. We also hypothesized that strategy making involved not only information, (Environmental Scanning) but also an adaptive response (Adaptive Decision Making) coupled with implementation through emphasizing one or all of the manufacturing strategic imperatives (Manufacturing Strategy). And lastly, we hypothesized that all of these relationships ultimately would impact Performance.

The second contribution is finding antecedents to the environmental scanning. Prior literature on environmental scanning has not identified such relationships to this point. In our model we hypothesized that increases in Industry Forces would increase Environmental Scanning of these external factors. This hypothesis was shown to be correct. We also hypothesized that as companies obtained or developed higher levels of Internal Resources and Capabilities that these resources would be considered more valuable and therefore scanning (Environmental Scanning) of these resources and capabilities

would increase. This hypothesis was also confirmed. Support for these relationships (H1 and H2) is in agreement with our theoretical argument that the Structure-Conduct-Performance paradigm may be appropriate in SMEs.

A third contribution is the development and testing of a multi-dimensional performance measure including financial, operational, and constituency performance dimensions. Based on work by Venkatraman and Ramanujam (1986) we proposed that performance in manufacturing SMEs could be measured in three dimensions including financial, operational, and constituency performance dimensions. A measurement scale for this multi-dimensional measure of performance was developed, tested, and confirmed in this research.

A fourth contribution is a second new construct, Adaptive Decision Making. Adaptive Decision Making is defined as "*a conscious or unconscious tendency to place a high priority on adaptation to ones environment throughout the decision making process*". We hypothesized that this would be the case in smaller organizations since they are compelled to adapt since they have only marginal impact on their industry, function with less and more costly capital, and are financially vulnerable. A scale for measuring Adaptive Decision Making in manufacturing SMEs was developed, tested, and confirmed in this research. The scale consists of three dimensions with a total of eight items.

A fifth contribution was made in the post-hoc testing for the inconsistency in the Manufacturing Strategy to Performance linkage found in structural model testing. Exploring the commonality of the Adaptive Decision Making and Manufacturing Strategy constructs resulted in the testing a third construct using

Adaptive Decision Making and Manufacturing Strategy as dimensions of a higher order construct named Adaptive Manufacturing Strategy (AMS). A measurement model for this construct was tested, and confirmed in the alternate structural model. Adaptive Manufacturing Strategy suggests that emphasis on manufacturing strategic imperatives may be coupled with adaptive decision making behavior in SME manufacturing organizations. This is consistent with prior literature in that Adaptive Decision Making represents strategy choice while the degree of emphasis on manufacturing strategic imperatives (Manufacturing Strategy) represents strategy implementation. According to our research results, Adaptive Manufacturing Strategy reflects the reality of the small organizations' operating environment. Small manufacturing organizations need to both concentrate on meaningful manufacturing goals and at the same time be adaptive responders. By combining these two behaviors, a small manufacturing company is more likely to benefit from both their inherent adaptability and their need to make wise strategic choices. According to the results of testing the alternate model the benefits of following an Adaptive Manufacturing Strategy for manufacturing SMEs is that it may lead to enhanced performance.

Testing the Adaptive Manufacturing Strategy construct in the alternate model significantly improved the model and further helped explain many of the important relationships among constructs. The results of this model testing produced a robust alternate model with highly significant relationships and a more straightforward interpretation.

6.3 Future Research

This dissertation has opened up several avenues for possible future research. First of all the three constructs introduced in this dissertation need to be explored further and duplicated by other researchers. In this dissertation we developed the multi-dimensional performance measure for a manufacturing context in which the measurement of operational performance is highly specific to manufacturing. Operational dimensions for the same measure needs to be developed for service organizations.

There is also need to explore additional items for the Adaptive Decision Making scale as well as the Adaptive Manufacturing Strategy construct. Since this research merely introduced the Adaptive Manufacturing Strategy construct, additional research could potentially produce meaningful contributions to strategy research by advancing our understanding of the role that adaptation plays in decision making and strategy in small manufacturing SMEs. Also, this same connection between Adaptive Decision Making and strategy should be explored in other contexts including service organizations and large organizations.

Finally, Additional research is needed to confirm our finding of antecedent relationships to Environmental Scanning. Discovering additional antecedent relationships to Environmental Scanning would provide support to the theoretical argument that the Structure-Conduct-Performance paradigm is an appropriate strategic approach for SMEs.

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APPENDIX A - SURVEY INSTRUMENT

MANUFACTURING PRACTICE, STRATEGY AND PERFORMANCE STUDY

Michigan Manufacturers Association

Sponsored By:

MICHIGAN MANUFACTURERS ASSOCIATION

Glenn A Metts
University of Toledo
College of Business Administration
Management Department
Toledo, OH 43606

Please direct any questions you may have regarding this questionnaire to:

Telephone: (419)-255-7701
Mobile: (419)-297-2060
Fax: (419)-255-7703
Email: gmetts@ameritech.net

APPENDIX A - SURVEY INSTRUMENT

Dear Manufacturing Association member:

Please read the following brief instructions before completing this survey.

1. Ideally a top executive or owner of the business should complete this survey.

2. Unless instructed otherwise please respond to each question by circling either a number (1....N) or listed item that most accurately reflects your organizations **current** condition. "N" is to be marked if the question does not apply or you do not know the answer.

3. Please read the scoring scales before circling your response as these scales change as you move through the survey.

4. Please respond according to your organizations current condition (not as it is projected to be in the future).

5. When completed please forward to the address below:

Glenn A Metts
425 Jefferson Ave, Ste 520
Toledo, OH 43604

6. Please indicate if you would like a summary report of the results of this survey by filling in your address information below.

Your name: _____

Company _____

Address _____

Email address _____

We sincerely thank you in advance for your participation and please note that the information provided in this survey will remain strictly confidential.

APPENDIX A - SURVEY INSTRUMENT

COMPETITIVE RIVALRY

How would you evaluate the intensity of competition your firm is facing in the following areas with respect to: (1=very weak competition, 2=weak competition, 3=average competition, 4=fierce competition, 5=very fierce competition).

	Very Weak		Moderate		Very Fierce	
Product characteristics	1	2	3	4	5	N
Promotional strategies among competitors	1	2	3	4	5	N
Access to distribution channels	1	2	3	4	5	N
Service strategies to customers	1	2	3	4	5	N

INDUSTRY CHARACTERISTICS

How would you evaluate the barriers to entry in your industry: (1=very easy to enter, 2=easy to enter, 3=average to enter, 4=difficult to enter, 5=very difficult to enter).

Very easy				Very difficult	
1	2	3	4	5	N

How would you evaluate the threat of substitute products within your industry: (1=not at all, 2=below average, 3=average, 4=above average, 5=extreme).

Not at all				Extreme	
1	2	3	4	5	N

How would you evaluate the bargaining power of buyers within your industry: (1=very weak, 2=weak, 3=average, 4=strong, 5=very strong).

Very weak				Very strong	
1	2	3	4	5	N

How would you evaluate the bargaining power of suppliers within your industry: (1=very weak, 2=weak, 3=average, 4=strong, 5=very strong).

Very weak				Very strong	
1	2	3	4	5	N

INTERNAL FACTORS

Please indicate for each of the following, your firm's strength relative to your competitors (1: much weaker than competitors, 2=weaker than competitors, 3=same as competitors, 4=stronger than competitors, 5=much stronger than competitors).

	Much weaker				Much stronger	
Managerial competencies	1	2	3	4	5	N
Knowledge and skills of employees	1	2	3	4	5	N
Firm climate (quality of work environment)	1	2	3	4	5	N
Efficient organizational structure	1	2	3	4	5	N

APPENDIX A - SURVEY INSTRUMENT

INTERNAL FACTORS cont'd

	Much weaker				Much stronger	
Coordination between employees	1	2	3	4	5	N
Strategic planning activities	1	2	3	4	5	N
Ability to attract creative employees	1	2	3	4	5	N
Market knowledge	1	2	3	4	5	N
Control and access to distribution channels	1	2	3	4	5	N
Advantageous relationships with customers	1	2	3	4	5	N
Current customer base	1	2	3	4	5	N
Efficient and effective production department	1	2	3	4	5	N
Economies of scale	1	2	3	4	5	N
Technical experience	1	2	3	4	5	N
Technical capabilities and equipment	1	2	3	4	5	N

BUSINESS ENVIRONMENT SCANNING

Please indicate the degree of importance your firm places on using a **formal system** to collect information about the internal and external operating environment (1=not important, 2=below average, 3=average, 4=above average, 5=essential)

	Not important				Essential	
	1	2	3	4	5	N

Please indicate the degree to which your firm seeks out (by a formal or informal information collection system) the following types of information about its operating environment (1=never, 2=infrequently, 3=sometimes, 4=frequently, 5=continuously).

	Never				Continuously	
Competitors' prices	1	2	3	4	5	N
Competitors' introduction of new products	1	2	3	4	5	N
Competitors' advertising/promotion programs	1	2	3	4	5	N
New product characteristics	1	2	3	4	5	N
Customers' buying habits	1	2	3	4	5	N
Customers' product preferences	1	2	3	4	5	N

APPENDIX A - SURVEY INSTRUMENT

BUSINESS ENVIRONMENT SCANNING cont'd

	Never				Continuously	
Customers' demands and desires	1	2	3	4	5	N
Your company's sales capabilities and resources	1	2	3	4	5	N
Your company's financial capabilities and resources	1	2	3	4	5	N
Your company's management capabilities and resources	1	2	3	4	5	N
Availability of external financing	1	2	3	4	5	N
Availability of labor	1	2	3	4	5	N
New manufacturing technologies	1	2	3	4	5	N
Local/national/global social conditions	1	2	3	4	5	N
Local/national/global political conditions	1	2	3	4	5	N
Local/national/global economic conditions	1	2	3	4	5	N

MANUFACTURING STRATEGY

Indicate the degree of emphasis which your manufacturing plant places on the following activities (1=no emphasis, 2=below average emphasis, 3=average emphasis, 4=above average emphasis, 5=extreme emphasis)

	No emphasis				Extreme emphasis	
Lead-time reduction	1	2	3	4	5	N
Setup time reduction	1	2	3	4	5	N
Ability to change priorities of jobs on the shop floor	1	2	3	4	5	N
Ability to change machine assignments of jobs on the shop floor	1	2	3	4	5	N
Statistical process control	1	2	3	4	5	N
Real-time process control systems	1	2	3	4	5	N
Updating process equipment	1	2	3	4	5	N
Developing new processes for new production programs	1	2	3	4	5	N
Developing new processes for old production programs	1	2	3	4	5	N
Provide fast deliveries	1	2	3	4	5	N
Meet delivery promises	1	2	3	4	5	N
Reduce inventory	1	2	3	4	5	N

APPENDIX A - SURVEY INSTRUMENT

MANUFACTURING STRATEGY cont'd

	No emphasis				Extreme emphasis	
Increase capacity utilization	1	2	3	4	5	N
Increase equipment utilization	1	2	3	4	5	N
Reduce production costs	1	2	3	4	5	N

ADAPTIVE DECISION-MAKING ORIENTATION

Indicate the degree of emphasis which your manufacturing plant places on the following activities/priorities (1=no emphasis, 2=below average emphasis, 3=average emphasis, 4=above average emphasis, 5=extreme emphasis)

	No emphasis				Extreme emphasis	
Adapt to competitors pricing	1	2	3	4	5	N
Adapt to market forces in our industry	1	2	3	4	5	N
Adapt our resources to customer needs and preferences	1	2	3	4	5	N
Adapt our capabilities to the current business environment	1	2	3	4	5	N
Adapt our product pricing to our suppliers pricing	1	2	3	4	5	N
Adapt to restraints of our cash flow	1	2	3	4	5	N
Adapt to restraints of capital availability	1	2	3	4	5	N
Adapt to debt holder's (bank's) requirements	1	2	3	4	5	N
Adapt to economic conditions	1	2	3	4	5	N
Adapt to social and political conditions	1	2	3	4	5	N

PERFORMANCE

Please circle one

Please indicate the average return on assets for your firm over the last 3 years	0-3%	3.1-10%	10.1-20%	20.1-40%	>40%	N
Please indicate the average percent change in sales for your firm over the last 3 years	0-2%	2.1-5%	5.1-10%	10.1-20%	>20%	N
Please indicate the average before tax profit margin for your firm over the last 3 years	0-2%	2.1-5%	5.1-10%	10.1-20%	>20%	N

APPENDIX A - SURVEY INSTRUMENT

PERFORMANCE cont'd

For each of the following measures please indicate how you believe your firm performs in comparison to your competitors (1=much worse than, 2=worse than, 3=about the same, 4=better than, 5=much better than).

	Much worse than				Much better than	
Average return on assets over the last 3 years	1	2	3	4	5	N
Average percent change in sales over the last 3 years	1	2	3	4	5	N
Average before tax profit over the last 3 years	1	2	3	4	5	N
Unit cost of manufacturing	1	2	3	4	5	N
Quality of product (meets customer specification)	1	2	3	4	5	N
On-time delivery performance	1	2	3	4	5	N
Your ability to quickly change production volumes	1	2	3	4	5	N
Customer satisfaction	1	2	3	4	5	N
Employee satisfaction	1	2	3	4	5	N
Ownership satisfaction	1	2	3	4	5	N
Your bank or financial institution satisfaction	1	2	3	4	5	N

PROFESSIONAL AFFILIATION AND FINANCING

Please indicate the extent to which your firm uses the following types of financing to finance new equipment purchases (1=never, 2=infrequently, 3=sometimes, 4=frequently, 5=always).

	Never				Always	
Leasing	1	2	3	4	5	N
Bank loan	1	2	3	4	5	N
Government financing (SBA or other)	1	2	3	4	5	N
Cash from operations	1	2	3	4	5	N

PROFILE QUESTIONS

Please indicate which of the following professional services you use and the extent to which you attribute their service to the success of your firm (Usage "yes(Y)" or "no(N)" and Contribution 1=no contribution, 2=little contribution, 3=some contribution, 4=significant contribution, 5=very significant contribution).

APPENDIX A - SURVEY INSTRUMENT

PROFILE QUESTIONS cont'd

	USAGE		CONTRIBUTION					
			No contribution				Very significant	
Attorney	Y	N	1	2	3	4	5	N
Accountant (CPA)	Y	N	1	2	3	4	5	N
Consultant	Y	N	1	2	3	4	5	N

Please indicate the number of production employees in your firm _____

Please indicate the number of non-production employees in your firm _____

Please indicate the percentage of the business you own _____

Please indicate the average annual sales over the last three years _____

Please indicate the number of years experience in your job _____

Please circle your age _____

Please write in the type of product(s) made _____

Please circle one

Please indicate your gender M F

Is this a family owned business Y N

Is your company pursuing ISO/QS quality certification Y N

If no, circle reason: *Lack of funds* *No pressure from customers* *No need for certification*

Please indicate your management level (0=Chief executive, 1=Top management, 2=Middle Management, 3= Lower management)

_____

Please indicate your functional background

Engineering *Management* *Science* *Technology* *General*

Please indicate your highest level of completed education

High school *Associates* *Bachelors* *Masters* *Doctorate*

THANK YOU FOR YOUR VALUABLE TIME

APPENDIX B - SURVEY COVER LETTER

mail merge name
company
address line 1
address line 2

Dear MMA Member:

You are invited to participate in a research study on small- to medium-sized manufacturing companies (fewer than 500 employees), focusing on manufacturing strategy and performance.

The researcher is Glenn A Metts, a doctoral student in Manufacturing Management and Engineering at the University of Toledo (Toledo, Ohio), who is conducting this study as part of his doctoral dissertation work.

The Michigan Manufacturers Association is sponsoring this research in a continuing effort to better serve our smaller manufacturing membership. The concerns of smaller firms are very under-represented in academic research and, as a result, are less represented in manufacturing literature. The research results will be used to identify the challenges and strengths faced by small- to medium-sized companies and will be available for your review.

Your participation in this study is critical for its ultimate success, and we have made every effort to minimize the length of the survey as we recognize the value of your time. All information provided in the survey will be treated in the **strictest confidence** and will only be used in coded form. Your responses will be completely anonymous and will be used only for data input so that your company name and information in the survey is not identifiable with your responses.

The summary results of this study will be published in MMA's *Enterprise* magazine and will also be made available on the Association Web site (http://www.mma-net.org), as well as made available to other academic and industry publications.

If you have any questions regarding the survey please call Glenn A Metts, at 419-297-2060 or e-mail him at gmetts@ameritech.net.

Sincerely,

Glenn A Metts
Glenn A Metts, ABD

John "Mac" MacIlroy
President and CEO

Enclosure

APPENDIX C - SURVEY ITEM CODING

ITEM CODING:

INDUSTRY COMPETITIVE FORCES (EXTERNAL FACTORS):

EFCR1-4	Competitive Rivalry (4 items)
EFIF1	Barriers to entry
EFIF2	Threat of substitute products
EFIF3	Bargaining power of buyers
EFIF4	Bargaining power of suppliers

INTERNAL CAPABILITIES AND RESOURCES (INTERNAL FACTORS):

IFO1-7	Organizational / Managerial capabilities (7 items)
IFM1-4	Marketing capabilities (4 items)
IFT1-4	Technical capabilities (4 items)

ENVIRONMENTAL SCANNING ACTIVITY:

ESCC1	Competitors prices
ESCC2	Competitors introduction of new products
ESCC3	Competitors advertising/promotions
ESCC4	New product characteristics
ESCC5	Customer buying habits
ESCC6	Customer product preferences
ESCC7	Customer demands and desires
ESIFR1	Company sales capabilities and resources
ESIFR2	Company financial capabilities and resources
ESIFR3	Company management capabilities and resources
ESSLF1	Availability of external financing
ESSLF2	Availability of labor
ESSLF3	New manufacturing technologies
ESSP1	Social conditions
ESSP2	Political conditions
ESSP3	Economic conditions

MANUFACTURING STRATEGIC IMPERATIVE EMPHASIS (MANUFACTURING STRATEGY):

MSFLEX1	Lead time reduction
MSFLEX2	Setup time reduction
MSFLEX3	Change job priorities
MS FLEX4	Change machine assignments
MSQLTY1	Statistical process control
MSQLTY2	Real-time process control
MSQLTY3	Updating process equipment
MSQLTY4	New processes for new products
MSQLTY5	New processes for old products
MSDEL1	Provide fast deliveries

APPENDIX C - SURVEY ITEM CODING

MSDEL2	Meet delivery promises
MSCOST1	Reduce inventory
MSCOST2	Increase capacity utilization
MSCOST3	Increase equipment utilization
MSCOST4	Reduce production cost

ADAPTIVE DECISION MAKING:

ADPT1	Adapt to competitor pricing
ADPT2	Adapt to market forces in industry
ADPT3	Adapt to customer needs and preferences
ADPT4	Adapt capabilities to current business environment
ADPT5	Adapt our product pricing to our suppliers pricing
ADPT6	Adapt to restraints of cash flow
ADPT7	Adapt to restraints of capital availability
ADPT8	Adapt to debt holders (i.e. bank's) requirements
ADPT9	Adapt to economic
ADPT10	Adapt to social and political conditions

PERFORMANCE 1 (OBJECTIVE MEASURES):

P1A	Return on assets
P1S	Change in sales
P1P	Profitability

PERFORMANCE 2 (MULTI-DIMENSIONAL PERFORMANCE MEASURE):

P2FINA	Return on assets
P2FINS	Change in sales
P2FINP	Profitability
P2OP1	Unit cost of manufacturing
P2OP2	Quality of product (meets customer specification)
P2OP3	On-time delivery performance
P2OP4	Ability to quickly change production volumes
P2OR1	Customer satisfaction
P2OR2	Employee satisfaction
P2OR3	Ownership satisfaction
P2OR4	Debt holder satisfaction

OTHER: PROFESSIONAL AFFILIATION AND FINANCING:

OLEA	Lease financing
OLOAN	Bank financing
OGOV	Government financing (SBA/other)
OCASH	Cash from operations financing
PRATTU	Attorney use
PRCPAU	CPA/accountant use
PRCONU	Consultant use

APPENDIX C - SURVEY ITEM CODING

PRATTV	Value of attorney services
PRCPAV	Value of CPA/accountant services
PRCONV	Value of consultant services

DEMOGRAPHIC:

DPEMP	Number of production employees
DNPEMP	Number of non-production employees
DBUS%	Percentage of the business you own
DSLS	Average sales over last 3 years
DEXP	Years of experience on job/industry
DAGE	Age
DPROD	Products manufactured at this location
DGEN	Gender
DBUS	Family business
DISO	Pursuit of ISO/QS certification
DISOR	Reason for not pursuing ISO/QS
DMGL	Management level
DFBG	Functional background
DEDU	Educational level

APPENDIX D

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Comp Rivalry (efcr1)	531	97.1%	16	2.9%	547	100.0%
Comp Rivalry (efcr2)	529	96.7%	18	3.3%	547	100.0%
Comp Rivalry (efcr3)	493	90.1%	54	9.9%	547	100.0%
Comp Rivalry (efcr4)	526	96.2%	21	3.8%	547	100.0%
EF Barriers to entry (efif1)	545	99.6%	2	.4%	547	100.0%
EF Substitue products (efif2)	534	97.6%	13	2.4%	547	100.0%
EF Barg powr buyers (efif3)	545	99.6%	2	.4%	547	100.0%
EF Barg powr suppliers (efif4)	543	99.3%	4	.7%	547	100.0%
IF Org & Mgr capabilities (ifo1)	539	98.5%	8	1.5%	547	100.0%
IF Org & Mgr capabilities (ifo2)	541	98.9%	6	1.1%	547	100.0%
IF Org & Mgr capabilities (ifo3)	538	98.4%	9	1.6%	547	100.0%
IF Org & Mgr capabilities (ifo4)	540	98.7%	7	1.3%	547	100.0%
IF Org & Mgr capabilities (ifo5)	533	97.4%	14	2.6%	547	100.0%
IF Org & Mgr capabilities (ifo6)	531	97.1%	16	2.9%	547	100.0%
IF Org & Mgr capabilities (ifo7)	524	95.8%	23	4.2%	547	100.0%
IF Marketing capabilities (ifm1)	533	97.4%	14	2.6%	547	100.0%
IF Marketing capabilities (ifm2)	487	89.0%	60	11.0%	547	100.0%
IF Marketing capabilities (ifm3)	537	98.2%	10	1.8%	547	100.0%
IF Marketing capabilities (ifm4)	537	98.2%	10	1.8%	547	100.0%
IF Technical capabilities (ift1)	529	96.7%	18	3.3%	547	100.0%
IF Technical capabilities (ift2)	521	95.2%	26	4.8%	547	100.0%
IF Technical capabilities (ift3)	537	98.2%	10	1.8%	547	100.0%
IF Technical capabilities (ift4)	537	98.2%	10	1.8%	547	100.0%
ES Competitor prices (escc1)	542	99.1%	5	.9%	547	100.0%
ES Competitor new products (escc2)	499	91.2%	48	8.8%	547	100.0%

APPENDIX D

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
ES Competitor ad and prom (escc3)	513	93.8%	34	6.2%	547	100.0%
ES New product characteristics (escc4)	495	90.5%	52	9.5%	547	100.0%
ES Customer buying habits (escc5)	526	96.2%	21	3.8%	547	100.0%
ES Customer product prefs (escc6)	512	93.6%	35	6.4%	547	100.0%
ES Customer demands/desires (escc7)	545	99.6%	2	.4%	547	100.0%
ES Company sales/resources (esifr1)	539	98.5%	8	1.5%	547	100.0%
ES Company fin capablty/res (esifr2)	542	99.1%	5	.9%	547	100.0%
ES Company mgnt capablty/res (esifr3)	542	99.1%	5	.9%	547	100.0%
ES Avail of external financing (esslf1)	531	97.1%	16	2.9%	547	100.0%
ES Avail of labor (esslf2)	542	99.1%	5	.9%	547	100.0%
ES New mfg technologies (esslf3)	543	99.3%	4	.7%	547	100.0%
ES Social conditions (essp1)	525	96.0%	22	4.0%	547	100.0%
ES Political conditions (essp2)	526	96.2%	21	3.8%	547	100.0%
ES Economic conditions (essp3)	534	97.6%	13	2.4%	547	100.0%
MS Flex - lead time reduction (msflex1)	541	98.9%	6	1.1%	547	100.0%
MS Flex - setup time reduction (msflex2)	531	97.1%	16	2.9%	547	100.0%
MS Flex - change job priorities (msflex3)	542	99.1%	5	.9%	547	100.0%
MS Flex - change mach assgnmts (msflex4)	518	94.7%	29	5.3%	547	100.0%
MS Qlty - SPC use (msqlty1)	506	92.5%	41	7.5%	547	100.0%
MS Qlty - real-time proc controls (msqlty2)	498	91.0%	49	9.0%	547	100.0%
MS Qlty - updating proc equip (msqlty3)	527	96.3%	20	3.7%	547	100.0%
MS Qlty - new proc for new prod (msqlty4)	512	93.6%	35	6.4%	547	100.0%
MS Qlty - new proc for old prod (msqlty5)	522	95.4%	25	4.6%	547	100.0%
MS Del - fast deliveries (msdel1)	540	98.7%	7	1.3%	547	100.0%
MS Del - meet del promises (msdel2)	543	99.3%	4	.7%	547	100.0%

APPENDIX D

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
MS Cost - Reduce inventory (mscost1)	525	96.0%	22	4.0%	547	100.0%
MS Cost - Inc capacity utilization (mscost2)	532	97.3%	15	2.7%	547	100.0%
MS Cost - Inc equip utilization (mscost3)	533	97.4%	14	2.6%	547	100.0%
MS Cost - Reduce production cost (mscost4)	539	98.5%	8	1.5%	547	100.0%
Adpt to competitor pricing (adpt1)	534	97.6%	13	2.4%	547	100.0%
Adpt to market forces (adpt2)	531	97.1%	16	2.9%	547	100.0%
Adpt to customer needs and prefs (adpt3)	537	98.2%	10	1.8%	547	100.0%
Adpt capabilities to cur bus environ (adpt4)	536	98.0%	11	2.0%	547	100.0%
Adpt prod pricing to sup pricing (adpt5)	528	96.5%	19	3.5%	547	100.0%
Adpt to cash flow restraints (adpt6)	527	96.3%	20	3.7%	547	100.0%
Adpt to capital avail restraints (adpt7)	526	96.2%	21	3.8%	547	100.0%
Adpt to debt holders (adpt8)	485	88.7%	62	11.3%	547	100.0%
Adpt to economic conditions (adpt9)	535	97.8%	12	2.2%	547	100.0%
Adpt to social and political cond (adpt10)	519	94.9%	28	5.1%	547	100.0%
P2 Fin - Return on assetts (p2fina)	494	90.3%	53	9.7%	547	100.0%
P2 Fin - Change in sales (p2fins)	514	94.0%	33	6.0%	547	100.0%
P2 Fin - Profitability (p2finp)	506	92.5%	41	7.5%	547	100.0%
P2 Oper - unit cost of mfg (p2op1)	499	91.2%	48	8.8%	547	100.0%
P2 Oper - quality of product (p2op2)	533	97.4%	14	2.6%	547	100.0%
P2 Oper - on-time delivery (p2op3)	531	97.1%	16	2.9%	547	100.0%
P2 Oper - flexibility (p2op4)	508	92.9%	39	7.1%	547	100.0%
P2 Org - Customer satisfaction (p2or1)	535	97.8%	12	2.2%	547	100.0%
P2 Org - Employee satisfaction (p2or2)	528	96.5%	19	3.5%	547	100.0%
P2 Org - Owners satisfaction (p2or3)	520	95.1%	27	4.9%	547	100.0%
P2 Org - Debt holder satisfaction (p2or4)	475	86.8%	72	13.2%	547	100.0%

APPENDIX D

SAMPLE NORMAL Q-Q PLOTS FOR ITEMS escc1 and escc2