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THE IMPACT OF MARKET-ORIENTED STRATEGY ON COMPETITIVENESS IN PRODUCT INNOVATION IN THE U.S. SOFTWARE INDUSTRY

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ABSTRACT

THE IMPACT OF MARKET-ORIENTED STRATEGY ON COMPETITIVENESS

IN PRODUCT INNOVATION

IN THE U.S. SOFTWARE INDUSTRY

By

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In today's marketplace where customers are ever more demanding and competition more intense, market orientation becomes increasingly important for firms to succeed in product innovation. Yet most traditional research embraces an inward-oriented paradigm that neglects market demand and needs in the innovation process.

Based on Drucker's theory of knowledge-based innovation, this dissertation develops and tests a model of a market-oriented strategy and a firm's competitiveness in product innovation. In the model, a market-oriented strategy is composed of four components: customer knowledge focus, integral knowledge focus, competitor knowledge focus, and R&D strength. Competitiveness in product innovation refers to a firm's ability to develop new products that create customer value more effectively and efficiently then competitors.

The data used to test the model were collected from the U.S. software industry. The selection of the software industry is consistent with the need for research on high technology products since, traditionally, the marketing literature

was biased toward mature consumer goods. In addition, the software industry is prolific in innovative products, thus providing an ideal environment for research on product innovation.

The model was tested using EQS general least squares (GLS) method. The results indicate that all four components of a market-oriented strategy exert a significant impact on competitiveness in product innovation. In turn, competitiveness in product innovation leads to superior market performance. Further, the research finds significant relationships between external and internal factors and a market-oriented strategy.

Dedicated to Feifei and Gen

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1. Importance of Product Innovation

In today's marketplace, product innovation is a major driving force behind corporate growth and competitiveness. In 3M, thirty percent of the sales (over $13.5 billion) comes from new products that didn't exist five years ago (McCarthy and Perreault 1993). Microsoft, through focusing on product innovation, developed from a tiny company in 1981 to the largest software producer in the world. In 1993, its market value exceeded General Motor's. In the United States as a whole, new products account for 75 percent of the national sales growth (Gruenwald 1992). Increasingly, product innovation is viewed as a major factor for creating national competitiveness (Porter 1990) in the global market.

The importance of product innovation has been long recognized by scholars in economics. More than half a century ago, Schumpeter in his historic works, *Business Cycle* (1939) and *Capitalism, Socialism and Democracy* (1942), impressively uncovered the nature of product innovation. He considered product innovation essential to economic progress. Product innovation fostered economic progress through replacing existing products with new innovative products, a process Schumpeter called "creative destruction". While Schumpeter's works examined the general relationship between product innovation and economic progress, other economists explored the specific conditions that contributed to

product innovation. In particular, Galbraith (1952) viewed firm size as a key factor in innovation success since large firms generally invested more in R&D than small firms. Since then the study of the impact of firm size and R&D investment on product innovation has been of interest to many economists (Adams 1970; Fisher and Temin 1973; Horowitz 1962; Scherer 1965).

While economists pioneered the study of product innovation, their views on the effect of firm size and R&D investment are often conflicting with phenomena in business practice. In one case after another, one observes small companies excel in product innovation whereas their resource-rich counterparts blunder in bringing new products into the market. This raises the question: "Why do some companies move quickly and efficiently to bring to market outstanding new products, while others expend tremendous resources to develop products that are late and poorly designed?" (Wheelwright and Clark 1992).

In search of more effective ways for product innovation, researchers in marketing shifted their attention to a different perspective: a market-oriented approach. Attempts to establish the market-oriented perspective include studies on the impact of customer knowledge focus on new product development (Cooper 1979, 1985, 1992; Griffin and Hauser 1991; Kohli and Jaworski 1990; Von Hippel 1977, 1978, 1986), the effect of marketing-R&D integration (Calantone and di Benedetto 1988; Calantone and Cooper 1977; Griffin and Hauser 1991; Gupta, Raj, and Wilemon 1986; and Souder 1987, 1988), and the influence of competitor knowledge focus (Day and Wensley 1988; Lawless and Fisher 1990; Narver and Slater 1990; and Rothchild 1979). Further contributions to the market-oriented

perspective have been made by studies (Gupta, Raj, and Wilemon 1986; Wheelwright and Clark 1992) that investigate the relationships between the market-oriented approach and the drivers of environmental factors.

Taken as a whole, these studies have made important contributions to our understanding of product innovation. On the one hand, economists have laid foundation for innovation research by highlighting the important function of product innovation in achieving economic progress. On the other hand, researchers in marketing have spearheaded a new direction for the research, a direction which may guide practitioners in their quest of competitive advantage in today's market place.

1.2. Motivation For the Research

The proposed study is motivated by both the accomplishments and weaknesses of previous research on product innovation. Over the past five decades, economists have analyzed and sifted through numerous economic forces, and eventually established product innovation as a major factor in social and economic evolution and progress (Pavitt 1980; Mansfield 1968; Schumpeter 1939, 1942, 1961). The achievements of the previous economics studies can also be found in the abundant empirical works that provided evidence supporting the role of product innovation in economy. However, when attempting to offer specific means to achieve success in product innovation, their contributions have been limited by their own analytical model which treats R&D investment and firm size as the sole factor in innovation success while neglecting the impact of market factors,

such as market demand and customer needs, on product innovation. These limitations are reviewed and analyzed in detail in the next chapter.

To overcome the limitations of economics studies, researchers in marketing have cultivated a new approach through establishing the market-oriented perspective. Specifically, studies in marketing have created a conceptual framework for analyzing the relationship between market orientation and competitiveness in innovation. Some empirical studies have provided evidence indicating the adoption of market orientation may lead to success in product innovation. However, most of these studies focus on a single aspect of market orientation. For example, empirical research on competitor knowledge focus seldom considers customer knowledge focus (Note 1), while investigation on marketing-R&D integration does not bring in competitor analysis. In general, research on market orientation still remains fragmented.

Previous studies (Day and Wensley 1988, Kohli and Jaworski 1990, Slater and Narver 1994, Wheelwright and Clark 1992) have also attempted to establish a relationship between market orientation and environmental factors by assuming that environmental factors, such as market growth, competition intensity, and technology turbulence, are the driving forces that provide impetus for organizations to take a market-oriented approach. However, this contingency perspective has become controversial lately. More empirical studies are needed to resolve the issue.

The unfinished work from previous studies provides a unique opportunity for the author in this research to integrate the past fragmented findings into a more

comprehensive framework.

1.3. Purpose of the Research and the Conceptual Model

The purpose of this research is to present and test a model of a market-oriented strategy in product innovation. Through an integration of the market-oriented approach in product innovation and the environmental contingency perspective, the model will address the following three fundamental research questions: (1) Does a market-oriented strategy lead to firm's competitiveness in product innovation? (2) Is competitiveness in product innovation correlated with market performance? (3) Do market environmental factors exert an impact on a market-oriented strategy?

The conceptual model in Figure 1.1. consists of three levels of constructs: (1) constructs of external and internal factors, (2) strategy constructs, and (3) outcome constructs. The inclusion of each construct in the model is supported by multiple studies. While a detailed literature review of these studies is provided in the next chapter, the following paragraphs briefly describe each construct in the model.

A marketed-oriented strategy is composed of four constructs (V5-V8): customer knowledge focus, integral knowledge focus, competitor knowledge focus, and R&D strength. Customer knowledge focus (V5) refers to the generation of knowledge pertaining to customer needs of new products through customer information acquisition and interpretation. Customer knowledge focus is hypothesized to have a positive impact on firm's competitiveness in product

innovation.

Integral knowledge focus (V6), the second strategy construct that is proposed to be positively related to competitiveness in innovation, is the generation of integral knowledge pertaining to solution to customer needs through marketing-R&D communication, information sharing, and cooperation in the process of new product development.

Competitor knowledge focus (V7), the third strategy construct, refers to the generation of competitor knowledge on the weakness and strengths of competitors' products through competitor information acquisition and interpretation. It is hypothesized that the level of competitor knowledge focus is positively correlated to competitiveness in product innovation.

R&D strength (V8), the fourth strategy construct, is measured by the level of firm's R&D investment. R&D strength is proposed to have a positive impact on competitiveness in product innovation.

Two outcome constructs (V9-V10) are included in the model. Competitiveness in product innovation (V9), the first outcome construct, refers to firm's ability to develop new products that create customer value more effectively and efficiently than competitors. While the level of competitiveness in product innovation is determined by the four strategy constructs, the other outcome construct, new product market performance (V10), is suggested to be influenced by competitiveness in product innovation.

Constructs of external environmental factors (V1-V3) include customer demandingness, competition intensity, and technology change. Customer

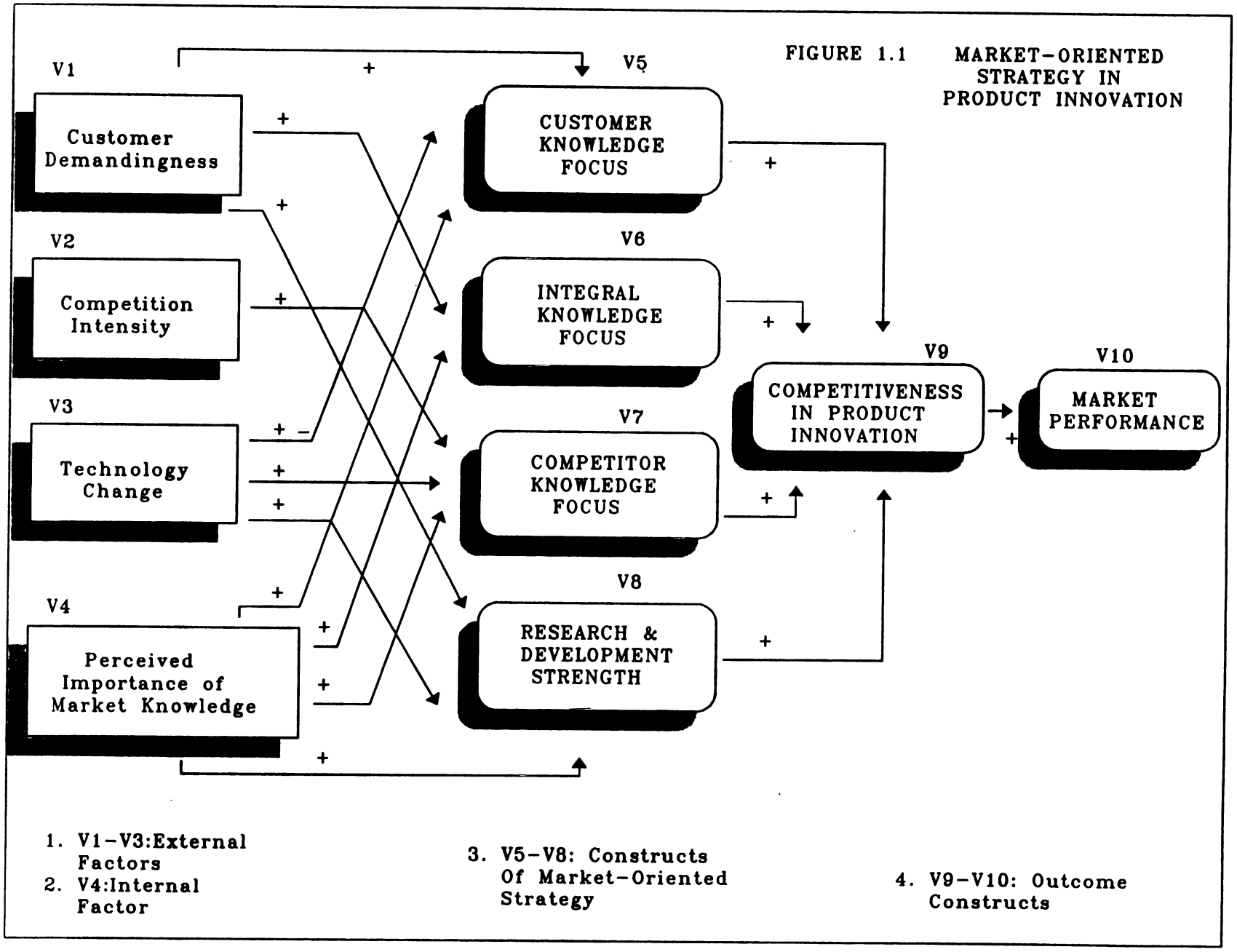

FIGURE 1.1 MARKET-ORIENTED STRATEGY IN PRODUCT INNOVATION

demandingness (V1) refers to the level of buyers' requirement for product performance and knowledge about technical specifications. As customers become more demanding, it is more imperative for firms to pursue customer knowledge and integral knowledge focuses, as well as to strengthen their R&D program.

Competition intensity (V2) refers to the level of competition in a product market including market concentration, volatility, and predictability. This external factor puts enormous pressure on firms to strive for competitor knowledge focus.

The last environmental factor is technology change (V3). Technology change is measured by two leading indicators: technology obsolescence rate and new product introduction rate. As technology in a product market changes rapidly, firms are compelled to further pursue both customer and competitor knowledge focuses, as well as to increase their R&D investment level.

The perceived importance of market knowledge (V4) is an internal factor that is proposed to have an impact on all four constructs of a market-oriented strategy.

1.4. Choice of the Software Industry

The U.S. software industry is selected for this research. The selection is based on several factors. First, the choice is consistent with the need for research on high technology products. According to Gatignon and Robertson (1989,p.35), until recently, the marketing literature has been biased toward mature consumer goods. Therefore, there is a need to develop a perspective on products with "high technology innovations, more compatible with the more general focus on

technology now emerging within the marketing field."

Second, there has been an interest in research on information intensive industries in the marketing literature. An industry is information intensive to the degree that its products are based on the information collected and processed as part of exchanges along the value-added chain (Glazer 1991). The software industry fits such a profile. In the software industry, information is the major component of a software product. For example, the programming of a computer-aided design software requires not only knowledge about technological programming, but also information about plant operations, and quality and productivity specifications.

Third, investigation on product innovation should be conducted in an "innovation-rich" environment. The software industry is prolific in innovative products, ranging from improved software to breakthrough software. The annual sales growth in the software industry has been at 25% over the last ten years, a rate higher than that of any other industries. The phenomenal growth is mainly fueled by new software introductions.

Based on a combination of these factors, it is worthwhile to use the software industry as a vehicle to study the impact of a market-oriented strategy on competitiveness in product innovation. The principles uncovered from this research may improve our understanding of both the software industry and other related information intensive industries.

1.5. Expected Contributions of the Research

The research is expected to contribute to the study of product innovation in several ways. First, a comprehensive model of a market-oriented strategy in product innovation is constructed to take into account of all four major components of market orientation: customer knowledge focus, integral knowledge focus, competitor knowledge focus, and R&D strength. This model will be the first of its kind in product innovation research.

Second, the effect of a market-oriented strategy on competitiveness in product innovation and market performance will be investigated empirically. The results from such a study will be particularly useful to practitioners since their major interest in product innovation is to improve their organizational performance and competitiveness in the market place. Further, for those practitioners who have already pursued a market orientation in their work, positive results will further reinforce their own experience and commitment.

Third, the contingency perspective will be integrated into the model to investigate the relationship between the drivers of environmental factors and a market-oriented strategy. Findings on the impact of these environmental factors will shed light on the controversial issue of the contingency perspective and the market oriented approach.

Finally, the industry selected for this research is the U.S. computer software industry, an industry characterized by high rate of growth and innovativeness. Although the computer software industry is one of the few industries that the U.S. still holds a competitive advantage over its competitors, the nature of product

innovation in this industry is not well understood. Findings about product innovation in the computer software industry will not only help practitioners in the industry understand and realize their own potential but also offer insights on competitiveness for managers in other fields.

Note 1: While some researchers (Day and Wensley 1988; Dickson 1992) conceptualize a twin-orientation, e.g. pursuing both competitor focus and customer focus, we have not come across any empirical studies on the adoption of the twin-orientation in product innovation literature. Narver and Slater's (1990) study can be considered an exception but their research is mainly on general business orientation, not on product innovation.

CHAPTER TWO

LITERATURE REVIEW AND THEORY CONSTRUCTION

2.1. Traditional Perspective of Innovation

The traditional research on product innovation was dominated by the "Schumpeterian theory", a theory customarily attributed to Schumpeter in the literature but actually developed and crystallized by Galbraith (1952) and several other economists (Adams 1970; Fisher and Temin 1973; Horowitz 1962; Scherer 1965). This theory is generally recognized as consisting of two interrelated sub-models: the input effect model and the size effect model (Kamien, Schwartz 1982).

The input effect model is R&D-centered with product innovation considered as the sole domain of the R&D engineers and scientists. The innovation success, according to the model, depends on the scale of investment on R&D. The higher the level of R&D investment, the more likely a firm will achieve innovation success. The production function schedule, which is commonly used in microeconomics to associate physical rate of input in production with physical output, is applied in describing mathematically the relationship between investment in R&D and innovation successes. Two measures of R&D input are often adopted: the number of scientists and engineers specifically assigned to R&D, and the amount of expenditure designated for R&D. A number of surrogates are used to measure innovation outcomes including number of patents obtained, number of new products developed, or rate of return on investment achieved.

In the size effect model, the firm size is viewed as the causal variable that exerts a positive impact on a firm's innovativeness. Therefore, the larger the firm size, the more innovative the firm will be. Further, large firms, according to the Schumpeterian economists, are more than proportionately more innovative than small firms. The large firm's innovativeness is attributed to a number of factors including the large firms' ability to finance a larger research and development staff, their possession of economies of scale in research and development, and their access to more opportunities to diversify their research and development projects.

In addition to the input and size effect models, the philosophical foundation of the traditional approach is the product concept which holds that customers will always favor those new products that are most technologically advanced. The product concept is also commonly referred to as the "technology sells" concept (Penn,Jr. and Mougel 1978) or "technology-push" hypothesis (Phillips 1966).

2.1.1. Critique of the Traditional Approach

While the traditional approach to innovation has been useful in highlighting the importance of innovation and the role of R&D, the perspective suffers from several critical weaknesses. First, the traditional approach is inward-oriented because it treats R&D as the only source of innovation and overlooks the impact of market demand and customer needs on firm's innovation activities. Such an orientation may lead to two pitfalls. On the one hand, firms with an inward orientation may miss innovation opportunities offered by emerging customer demand and needs. On the other hand, new innovative products introduced by those firms may not be accepted by the market since information about customer

needs is not integrated into the innovation process. Long recognizing the drawbacks of the traditional approach, Utterback (1971,p.81) argues that the main limitation of such an inward-orientation "appears to be its ability and perhaps aggressiveness in recognizing needs and demands in its external environment".

A second limitation of the traditional view is that it largely ignores the impact of competitors on the firm's innovation activities. In the real world, the firm formulates its innovation strategy in response to its external competitive environment. When the competitor has already developed a superior product, the firm may not want to compete head-on with the competitor but adopt a differentiation strategy to nullify the competitor's advantage. When the rival company is financially stronger, the firm may not want to outspend its competitor in innovation but adopt a immediate follower's approach with an imitated product. It is hard to imagine that a firm can succeed in innovation by focusing exclusively on the scale of R&D investment without considering its external environment as suggested by the traditional perspective.

A third deficiency of the traditional view is that it treats R&D as the only source of innovation and neglects other sources within the firm. Researches (Gupta, Raj, and Wilemon 1986) on innovation have demonstrated that product innovation is a multidisciplinary process and it is essential to recognize efforts from other departments and to systematically integrate them with those of R&D. Excluding contributions from other functional areas is not only conceptually deficient but also practically unacceptable since it severely limits a firm's chances of success in innovation.

A fourth weakness of the traditional view is that it overlooks the effect of innovation on firm size and performance. In the traditional model, firm size is hypothesized as the causal factor and the larger the firm size, the more innovative the firm will be. However in practice, the direction of causality may be reversible since firm size can be the consequence of innovation rather than a cause. This appears to be the case in the PC software industry where small firms such as Microsoft Corporation and Lotus Development Corporation have grown into large firms through offering innovative products while the traditional large firms such as IBM and Texas Instrument have failed to catch major share in this market.

Finally, the traditional model has not provided professionals in small and medium size firms with much managerial guidance in their quest for competitiveness in innovation. The two major factors that the traditional approach focuses on are the scale of R&D investment and firm size for which small and medium size firms normally are limited in their ability to control in their competition with large firms. On the contrary, the traditional model has offered little on the factors that are within the firm's ability to manage such as the interaction with customers and the response to competitors.

2.2. The Need for a New Theoretical Structure

The deficiencies of the traditional view highlight the need for a theoretical structure which:

(1) overcomes the inward orientation of the traditional model and assumes a market-oriented strategy which takes consideration of customers, competitors,

marketing-R&D integration, and R&D strength.

(2) identifies the likely impact of a market orientation on firm's competitiveness in innovation and market performance.

(3) examines a set of contingent environmental factors such as customers, competitors, and technology which moderates the effects of a market-oriented strategy on performance.

2.3. Market-Oriented Strategy

A market-oriented strategy in product innovation is defined as a behavioral approach aiming at creating superior value for buyers through new product development. This strategy consists of two unique characteristics: a customer-oriented objective and three behavioral components. While the strategy emphasizes the three behavioral components, the importance of R&D investment is not neglected. In this section, these two features are elaborated through an integration of writings from various researchers who have contributed to the development of this approach over the last two decades.

2.3.1. Customer-Oriented Objective

First, a market-oriented strategy has an unequivocally customer-oriented objective. In his classical research on product innovation, Cooper (1979, p.98) identifies the "winners" as those market-oriented firms with an aim at developing superior products that "met customer needs better than competing products; allowed the customer to reduce costs or to do something previously impossible; and were of higher quality than competing products." On a similar line of research,

Penn,Jr. and Mougel (1978, p.135) demonstrate that market oriented firms are those that devote a concerted effort to "match the product to a customer need in such a way that the customer perceived the benefits of using it." Recently, this customer-oriented objective is further reinforced by Narver and Slater (1990, p.21) who define market orientation as "the organization culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and, thus, continuous superior performance for the business."

The significance of customer-oriented objective lies in its resurrection of the customer interest. In the traditional economic model of innovation, the customer is normally neglected or at most treated as a passive adopter of new product. Now, customer-orientation specifies without ambiguity that innovation must accommodate customer interest. Further more, by an emphasis on the customer interest, an unbiased criterion is created for evaluating innovation success, that is, the creation of value for the customer and eventual market acceptance.

2.3.2. Three Behavioral Components

The second characteristic of a market-oriented strategy is its three behavioral components. Among the limited number of models of market orientation that exist in the literature, the conceptual model by Narver and Slater (1990) has received particular attention. The model assumes that a market orientation is composed of three behavioral components: customer focus, competitor focus, and interfunctional coordination. While the authors define "customer focus" as the sufficient understanding of one's target buyers, and "competitor focus" as the sufficient understanding of the short-term strengths and weaknesses of key

competitors, they consider "interfunctional coordination" as the coordinated utilization of company resources in creating superior value for target customers. Narver and Slater's three-component model is also consistent with the perspective of an earlier model by Kohli and Jaworski (1990) who propose that a market orientation consists of two fundamental pillars, customer focus and coordinated marketing. Kohli and Jaworski (1990, p.6) define market orientation as "the organizationwide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organizationwide responsiveness to it." Although competitor intelligence is not expressed as a component in the model, the authors implicitly include competitor information as part of general market intelligence the firm must acquire.

In this research, while I adopt the perspective of the three-component model, my operationalization of a market-oriented strategy is distinctive on several aspects. First, I consider knowledge generation the essence of all three behavioral components. Thus I reconceptualize the three components as customer knowledge focus, integral knowledge focus, and competitor knowledge focus. My reconceptualization is based on Drucker's theory of knowledge-based innovation. In his book *Innovation and Entrepreneurship* (1985), Drucker raises several propositions on product innovation which are summarized in the following:

- Product innovation is knowledge-based.
- Success of product innovation requires market knowledge, technological knowledge, and an integration of market knowledge and technological knowledge.

- Knowledge-based innovation should be market-focused and market-driven.

Second, I treat the three behavioral components as three individual constructs whereas in Narver and Slater's model the three components were combined together (the weighted average scores were used) to represent one construct, market orientation. This treatment is in line with several works on the subject. For example, Day and Wensley (1988) consider customer focus distinguishable from competitor focus and conclude an effective marketing strategy requires a balanced mix of the two. Similarly, Dickson (1992, p.78) argues "a competitive focus is not an alternative to a customer focus; the greater the competition, the greater the firm's need to focus on and serve the customer better than the competition." Furthermore, other researchers (Griffin 1989; Gupta, Raj, and Wilemon 1986) treat functional coordination as an independent construct in their research on product innovation strategy. Third, my conceptual development of the three behavioral components in the next section will be primarily based on contributions from researchers on product innovation since these contributions are most relevant to the subject of this study.

2.3.2A. Customer Knowledge Focus

Customer knowledge focus is defined as the generation of knowledge pertaining to customer needs of new products. Specifically, customer knowledge focus consists of two aspects: customer information acquisition and interpretation. These two aspects of customer knowledge focus provide an understanding of two key questions in regard to the generation of customer information:

1. How customer information can be acquired?

2. How customer information can be interpreted?

Information acquisition. In order to understand customer needs for new products, information about their needs must be acquired first. Interaction with customers is the most efficient way to acquire such information since customer needs and preferences are normally complex and sophisticated and can only be understood by direct communication. Several researchers have cited complexity of customer needs as the main reason for customer interaction. For example, Griffin and Hauser (1991) classify buyer's needs into basic needs, articulated needs, and surprise needs and propose focus group and one-on-one interview as an effective means to tap such needs. Kohli and Jaworski (1990), on the other hand, use the dichotomy of current needs and future needs and propose such interaction mechanism as discussions, meetings, and information exchange as a way to understand them. Further, von Hippel (1977, 1978, 1986) introduces the concept of lead user's needs, the needs that face a small group of users months or years before the bulk of that marketplace encounters them. The author recommends the use of personal interviews and problem solving sessions to uncover such needs. The importance of customer interaction in generating customer information is empirically supported by Cooper (1979, 1992), and Rothwell and Robertson (1975) who demonstrate that customer interaction is a major factor contributing to innovation success and lack of such interaction is a main reason behind innovation failure. Table 2.1. is an overview of selected literature on customer information acquisition.

TABLE 2.1.

Overview of Studies on Customer Knowledge Generation

Information Acquisition Selected literature	Means of acquisition	Reasons for acquisition
Utterback (1977)	informal, formal, oral communication	obtaining information about needs, technical possibilities, generating and developing new product ideas
Kohli and Jaworski (1990)	meetings, discussions, information exchange	obtaining information about current and future needs and preferences
Rothwell and Robertson (1975)	personal contact	interaction leads to success
Ram (1989)	face to face, printmedia	reducing perceived risk, behavioral resistance, modifying products
Von Hippel(1977,1978, 1986); Urban, and von Hippel(1988)	personal interviews, problem solving sessions	obtaining information about needs of lead users, benefits expected from lead users
Griffin and Hauser (1991)	focus groups, one-on-one interview	acquiring information about basic needs, articulated needs surprise needs
Information Interpretation Selected Literature	Means of interpretation	Reasons for interpretation
Griffin and Hauser (1991) Griffin (1992)	identifying,structuring prioritizing customer needs (bottom up)	making customer needs manageable, finding gaps between needs and product offered, matching needs with product attributes
Meyers and Athaide (1991)	knowledge sharing, infusion, generation	finding a match between known/emerging needs with stable/evolving technology
Holak and Lehmann (1990)	examination and evaluation of attributes: relative advantage, compatibility complexity, divisibility (top down)	finding a match between new product design and customer preference, increasing acceptability and reducing risk

Information interpretation. Once information is acquired, it needs to be processed and interpreted because the initial information is normally unorganized and unstructured and thus inappropriate to be used as an input in innovation process. The necessity of information interpretation has been the research focus of several authors. Griffin and Hauser (1991) argue that in order to make information about customer needs manageable and close the gap between unprocessed customer needs and product attributes offered by innovation, the company should employ well structured methods in information interpretation. Accordingly, the authors introduce an approach in which various customer needs are (1) identified through focus groups; then (2) structured into a hierarchy of primary needs (also called strategic needs which set the strategic direction for the new product), secondary needs (also known as tactical needs which indicate more specifically what can be done to fulfill the corresponding primary needs), and tertiary needs (also called operational needs which provide detailed requirements to R&D); and eventually (3) prioritized into ranked groups that can help the firm make decisions which balance the cost of fulfilling a need and the benefit to the customer. In another study, Meyers and Athaide (1991) suggest that information interpretation is the key in finding a match between customer needs and technology. They classify customer needs into two kinds: those that are known to the market and those that are still emerging; and technology into two categories: stable technology and evolving technology. To find a fit between needs and technology, according to the authors, the firm should initiate an information interpretation process called mutual learning in which the firm and the customer

share and infuse their respective knowledge and generate new integrated knowledge. While many authors concentrate on a bottom-up approach in which customer needs are processed first, and then product attributes are designed to meet these needs, Holak and Lehmann (1990) introduce a top down approach in which the firm presents its new product design to buyers and let buyers examine and evaluate attributes of the product design on several dimensions of needs including relative advantage, compatibility, complexity, and divisibility. Such a method is helpful in increasing the customer acceptability of a new product and reducing the customer perceived risk. Table 2.1 presents a brief literature review on information interpretation.

2.3.2B. Integral Knowledge Focus

Integral knowledge focus is defined as the generation of integrated knowledge of solution to customer needs through marketing-R&D communication and cooperation.

Integral knowledge is critical to product innovation because of the nature of new product development. According to Griffin and Hauser (1991) new product development is a process of synthesizing the knowledge of what is needed in the market and the knowledge of how to create a product to meet the need. While the knowledge of what is needed is normally best possessed by the marketing function because of its close ties with the market, the knowledge of how to produce is best manifested by the R&D function because of its technological specialization. However, if the two functions are secluded from each other, the knowledge of what is needed in the market and the knowledge of how to produce will be isolated,

resulting in a mismatch between what is produced and what is needed. On the other hand, when the two functions communicate and cooperate with each other, their abilities to produce successful products will increase. In a similar line of argument, Moenaert and Souder (1990) propose that product innovation is a process of reducing innovative uncertainty. The innovative uncertainty exists because there is normally a gap between unrealized user requirements and knowledge about technological solutions. When marketing and R&D functions are integrated, such a gap will be narrowed or closed thus reducing the innovative uncertainty. However, if the two functions are insulated from each other, the gap will stay untouched and the innovative uncertainty will remain.

Because of its impact on product innovation success, knowledge integration has been the focus of a number of conceptual and empirical studies (Cooper 1983, 1984; Cooper and de Brentani 1991; Griffin and Hauser 1991; Gupta, Raj, and Wilemon 1986; Pinto and Pinto 1990; Souder 1978, 1988). In each study, the researchers either support or are consistent with the hypothesis that knowledge integration enhances success. Summarizing the findings of these studies, Griffin and Hauser (1991, p.5) conclude that the evidence of knowledge integration leading to success is "strong, consistent, common to a variety of methodologies, and seemingly applicable in both services and products and in both consumer and industrial markets. Few, if any, management principles are based on such univocal evidence."

Marketing-R&D Communication. Communication plays a key role since the two functions integrate their knowledge through communication and the intensity

of their communication has a direct impact on success of new product development. The importance of communication is demonstrated by several studies on product innovation. Utterback (1971) suggests that communication is the key in matching market needs and technical possibilities and developing new product ideas. Pinto and Pinto (1990) uncover a strong positive relationship between cross-functional communication and success of new product development project. Dougherty (1987), in a comprehensive research on innovation and communication, studied pairs of successful and unsuccessful new-product projects and revealed that the intensity of communication between functions on all relevant topics separated successful projects from unsuccessful projects. Further, Gupta, Raj, and Wilemon (1985) find that lack of communication is the number one barrier to achieving knowledge integration. Table 2.2. offers an overview of selected literature that demonstrates the importance of communication in achieving marketing-R&D knowledge integration.

Marketing-R&D cooperation. Marketing and R&D functions can cooperate in a number of ways. The first is task specification. Griffin and Hauser (1991) classify functional responsibilities into three categories: 1) marketing dominant responsibilities, 2) R&D dominant responsibilities, and 3) shared responsibilities. The shared responsibilities are those core tasks, such as setting new-product goals and establishing the core benefit proposition for new product, that require cooperation and combined expertise of both functional groups throughout the period of the task and upon which the success of the enterprise rests. In task specification, those responsibilities and activities that are needed to be shared are

TABLE 2.2.

Overview of Studies on Marketing-R&D Knowledge Integration

Marketing-R&D Communication Selected literature	Evidence
Dougherty (1987)	The intensity of communication on all relevant topics separated successful projects from unsuccessful projects.
de Brentani (1989)	Communication between functions in the process of product innovation had a positive impact on sales and market share.
Gupta,Raj,and Wilemon (1985)	Lack of communication was found to be the number one barrier to achieving integration among marketing and R&D.
Pinto, Mary Beth and Jeffrey K. Pinto (1990)	Strong positive relationship existed between cross-functional communication and success of the new project.
Rothwell and Robertson (1975)	Poor communication between functions contributed to innovation failure.
Utterback (1971)	Communication is the key in developing new product ideas and matching market needs and technical possibilities.

Marketing-R&D Cooperation Selected literature	Mechanism suggested	Reasons for cooperation
Moenaert and Souder (1990)	task specification, organizational structural design, organizational climate	interdependence of R&D and marketing, synergy effect, integration leads to success, reduce information uncertainty
Griffin and Hauser (1992)	organizational structure, shared responsibilities, organizational culture	interdependence of market opportunities & technological feasibility, integration leads to success
Souder (1987, 1988)	specification of core benefits and shared responsibilities	matching market needs with product benefits
Wheelwright, and Clark(1992)	joint decision making process	reducing barriers to cooperation

explicitly specified and planned, thus providing a direction for functional cooperation (Cooper 1983; Griffin and Hauser 1991; Moenaet and Souder 1990). The second mechanism for cooperation is the design of organizational structure. In a study of 80 technology intensive companies, Gupta and Wilemon (1988) found organization structures that facilitate cooperation normally possess a number of distinctive characteristics such as harmonious operation, decentralization, innovativeness, cooperation, and joint reward system. Organizational structures that demonstrate these characteristics have been proposed and explored, including multidisciplinary groups (Moenaert and Souder 1990), coordinating groups (Lorsch and Lawrence 1965; Griffin and Hauser 1991), project or program teams (Marguis and Straight 1965; Griffin and Hauser 1991), the new product committee (Souder 1987, 1988), and matrix organization (Babcock 1991). The third mechanism for cooperation is the promotion of an organizational culture that nourishes functional cooperation. Although a short-term marketing and R&D cooperation may be achieved through administrative means, this cooperation cannot sustain without a supportive organizational culture. As proposed by Moenaert and Souder (1990, p.96), "promoting an ingrained cultural sense of coordination and integration among its members may be the most effective mechanism" for cooperation. Table 2.2 provides a short summary of the studies that propose the three mechanisms for cooperation.

2.3.2C. Competitor Knowledge Focus

Competitor knowledge focus is the third component of a market-oriented strategy. According to Day and Wensley (1983, 1988) and Kotler (1988), the

adoption of a competitor knowledge focus is a recent phenomenon resulting from the intensified competition in the market. Since the late 70s and the early 80s, competition is characterized by the increasing number of foreign firms entering the U.S. market (Ohmae 1986), the shortening of product life cycle and new product development time (Edgett, Shipley, and Forbes 1992), and rapid diffusion of new technology (Gatignon and Robertson 1989). With competition ever sharpening, "having an understanding of customers is not enough today" (Kotler 1988, p.234) since competitors may (1) develop a superior new product that can better satisfy customer needs, (2) launch a similar product ahead of your firm, or (3) produce an imitated version of your product with better functions. Consequently, "today's companies are starting to pay as much attention to tracking their competitors as to understanding their target customers." (Kotler 1988, p.234)

Specifically, competitor knowledge focus means the generation of competitor knowledge on the weakness and strengths of competitors' products through competitor information acquisition and interpretation.

Competitor information acquisition. It is important to acquire competitor information because such information provides diagnostic value in the analysis of competitive positioning (Day and Wensley 1988). In product innovation, firms can be generally classified into any of the three positions: positional inferiority, positional parity, and positional superiority. In positional inferiority, the firm is inferior to its major competitors on key dimensions of product innovation such as technology ownership, resource control, and product characteristics (functions, forms, performance). In positional parity, the firm gains identical footing on these

dimensions with its rivalry. In positional superiority, the firm is superior to its competitors on these dimensions. However, without competitor information acquisition it will be impossible to diagnose the firm's position since there is no framework of comparison. As stated by Day and Wensley (1988), competitor information provides the standard of comparison in assessing advantage. To fully realize the diagnostic value of competitor intelligence, several studies examine what types of competitor information are needed for acquisition. Table 2.3. presents a brief view of these studies.

Competitor information interpretation. Once competitor information is acquired, it should be interpreted and utilized to create competitive advantage. The value chain analysis proposed by Day and Wensley (1988) provides a proper conceptual framework to interpret and utilize competitor information. The value chain can be classified into two types: the internal chain and the external chain. The internal value chain is linked by value-added activities within a functional area whereas the external value chain is joined by value-added activities of different functional areas. Lawless and Fisher (1990) propose that along the internal chain in product innovation, three links are essential. They identify these links as design of product function (physical attributes relating to a new product's instrumental performance), design of product form (physical attributes relating to a new product's aesthetic design), and design of product intangibles (nonphysical product characteristics). To create competitive advantage, the firm needs to compare its capabilities with those of its competitors in creating customer value along these links. Then, the firm should concentrate its efforts on those activities

TABLE 2.3.

Overview of Studies on Competitor Knowledge Focus

Competitor Information Acquisition	
Selected literature	Information required
Narver and Slater (1990)	short-term strengths and weaknesses, and long-term capabilities and strategies of the key competitors
Day and Wensley (1988)	strengths and weaknesses, technological skills, relative size of resources, cost structure, attribute ratings of products
Maidique and Patch (1978)	product development strategy, technology selection or specialization, level of competence, sources of capabilities, R&D investment level, competitive timing: initiate versus respond, customer perceptions
Rothschild (1979)	technical resources: concepts, patents and copyrights, technological sophistication; human resources: key people and skills, use of external groups; funding: total, percentage of sales, internally generated, market response

Competitor Information Interpretation	
Selected literature	Creating advantage
Lawless and Fisher (1990)	creating strategic non-imitability in product form, product function, and product intangibles
Cooper (1979, 1992)	creating unique and superior product (unique features, higher quality, better customer perception)
Edgett, Shipley, and Forbes (1992)	superior quality, superior reliability, superior design

that (1) can result in product attributes valued by customers, (2) can produce those product characteristics that are not easily imitated by competitors, and (3) the firm is capable of doing. In addition, the external chain, which consists of production, packaging, promotion, pricing, and distribution, can be analyzed in a similar manner to determine how to facilitate the success of new product. However, in product innovation, the analysis of the internal chain is of primary importance since the major task here is to create a competitive new product.

2.3.2D. R&D Strength

While this study criticizes the economics view on R&D investment, it is not my intention to underestimate the role of R&D investment in product innovation. On the contrary, I do consider R&D strength is an important factor in product innovation. Together with the other three behavioral components of a market-oriented strategy, it will exert an positive impact on competitiveness in product innovation.

2.4. Outcome Measures of Market-Oriented Strategy

The outcome measures of a market-oriented strategy can be classified into two types: those embodied in the product characteristics such as product quality, reliability and uniqueness, and those reflected in the firm's market achievements such as profitability and sales revenue. While those embodied in the product characteristics can be summarized as competitiveness in product innovation, those reflected in the firm's market achievements can be generalized as market performance. Further, competitiveness in product innovation is considered as the

direct measure of a market oriented strategy and market performance is the indirect measure that is moderated upon by the direct measure.

2.4.1. Competitiveness in Product Innovation

Competitiveness in product innovation refers to a firm's ability to develop new products that create customer value more effectively and efficiently than competitors (Kotler 1988). However, such competitiveness can not be gauged by a single measure since a single measure reflects only one facet of the construct. A synthesis of the previous studies suggests competitiveness can be measured in two dimensions: customer attributes dimension, and efficiency and effectiveness dimension. Table 2.4. presents an overview of the two dimensions used in the literature.

Customer attributes. Customer attributes dimension measures the firm's ability to meet customer needs on major product attributes such as new product quality, reliability, design, newness, and uniqueness. In recent years, customer attributes dimension has been adopted widely by researchers (Crawford 1987; Cooper 1979, 1983, 1985, 1992; Edgett, Shipley, and Forbes 1992; Griffin and Hauser 1991; Wheelwright and Clark 1992) in product innovation because it provides a more concrete picture of the firm's competitiveness in product innovation. Further, such measures can be adapted minutely to different product categories as has been done by Wheelwright and Clark (1992, p.230) who offer an example of using accuracy, smoothness, weight, quietness, compactness, reliability etc. to measure competitiveness in gear products.

Efficiency and effectiveness. Efficiency and effectiveness in product

TABLE 2.4.

Competitiveness in Product Innovation

Customer Attribute Dimension	
Selected literature	Description
Cooper (1983)	Products offer unique features to customers Products have better quality than competing products Products allow the customer to reduce costs Products allow the customer to increase work efficiency
Cooper (1992)	Product superiority/quality Economic advantage
Edgett, Shipley and Forbes (1990)	Products superior to competition in quality, design, reliability, value for money,
Wheelwright and Clark (1992)	Products superior to competitor in reliability, accuracy, smoothness, cost, weight, sound, wait time, etc.

Efficiency and Effectiveness Dimension	
Selected literature	Description
Cooper and Kleinschmidt (1991)	Firm's ability to develop product faster than competition Firm's ability to develop product on target
Millson, Raj, and Wilemon (1992)	Firm's ability to accelerating new product development
Wheelwright and Clark (1992)	Speed: firm's ability to design and bring new products quickly in response to competition Productivity: firm's ability to exploit product variety, to utilize resources more efficiently per project

innovation refer to the firm's ability to develop new products more quickly and productively than competitors (Wheelwright and Clark, 1992). The importance of speed as a competitiveness measure has been long recognized by researchers in product innovation (Cooper 1979; Millson, Raj and Wilemon 1992). In recent years, with the shortening of product life cycle and rapid diffusion of technology, bringing new products faster to the market becomes even more critical. In addition to speed, Wheelwright and Clark (1992) propose using innovation productivity as another measure of competitiveness. They (1992, p.5) argue "because the number of new products and new process technologies has increased while model lives and life cycles have shrunk, firms must mount more development projects than has traditionally been the case utilizing substantially fewer resources per project."

2.4.2. Market Performance

The literature suggests that profitability is the major performance measure for a market orientation since profitability is the overriding objective for businesses (Kohli and Jaworski 1990; Narver and Slater 1990). However, for organizational innovativeness, other financial measures such as return on investment and sales growth are also found to be valid measures (Deshpande, Farley, and Webster 1993). In this study, I take a compromise position and adopt an integrated measure of performance which includes profitability, return on investment, and sales growth.

2.5. Environmental Factors: A Contingency Perspective

In the previous section, I develop a framework for a market-oriented strategy. This section presents a contingency theory which integrates environmental factors with a market-oriented strategy. Specifically, this theory proposes that the extent to which a firm adopts a market-oriented strategy is influenced by three drivers of environmental factors: customer demandingness, competition intensity, and technology change.

This section is divided into three portions. First, I conduct a literature review on environmental perspective so that a better understanding of the historic background of the contingency theory can be achieved. Second, the contribution from management science is examined since the development of contingency theory was mainly attributed to professionals in this discipline. Third, I review how marketing discipline contributed to environmental perspective through conceptualization of three major market factors. Finally, the three environmental factors that exert an impact on a market-oriented strategy are introduced and discussed.

2.5.1. Ecology and Environmental Perspective

The study of the impact of environmental factors was not only initiated historically by ecologists but also has been their research focus ever since. According to ecological theories (Farb 1963), environment, which is defined as the surrounding of an individual organism or a community of organisms that is able to sustain life, has a direct impact on the way of living adopted by different species. The environmental impact can be observed in several ways: (1) Each species has

to adapt its way of living to environment; (2) A particular way of living may be associated with a specific type of environment; (3) A species that adapts well will survive; and (4) A species that can not adapt will perish (Farb 1963; Emlen 1973).

Human ecology extended the theory of environmental impact to the relationship between human beings and their natural and physical environment, and found many cases where different ways of life were associated with different habitats of environment (Hawley 1950). For example, in his classical case study, Barth (1956) discovered that in a mountainous area in Pakistan, three ethnics groups, the Kohistanis, the Pathans, and the Gujars, lived in three different habitats - the valley, the mountain, and the marginal area in between. As a result of their heterogeneous habitats of environment, each ethnic group adopted a different way of life.

The ecological view was pivotal in our understanding of environment and human behavior. For the first time, human behavior was no longer seen as a isolated phenomenon, but a function of its surroundings. Most importantly, the concepts created by ecologists, such as environment, environmental impact, and adaptation, have laid theoretical ground work for study of the relationship between environment and human behavior by other disciplines.

2.5.2. Management and Environmental Perspective

Applying the ecological approach to the study of organizational behavior, researchers in management tend to "view the environment as a deterministic influence to which organizations adapt their strategies, structures, and processes" (Zeithaml and Zeithaml 1984). This transformation of the ecological view to the

organizational contingency perspective was reflected particularly in landmark research such as Duncan (1972), Lawrence and Lorsch (1967), and Neghandi and Reimann (1973). As a group, these authors posit that (1) a firm's external environment changes over time; (2) the changing environment influences firm's strategic choice and economic performance; and (3) firms that do not respond to changes in external environment cannot compete effectively. Guided by the contingency approach, a stream of literature was formed in organizational behavior to explore what environmental factors may affect a firm (Downey, Hellriegial, and Slocum 1975); what strategies may be formulated to respond to changes in environment (Bourgeois 1980; Hofer 1975); and what conditions may result in a fit between a firm's strategy and changing environment (Stoner 1982).

In summary, the contingency perspective conceptualizes the environment as a causal variable: organizational performance is dependent upon the efficient and effective adaptation of organizational strategies to environmental contingencies (Zeithaml and Zeithaml 1984).

The emergence of contingency perspective is a landmark in research on organization and strategy. Prior to the contingency approach, the study of organization was dominated by the classical and quantitative schools of management thought which focused solely on the internal operations of a firm such as job design, specialization, productivity, and structure. However, in their concern with the internal environment, they underplayed the importance of the external environment. In contrast to the classical approaches, the contingency theory emphasizes the interaction between a firm and its external environment and

uncovers the dependent relationship between a firm's strategy and its external market factors. Most significantly, the contingency theory views external environment as dynamic rather than static and establishes the analysis of the changing environment as a prerequisite in a firm's formulation of strategy.

2.5.3. Marketing and Environmental Perspective

Influenced by the ecological view and the organizational contingency theory, marketing literature also emphasizes the importance of the environmental impact. Further more, through integrating the ideas from the allied disciplines with marketing experience, researchers in marketing have contributed uniquely to the development of the environmental perspective.

2.5.3A. Customer as an Environmental Factor

First, marketing discipline, through the marketing concept, established customer needs and wants as the primary environmental factor that impacts the firm's strategy and goal achievement. This view of customer priority is reflected in Kotler's interpretation of the marketing concept (1988, p.17):

"The marketing concept holds that the key to achieving organizational goals consists in determining the needs and wants of target markets and delivering the desired satisfactions more effectively and efficiently than competitors."

Therefore, the organization should first determine what the customer's needs and wants are, analyze opportunities offered by the market demand, structure organizational goals, then design marketing strategies to satisfy such needs and wants better than competitors.

The view that customer needs and wants are primary and the company

must adapt its strategy to meet these needs and wants is considered a break-through in managerial thinking (Sheth, Gardner, and Garrett 1988, p.97). Prior to the marketing concept, managerial principles, such as the product concept and the production concept, took the position that the company was the center of the business universe and the company should be skillful in making the customer do what suits the interests of the business. With the adoption of the marketing concept, this position is reversed as indicated by one of the pioneers of the concept, McKitterick (1957):

"So the principal task of the marketing function in a management concept is not so much to be skillful in making the customer do what suits the interests of the business as to be skillful in conceiving and then making the business do what suits the interests of the customer."

2.5.3B. Competitor as an Environmental Factor

The second contribution of marketing discipline to the environmental perspective is the identification of the competitor as a main factor influencing a firm's strategy. The emphasis on competitor can be found in several writings. For example, Lehmann and Winer (1988, p.8) point out:"Monitoring competitors' strategies and anticipating their future moves is a key to the development of successful marketing strategy."

Similarly, Kotler argues (1988, p.234):"The fact is that knowing one's competitors is critical to effective marketing planning. The company should constantly compare its products, prices, channels, and promotion with those of its close competitors. In this way, it can discern areas of potential competitive

advantage and disadvantage."

Hence, the design of an effective strategy depends on sufficient understanding of the competitor. On the one hand, the organization must learn major characteristics of its competitors such as their capabilities, objectives, strategies, strengths and weakness in order to design a strategy to gain differential advantages over competitors. On the other hand, the firm must constantly monitor moves from its competitors and adjust its strategy accordingly to maintain its competitive advantage.

The explicit recognition of competitive forces as a major environmental factor is no coincidence but reflects the reality of today's competitive market. Among the U.S. firms, competitive pressures are so intense that gains in sales volume and market share by one company are often derived from the losses by other firms. Further, foreign companies have made much erosion into many of the product markets such as automobile, airplane, and electronics which were traditionally dominated by the U.S. organizations. Under such competitive conditions, firms that neglect competitors are doomed to failure.

2.5.3C. Technology as an Environmental Factor

In addition to competitive impact, the effect of technology on business strategy also receives great attention in marketing. Technology is defined as "technical skills and equipment that affect the way an economy's resources are converted to output," (McCarthy and Perreault 1993, p.121). In the last two decades, technological change has been accelerated and become a major factor

of instability, as stated by Capon and Glazer (1987, p.1) that "it is by now apparent that a major engine of the unprecedented instability is technology or, more precisely, the emergence of rapidly changing technologies into the environment." The accelerating pace of technological change exerts a major impact on firm's strategic formulation since such change can shorten product life cycle, create market segment instability, and shift product market boundaries.

2.6. Environmental Factors and Market-Oriented Strategy

The three major environmental factors, customer, competitor, and technology, are the major drivers for the adoption of a market-oriented strategy. In this section, the characteristics of these drivers are examined.

2.6.1. Customer Demandingness

Customer demandingness refers to the level of buyers' requirement for product performance such as quality and reliability, and their knowledge about technical standards and specifications. These customer features have a profound impact on innovation strategy and performance. Porter (1990) observes in his book, *Competitive Advantage of Nations*, that sophisticated and demanding customers are a major demand factor that drives firms to update innovation and achieve superior performance.

In recent years, this demand factor has become more significant as there has been a steady increase in customer sophistication and demandingness for the products they want to buy. This characteristic of demand factor is emphasized by Wheelwright and Clark (1992, p.2) who argue in their book, *Revolutionizing*

Product Development, that "Customers have grown more sophisticated and demanding. Previously unheard of levels of performance and reliability are today the expected standard. Increasing sophistication means that customers are more sensitive to nuances and differences in a product, and are attracted to products that provide solutions to their particular problems and needs."

As customers become more demanding, firms are prompted to focus more intensely on their needs and wants in order to develop needs-satisfying products with superior value, thus highlighting the importance of customer focus in product innovation.

2.6.2. Competition Intensity

The second environmental factor that provides a stimulus for a market orientation is competition which has become more intensified over the last two decades. This can be observed in two aspects. First, the entry barriers many firms used in the past to protect themselves have become less protective. According to Capon and Glazer (1987, p.3), because of rapid dispersion of technology and corresponding decrease in technology proprietorship, "markets and products are less proprietary and entry barriers that firms have relied on to protect their positions are coming down." Second, more and more firms have entered the global market and posed serious threats to companies with a traditional domestic approach, as noted by Wheelwright and Clark (1992, p.2) that "in business after business, the number of competitors capable of competing at a world-class level has grown at the same time that those competitors have become more aggressive," resulting in a more competitive environment in which "the list of one's

toughest competitors now includes firms that may have grown up in very different environments in North America, Europe, and Asia."

The reduced protection from entry barriers and the growth of global competition have exerted enormous pressure on firms to observe more closely their competitors and continuously improve their competitive advantage through product innovation thus signifying the imperativeness of adopting competitor focus.

2.6.3. Technology Change

The third environmental factor that impacts on product innovation is technology. In today's competitive market, technology is characterized by diversity and rapid change. Diversity refers to the breadth and depth of technological knowledge and equipment that are available in new product development. In the last two decades, both the breadth and depth of technology have increased resulting in a growth in "the variety of possible solutions available to engineers and marketers in their search for new products." (Wheelwright and Clark 1992, p.2) For example, in automobile industry alone, the engine-drive train technology had grown from 5 in 1970 to 33 in early 1980s.

Another feature of technology is its rapid dispersion and change. Ohmae observes (1989, p.145), in industry after industry, technology has become more diverse and firms, whose end products are used as input of technical skills and components by other producers, are eager to "sell their products as wide a range of customers as possible". According to the author, "the inevitable result is the rapid dispersion of technology" and "no one can truly keep all critical technologies out the hands of competitors around the globe."

In Section 2.6., through a synthesis of studies on environmental impact, I develop a contingency perspective and identify three environmental factors that may provide impetus for firms to pursue a market-oriented strategy in product innovation. These factors are customer demandingness, competition intensity, and technology change.

2.7. Top Management Perception of Market Knowledge

In addition to the external environmental factors, several authors suggest that top management plays a key role in shaping an organization's orientation and values (Deshpande, Farley, Webster 1993; Felton 1959; Hambrick and Mason 1984, Kohli and Jaworski 1990). Summarizing the theme of these writers, Jaworski and Kohli (1993, 55) note: "Unless an organization gets clear signals from top managers about the importance of being responsive to customer needs, the organization is not likely to be market-oriented. Top management reinforcement of the importance of a market orientation is likely to encourage individuals in the organization to track changing markets, share market intelligence with others in the organization, and be responsive to market needs."

In a similar manner, when top management is more appreciative of the value of market knowledge in product innovation, the organization is more likely to pursue customer, competitor, and integral knowledge focuses. By contrast, if top management disregards the importance of market knowledge, the organization is more likely to follow an inward orientation and be unresponsive to the market. Therefore, I propose a positive relationship between the top management's

perceived importance of market knowledge and the organization pursuit of market orientation in product innovation.

2.8. Summary

In this Chapter, through a review and integration of literature in marketing and product innovation I develop a model of a market-oriented strategy in product innovation. Three levels of constructs are delineated: (1) market-oriented strategy constructs, (2) outcome constructs, and (3) constructs of external and internal factors. The development of the model leads to the following research questions:

1. Does the adoption of a market-oriented strategy have a postive impact on competitiveness in product innovation?
2. Does competitiveness in product innovation lead to superior market performance?
3. Do the external and internal factors influence a market-oriented strategy?

CHAPTER THREE

HYPOTHESES AND RESEARCH MEASUREMENT

In the previous chapter, through an integration of the market-oriented approach and the contingency perspective I develop a model of a market-oriented strategy in product innovation. In the model, three levels of constructs are identified and delineated: constructs of a market-oriented strategy, constructs of innovation outcomes, and constructs of external and internal factors. The development of the model raises three key research questions: (1) Does each construct of a market-oriented strategy exert an impact on firm's competitiveness in product innovation? (2) Does competitiveness in product innovation lead to superior market performance? and (3) Does each construct of external and internal factors influence a firm's implementation of a market-oriented strategy?

In this chapter I propose and develop a series of hypotheses to address these research issues. In the first section, the relationship between each construct of a market-oriented strategy and competitiveness in product innovation is discussed and hypothesized. Next, the relationship between competitiveness in product innovation and market performance is analyzed and postulated. Finally, the relationship between each construct of external and internal factors and a market-oriented strategy is examined and proposed.

3.1. Market-Oriented Strategy and Competitiveness in Product Innovation

3.1.1. Customer Knowledge Focus and Competitiveness in Product Innovation

Several insights obtained from the literature pertain to the implementation of customer knowledge focus and the consequence of such implementation. In a study of 56 industrial firms in Europe, Sanchez and Elola (1991, p.51) provided evidence supporting the view that customer knowledge focus is an industry-wide practice. They noted: "Direct, permanent contact with customers is the most frequent method of finding out whether or not there is a suitable market for the new product, which correlates with the preponderance of market as a source of new ideas." Further more, the authors found that customer knowledge focus provides "the greatest stimulus to innovation in the industrial firms analyzed."

Similarly, Cooper (1992, p.124) argued that customer knowledge focus enhances product innovation success through an evaluation of true benefits and value offered to customers by new products. The author explained that a customer knowledge focus approach "which entailed discussion with key potential customers would determine product performance requirements and confirm or refute that ... proposed features were indeed customer benefits and of value to customers." Most importantly, in his decade-long research on NewProd project which involved firms in the U.S., Canada, and Europe, Cooper (1979, 1983, 1985, 1992) identified customer knowledge focus to understand and meet customer needs as one of the most important factors in enhancing competitiveness in product innovation.

Not surprisingly, other researchers on product innovation reached similar conclusion that customer knowledge focus strengthens competitiveness. For example, in a comparative study of 116 Japanese firms and 86 British firms, Edgett, Shipley, and Forbes (1992) identified customer focus to understand and match customer needs as the most important factor contributing to innovation competitiveness and success. On the other hand, among all the failure factors, inability to understand customer needs was found to be the major cause of product failure. Hence:

H_{1a}: The greater the customer knowledge focus of an organization, the greater its competitiveness in product innovation.

3.1.2. Integral Knowledge Focus and Competitiveness in Product Innovation

In the previous chapter I define integral knowledge focus as the generation of solution pertaining to customer needs through marketing-R&D communication and cooperation in the process of new product development. Integral knowledge focus is critical to competitiveness in product innovation since market acceptance of a new product depends on how well the firm synthesizes the knowledge of what is needed in the market and the knowledge of how to produce it (Griffin and Hauser 1991). While effective integration of marketing and R&D generates strong infusion of the two types of knowledge thus resulting in customer needs being better served, the seclusion of the two functions spawns a mismatch between market needs and a company's offering.

Because of its strong impact on competitiveness in product innovation, integral knowledge focus has received extensive attention in the literature (Cooper

1983, 1984; Cooper and de Brentani 1991; Griffin and Hauser 1991; Gupta, Raj, and Wilemon 1986; Pinto and Pinto 1990; Souder 1978, 1988). In each study, the researchers either support or are consistent with the proposition that integral knowledge focus enhances competitiveness in product innovation. Hence:

H_{1b}: The greater the integral knowledge focus of an organization, the greater its competitiveness in product innovation.

3.1.3. Competitor Knowledge Focus and Competitiveness in Product Innovation

Competitor knowledge focus refers to generation of competitor information on the weaknesses and strengths of the key current and potential competitors. Competitor knowledge focus is strategically valuable since knowledge of the competitor's weakness and strengths allows an organization to create competitive advantage in product innovation in three ways: (1) exploiting the competitor's weakness by pitching the organization's strengths against the competitor's weakness, (2) internalizing the competitor's strengths by first imitating and then improving on the competitor's strengths, or (3) avoiding the competitor's strengths by differentiating its products. Similarly, when being ignorant of its competitors' activities, the organization's strong position may be eroded by its more informed foes. And for a weak firm, it may further lag behind its rivals. Consequently, "today's companies are starting to pay as much attention to tracking their competitors as to understanding their target customer." (Kotler 1988, p.234) Several authors (Day and Wensley 1988; Sheth, Gardner, and Garrett 1988) even posit that strategy should be founded on two pillars - a thorough understanding

of the customer's needs and behavior, and a critical analysis of competitors for competitive advantage.

While the idea that competitor knowledge focus strengthens competitiveness is well conceptualized in the literature, empirical study is lacking. Therefore I hope to address this deficiency through the following proposition:

H_{1c}: The greater the competitor knowledge focus of an organization, the greater its competitiveness in product innovation.

3.1.4. R&D Strength and Competitiveness in Product Innovation

The traditional economics theories (Adams 1970; Galbraith 1952; Fisher and Temin 1973) used the absolute amount of R&D expenditure to gauge a firm's R&D strength. Recent studies (Chussil 1988) in marketing and management adopted more relative measures such as a firm's R&D investment as percentage of its sales, and a firm's R&D expenditure compared with its competition's.

When R&D was employed as the only factor to explain product innovation and performance the result was often inconclusive (Chussil 1988). But when it was used with multiple factors to explain innovation outcomes, it frequently yielded positive impact on innovation and product quality (Hill and Snell 1989; Szymanski, Bharadwaj, and Varadarajan 1993) since buyers may prefer products with more innovative features and better quality and be willing to pay a premium price for these products. Consequently, the increase in sales and greater revenues per sale may more than offset the increased expenditures on R&D since R&D expenditure per unit of products sold decrease as total sales increase (Buzzell and Gale 1987). Therefore I propose:

H_{1d}: The greater the R&D strength, the greater the competitiveness in product innovation.

3.2. Competitiveness in Product Innovation and Market Performance

3.2.1. Competitiveness in Product Innovation and New Product Market Performance

The ultimate goal of a firm's innovation strategy is to succeed in the market place. However, the issue of whether competitiveness in product innovation correlates with performance is controversial. On the one hand, a number of empirical studies in product innovation (Cooper 1982, 1983, 1992; Edgett, Shipley, and Forbes 1992; Hise, O'Neal, Parsuraman, McNeal 1990) provide strong evidence that competitiveness in product innovation leads to superior product market performance. On the other hand, research on first mover advantage (Kerin, Varadarajan, and Peterson 1992) indicates that the evidence is inconclusive.

A careful examination of the two types of studies reveals the source of the deviation: different measures of product innovation. Studies on product innovation often measure competitiveness in product innovation in multiple measures: e.g. product newness, reliability, quality, and productivity, etc. Studies on first mover advantage focus on one dimension only: the time of product introduction.

In this study, while I agree that the first mover may not achieve super performance I believe that competitiveness measured by multiple indicators can give a better picture of a firm's product innovation and therefore may lead to superior performance. Hence:

H_{2a}: the greater the competitiveness in product innovation, the better the product market performance.

3.3. Environmental Factors and Market-Oriented Strategy

In Chapter 2, from a comprehensive review of the contingency perspective we learn that the environment may act as a causal factor influencing a firm's strategy formulation and organizational performance is dependent upon the efficient and effective adaptation of organizational strategies to environmental contingencies. In particular, I identify three environmental factors that may provide impetus for firms to pursue a market-oriented strategy: customer demandingness, competition intensity, and technology change.

3.3.1. Customer Demandingness

The first factor hypothesized to have an effect on a market-oriented strategy is customer demandingness. Customer demandingness refers to the level of buyers' requirement for product performance such as quality and reliability, and their knowledge of technical standards and specifications. In recent years, as customers in many product markets become more sophisticated they are demanding for products with better quality, high reliability, and more advanced features. Several authors point to customer demandingness as a catalyst for firms to pursue a market-oriented strategy in product innovation (Gupta, Raj, and Wilemon 1986; Porter 1990; Wheelwright and Clark 1992). Essentially, customer demandingness drives firms to learn more about their clients' particular needs and preferences through customer knowledge focus, and then integrate their customer

knowledge with their technological capabilities. In addition, greater customer demandingness may signal that customers are not satisfied with existing products, thus pushing firms to increase their R&D investment to develop new products to replace those in the market. No effects are expected for competitor knowledge focus, since not every firm operates in a competitive product market. For those firms in less competitive product markets (such as a monopolistic market), they mainly respond to their customers to maintain their market status. Therefore, it is hypothesized that:

H_{3a}: The greater the customer demandningness,the greater customer knowledge focus.

H_{3b}: The greater the customer demandingness, the greater the integral knowledge focus.

H_{3c}: The greater the customer demandingness, the greater the R&D strength.

3.3.2. Competition Intensity

The second factor proposed to affect a market-oriented strategy pertains to competition intensity. Competition intensity refers to the level of competition in a product market including market volatility, predictability, and number of competitors.

As several authors (Gupta, Raj, and Wilemon 1986; Kohli and Jaworski 1990) observe, in the absence of competition, monitoring competitors is not a necessity by default. By contrast, under conditions of intensified competition, an organization may be pressed to study its competitors constantly since competition

may introduce new products that are superior in quality and performance and negligence of competition may end up in losing market share and customers. Stated formally:

H_{4a}: The greater the competition intensity, the greater the competitor knowledge focus.

3.3.3. Technology Change

The last environmental factor posited to influence a market-oriented strategy, is the rate of technology change, measured by technology obsolescence rate and new product introduction rate.

In a product market where technology experiences a shorter life cycle and firms rival each other for new product development speed, organizations may have a stronger need for gathering competitor information and for increasing R&D investment. On the other hand, in a market with low rate of technology change, the pressure on firms to engage in competitor intelligence gathering and to increase R&D intensity may not be as heavy. The formal testable hypotheses are:

H_{5a}: The faster the rate of technology change, the greater the competitor knowledge focus.

H_{5b}: The faster the rate of technology change, the greater the R&D strength.

The effect of technology change on customer knowledge focus is not as clear. On the one hand, several authors (Day and Wensley 1988; Narver and Slater 1990) suggest that when technology experiences faster rate of change, it is more imperative for firms to interact with customers since customer needs and

preferences may provide the directions for the changing product market. On the other hand, other researchers (Jaworski and Kohli 1993) posit that when technology changes rapidly, the importance of customer knowledge focus may be diminished since a firm's current customers may know little about nascent technologies and close interaction with these customers may provide little insight into the emerging markets associated with the new technologies. Thus, the conflicting arguments are hypothesized as:

H_{5c}: The faster the rate of technology change, the greater the customer knowledge focus, or the weaker the customer knowledge focus.

3.4. Top Management Perception of Market Knowledge and Market-Oriented Strategy

Top management plays a key role in shaping an organization's orientation and values (Deshpande, Farley, Webster 1993; Felton 1959; Hambrick and Mason 1984; Kohli and Jaworski 1990). Unless top managers understand and appreciate the value of market knowledge, the organization is unlikely to pursue a market-oriented strategy.

The perceived importance of market knowledge is measured by several indicators including top management's perceptions of the importance of continuous interaction with users, knowledge of customer needs, continuous learning of market trends and change, and knowledge of competitors. The formal testable hypotheses are:

H_{6a}: The greater the perceived importance of market knowledge, the greater the customer knowledge focus.

H_{6b}: The greater the perceived importance of market knowledge, the greater the integral knowledge focus.

H_{6c}: The greater the perceived importance of market knowledge, the greater the competitor knowledge focus.

H_{6d}: The greater the perceived importance of market knowledge, the greater the R&D strength.

3.5. Construct Measurement

In this section, I provide indicators and measures for the constructs in the model. The indicators are either borrowed from previous research or newly developed from conceptual studies in the literature. Several measures are adopted including: (1) 7-point semantic differential, (2) financial indicators, e.g. profit , sales, return on investment, and (3) length of time, e.g. one year, two years, three years. The indicators and measures of all the constructs are listed in Table 3.1.

TABLE 3.1.

Construct Measurement

CUSTOMER KNOWLEDGE FOCUS	**(7-point semantic differential)**
1.	We rarely/regularly meet customers to learn their current and potential needs for new products.
2.	Our knowledge of customer needs is scant/thorough.
3.	We rarely/regularly use research procedures, e.g. personal interviews, focus groups, and surveys, to gather customer information.
4.	We casually/systematically process and analyze customer information.
5.	Customer information is barely/fully integrated in new software design.
6.	We seldom/regularly use customers to test and evaluate new products.
7.	Our spending on learning customer needs as a percentage of product development cost is minimal/substantial.
8.	We barely/fully understand our customers' business.
9.	We rarely/regularly study customers' operations for new product development.
INTEGRAL KNOWLEDGE FOCUS	**(7-point semantic differential)**
	Marketing and R&D:
1.	rarely/regularly communicate for new product development.
2.	Rarely/regularly share information on customers.
3.	Rarely/regularly share information about competitors' products and strategies.
4.	Seldom/fully cooperate in establishing new product development goals and priorities.
5.	Seldom/fully cooperate in generating and screening new product ideas, and testing concepts.
6.	Seldom/fully cooperate in evaluating and refining new software.
7.	Our company never/wholeheartedly fosters a culture of cooperation between R&D and marketing.
8.	R&D and Marketing are inadequately/fully represented on our product development team.
9.	Technological knowledge and market knowledge are never/fully integrated in our new product development.

TABLE 3.1. (cont'd)

COMPETITOR KNOWLEDGE FOCUS (7-point semantic differential)

1. We rarely/regularly search and collect information about our competitors' products and strategies.
2. We casually/systematically analyze information about competitors.
3. Information about competitors' products is scarcely/fully integrated as a benchmark in our product design.
4. Our knowledge of our competitors' strengths and weakness is scant/thorough.
5. Our expense in competitor intelligence as a percentage of product development cost is minimal/minimal.
6. We rarely/regularly study our competitors' software.

STRENGTH OF RESEARCH AND DEVELOPMENT

1. What is your annual R&D expenditure as a percentage of sales?
   1%<, 1-3%, 4-6%,7-9%, 10-12%, 13-15%, >.15%
2. How would you compare the level of your annual R&D expenditure with your largest competitor's? Ours is much lower/higher.
3. How would you compare the strength of your company's proprietary technology with your largest competitor's? Ours is much weaker/much stronger.

COMPETITIVENESS IN PRODUCT INNOVATION (7-point semantic differential)

Compared with our largest competitor's product, our software is not superior at all/extremely superior:

1. in terms of newness, i.e. the extent to which a product is new to the market.
2. in terms of productivity, i.e. the extent to which a software increases a customer's work efficiency.
3. in terms of reliability, i.e. the extent to which a software is free of errors.
4. in terms of compatibility, i.e. the extent to which a software is compatible with hardware and other software.
5. in terms of uniqueness, i.e. the extent to which a software has unique features.
6. in terms of ease of use, i.e. the extent to which a software is easy to learn and use.
7. in terms of functionality, i.e. the extent to which a product meets customers' functional needs.
8. in terms of service, i.e. the extent to which a software is supported by the producer.

TABLE 3.1. (cont'd)

MARKET PERFORMANCE

Estimate of the market performance of this software in comparison with similar products of other firms in the same market.

1. Before tax profit
   lowest 20%, lower middle 20%, middle 20%, upper middle 20%, top 20%

2. Return on investment
   lowest 20%, lower middle 20%, middle 20%, upper middle 20%, top 20%

3. Return on assets
   lowest 20%, lower middle 20%, middle 20%, upper middle 20%, top 20%

4. Sales growth
   lowest 20%, lower middle 20%, middle 20%, upper middle 20%, top 20%

CUSTOMER DEMANDINGNESS (7-point semantic differential)

How would you compare your customers with other customers in the same industry?

Our customers are:

1. less/more demanding for product quality and reliability.

2. less/more sophisticated in terms of software technical specifications.

3. Less/more sensitive to product cost.

4. Less/more demanding for product service and support.

5. Less/more concerned with software productivity.

6. Less/more concerned with a good fit between their needs and product offering.

COMPETITION INTENSITY (7-point semantic differential)

How would you describe your product market in general?

This product market:

1. is predictable/unpredictable.

2. is not competitive/very competitive.

3. has stable market share/volatile market share.

4. has few new domestic competitors/many new domestic competitors.

TABLE 3.1. (cont'd)

TECHNOLOGY CHANGE

1. Rate of new software introduction instigated by competitors.
   1 yr 2 yr 3 yr 4 yr 5 yr 6 yr 7 yr

2. Product obsolescence rate in this product market.
   1 yr 2 yr 3 yr 4 yr 5 yr 6 yr 7 yr

3. Rate of technology change in this product market: slow/fast.

MANAGEMENT PERCEPTION OF MARKET KNOWLEDGE (7-point semantic differential)

Not at all important/extremely important

1. Continuous interaction with users.

2. Knowledge of customers' needs.

3. Continuous learning of market trends and change.

4. Generating competitive intelligence.

5. Knowledge of competitors' products.

CHAPTER FOUR

THE SOFTWARE INDUSTRY

The software industry consists of firms that write programs for computers. Over the last two decades, the software industry has exerted a significant impact on our society. Wordprocessor programs have changed the way we read and write; spreadsheets have provided us with an entirely new means of computing; and database programs have revolutionized the process we manage information.

In terms of historical significance, only steam engine may rival computer software. While the invention of steam engine made the Industrial Revolution possible more than two hundred years ago, today the application of computer software has transformed us into information society.

Because of its importance in the economy, the software industry has experienced phenomenal growth in the U.S.. In 1983, the industry sales were merely $7 billion. In 1993, sales reached $64 billion. The annual growth rate was 25%, higher than that of any other industry. The industry sailed through the economic slump from 1991 to 1993 unscathed. In fact, the industry's sales continued to grow throughout downturn in 1991 and the ensuing sluggish recovery. To a great extent, the software products the industry provide can cut costs for businesses, so the incentive to purchase them is high even at tough times.

In this chapter, a brief historical account of the U.S. software industry is provided, along with a discussion of the market segmentation of the industry.

4.1. The Dominance of the Mainframe Producers in the 70s

In the 70s, software was produced by two sources: mainframe vendors and independent vendors. Mainframe vendors were manufacturers of mainframe computers, such as IBM, Digital Equipment, Burroughs, and Honeywell. These vendors produced both mainframe computers and software products. These software products were normally for use on their own machines and were incompatible with mainframe computers from other vendors. Independent vendors developed software only and did not produce hardware. Their products were normally application software for use on different main frame computers. With fewer than ten of them, the mainframe suppliers were very limited in number. On the other hand, there were more than 1000 independent vendors.

Although limited in number the software market was dominated by mainframe vendors. The industry classifies software into two broad classes: system and application software. More than 60% of the sales in system software was generated by mainframe vendors. Mainframe suppliers dominated the system software market because development of appropriate system software required in-depth knowledge of the hardware. With 40% of the sales in the application software market, mainframe vendors as a whole did not appear to have the overall dominance. However, in terms of market share per vendor, the main frame producers were much more superior to the independent vendors. The sales of application software by any hardware vendor was normally ten times of the sales by the largest independent vendor. Table 4.1. lists software revenues in 1979 from mainframe producers and Table 4.2. shows software revenues from the top ten

TABLE 4.1.
Software Product and Service Revenues
1979-1980
($ millions)

	1979	1980
International Business Machine	$1,607	$1,026
Burroughs	566	580
NCR	541	598
Digital Equipment	422	589
Sperry	334	383

Source: Ulric Weil, Information Systems In the 80's, p.22, New Jersey: Prentice-Hall.

TABLE 4.2.
Revenues of Independent Software Vendors
In 1979
($ millions)

MSA	48
Cincom Systems	34
Policy Management Systems	32
Pansophic Systems	31
Cullinane	29
Applied Data Research	29
American Management Systems	29
Software AG of North America	26
Computer Associates	25
Kirchman	19

Source: Ulric Weil, Information Systems In the 80's, p.23, New Jersey: Prentice-Hall.

independent software vendors.

Among the mainframe vendors, IBM was undisputedly the dominant leader. At the end of the 70s, IBM had 60% of the mainframe market share and 35% of the system software market share. Its revenues from software products and service were 40 times of the largest independent vendor.

4.2. The Rise of the Independent Software Companies in the 80s

In the 70s, the computer software industry was dominated by mainframe producers and the role of independent software companies was minimal. In the 80s, the industry experienced a revolutionary change and independent producers no longer played a supplementary role.

This change can be observed in several areas. First, large-sized independent software producers emerged. In the 70s, shadowed by the mainframe manufacturers, independent firms were limited both in revenue and employment. For example, in 1979 the sales of none of the top ten software vendors reached $50 million. In the 80s, there were more than 30 independents whose sales topped 100 million. Many of these firms had more than 1000 employees. Table 4.3. shows the 1990 revenue and employment of the top 30 independent software firms.

Second, most of these independent vendors were young firms with a short history. Among the top 30 firms, almost half were established in the 80s and only four were founded in the 60s. Surprisingly, none of the top 10 independent vendors in the 70s were still on the top 30 list of the 80s. This indicates that experience alone does not guarantee success in this industry.

TABLE 4.3.
Revenues and Employment of Independent Vendors
In 1990
($ millions)

Rank	Company	Revenue	Employment	Year Founded
1	Computer Associates Int'l Inc.	1290	6900	1976
2	Microsoft Corp.	1180	5635	1975
3	Oracle Corp.	970	7576	1977
4	Lotus Corp.	684	3538	1982
5	Dun & Bradstreet Software Svcs.	538	3500	1980
6	WordPerfect Corp.	452	2469	1979
7	Software AG N.A.	389	3800	1969
8	American Management Systems Inc.	261	3200	1970
9	SAS Institute Inc.	240	2264	1976
10	Ashton-Tate	230	1620	1980
11	Pansophic Systems Inc.	218	1500	1969
12	Cincom System	209	1400	1968
13	ASK Computer Systems Inc.	207	900	1972
14	Sterling Software Inc.	200	1900	1981
15	Information Builders Inc.	191	1400	1975
16	Autodesk Inc.	178	1100	1982
17	Legent Corp.	169	1200	1989
18	Adobe Systems Inc.	168	508	1982
19	Ingres Corp.	157	1300	1980
20	Candle Corp.	151	950	1977
21	Informix Software Inc.	146	1100	1980
22	Software Publishing Corp.	140	700	1980
23	Aldus Corp.	135	860	1984
24	Systems Software Assoc.	124	550	1981
25	Compuware Corp.	118	1260	1973
26	Goal Systems Int'l Inc.	117	700	1975
27	Cognos	116	1034	1969
28	Borland	113	875	1983
29	The Santa Cruz Operation	106	1300	1979
30	Systems Center Inc.	105	841	1981

Source: InformationWeek, June 3, 1991. CMC Publications Inc. 600 Community Drive, Manhasset, NY 11030.

Third, according to SoftLetter, the independent software producers became the most productive of any industry. In 1990, average sales per employee for the top 100 independent software companies was $151,957. Average sales per employee for the top 25 firms was $198,065.

4.2.1. Four Large Independent Software Vendors

Microsoft Corp. With 14,430 employees, Microsoft Corp. is the largest independent maker of personal computer software. Its systems software and languages, the sales of which made up 34% of the company's revenue in 1993, include MS-DOS, Windows and LAN Manager. MS-DOS is by far the most widely used operating system for IBM PCs and compatibles. Applications software which made up 58% of the sales in 1993 includes word processing, spreadsheet, database management, and other business programs. Non-U.S. sales were 48% of sales and 37% pretax profits. The company spent 12% of the sales revenue on research and development.

TABLE 4.4.
MICROSOFT CORP.
Financial Statistics
($ millions)

	1988	1989	1990	1991	1992	1993
Sales	590	803	1183	1843	2758	3753
Net Profit	123	170	279	462	708	953
Retained to Eq.	33%	30%	30%	34%	32%	29%
Stock Price						
High	15.7	19.8	35.9	74.7	95.0	98.0
Low	10.1	10.2	18.7	32.4	65.5	70.4

Source: Value Line, March 11, 1994.

Novell Inc. Novell Inc. designs, manufactures, and services high performance local area networks (LANs). The company's products are based on the proprietary NetWare operating system and enable PCs to share resources and communicate with other PCs on the same network. Products include NetWare software, DR DOS and UnixWare operating software, data storage subsystems, and communications products. International sales was 48% of total in 1993. R&D was 15% of the sales. The company has 4,429 employees.

TABLE 4.5.
NOVELL INC.
Financial Statistics
($ millions)

	1988	1989	1990	1991	1992	1993
Sales	281	421	497	640	933	1122
Net Profit	30	45	94	162	249	282
Retained to Eq.	22%	19%	23%	27%	26%	28%
Stock Price						
High	4.1	4.8	8.5	32.4	33.5	35.3
Low	2.2	3.0	3.4	7.6	22.5	17.0

Source: Value Line, March 11, 1994

Lotus Development. Lotus Development Corp. is one of the three largest independent makers of personal computer software. 1-2-3, which is the most popular personal computer application in the world, combines spreadsheet, database, and graphing functions into a single program. It also sells Ami Pro, a word processing application, Freelance Graphics, a presentation graphics package, Notes, a workgroup product, and cc:Mail, an electronic application.

Foreign sales was 45% of the total in 1993. The company has 4450 employees.

TABLE 4.6.
LOTUS DEVELOPMENT
Financial Statistics
($ millions)

	1988	1989	1990	1991	1992	1993
Sales	468	556	684	828	900	981
Net Profit	58	63	76	61	57	75
Retained to Eq.	25%	22%	24%	18%	14%	14%
Stock Price						
High	34.3	33.5	39.3	40.8	38.8	58.8
Low	14.8	18.0	12.5	14.8	14.8	18.8

Source: Value Line, March 11, 1994

Borland International. Borland International Inc. develops and markets object-oriented programming languages and application software. Three principal product families are database (Dbase, Paradox), spreadsheet (Quattro Pro), and languages, which are designed to run on IBM and compatible personal computers under the MS-DOS or Window environments. The U.S. business accounted for 49% of 1993 revenue and R&D expenses were 15.5% of the revenue. The company acquired Ashton-Tate in October, 1991. Currently, the company has 1885 employees.

TABLE 4.7.
BORLAND INTERNATIONAL
Financial Statistics
($ millions)

	1988	1989	1990	1991	1992	1993
Sales	90	113	226	482	464	450
Net Profit	d2	11	26	d15	d29	7
Retained to Eq.	NMF	21%	31%	NMF	NMY	3%
Stock Price		10.5	32.0	82.5	81.0	27.0
Book Value		9.6	9.9	27.9	20.3	13.5

Source: Value Line, March 11, 1994

4.3. The Software Industry Segmentation

The software industry can be segmented according to software product functions. The most popular segmentation is the horizontal and vertical classification. Horizontally, the industry is classified into five major segments: system software, business operation software, office automation software, educational software, and recreational software. Vertically, each major segment is further classified into numerous subsegments.

System software. System software is required for every computer. There are two major types of system software: operating system (OS) software and software development tool.

Programs that manage the operation of a computer are called operating system. The operating system can be relatively simple, as it is for PCs (such as DOS), or very complex, as it is for mainframe computers (such as UNIX). The

operating system is important because nearly all application programs use the capabilities of the operating system and must adhere to its interfacing conventions.

Software dvelopment tools are programs that help construct new programs and maintain old programs. Examples are high-level languages such as Basic, Cobol, Fortran, C and Pascal. Other tools such as language compilers and interpreters translate the higher level languages into machine code that computer can understand. Further, languages that use object technology have become important because they make it easier to manage complex programs. Small talk and C++ are examples of object oriented lanaguages. Utility programs which simplify software development or computer operation also belong to this category. Examples of utility software are disk management programs, performance monitors, and backup programs.

Business operation software. Business operation software is a category of programs that manage organizational activities. These applications usually have a centralized database that is used by multiple divisions and by mutiple users. Examples are accounting and inventory management software. Most of the manufacturing processess and product design activities also fall in this segment. Programs in this segment can be further classified into many market niches, such as accounting software for medical offices, sales managment software for home products dealers, design software for mechanical engineers and circuit design simulation software for electronic engineers.

Office automation software. Office automation software is one of the largest segment in the software market. Programs in this segment can help with common

tasks such as writing, calculating, filing, drawing, managing, decision making and communicating with others. The majority of products in this segment are for personal computers and, to a lesser degree, for workstations. Software products in this segment play a critical role in the running of today's organizations. The following are the most popular products listed by their segments.

TABLE 4.8.
Office Automation Software

Wordprocessing	Company
WordPerfect	WordPerfect Corp.
Microsoft Word	Microsoft Corp.
Spreadsheet	
Lotus 1-2-3	Lotus Development
Microsoft Excel	Microsoft Corp.
Quattro Pro	Borland International
Database	
Dbase IV	Borland International
Paradox	Borland International
Graphics	
Harvard Graphics	Software Publishing

Educational software. Educational software teaches specific subjects or tasks to people. Therefore, educational programs are also called computer-aided instruction (CAI) and computer-based training (CBT). Examples of CAI are mathematics for 5th grade, SAT training programs, and high school physics. CBT software ranges from relatively simple tasks such as learning Lotus 1-2-3 to complex multimedia

software to learn to operate military weapons systems.

Recreational software. Recreational software became popular when personal computers were introduced. The large installed base of PCs created a large market for recreational software such as games and music programs. There is now a large variety of computer games ranging from the classical board games such as Chess and Monopoly to card games and simulation games. New classes of games such as adventure games and battle simulations have become very popular.

4.3.1. Case Analysis: The Growth of Network Software Market

PC Network software is the fastest growth market in the system software segment. In 1987, the worldwide revenue from LANs, one of network software product, was only $190 million. In 1992, the sales of LANs reached $1.38 billion.

What is network software?

Network software connects multiple PCs to share printers, database, and programs. Two types of technology are available for PC networking: peer-to-peer networking and client-server networking.

Peer-to-peer mode requires that software and a computer board be added directly into every PC. A cable links the computers to shared printers. Peer-to-peer is generally the easiest and cheapest solution in very small firms where sharing printers is the main goal.

The client-server mode also requires new hardware and software on the PC. However, the bulk of the software is located on a PC dedicated to controlling the networks. This dedicated computer is called a "server" and is the brain of the network. The server directs data traffic between individual PCs that are called

"clients." Servers require special software called "NOS" (network operating system) that talks to clients and handles all network functions. Severs controlled by a NOS allows users to more rapidly pass files between PCs. Users can also store directly on the server large files regularly accessed by several people. The higher performance client-server networks became dominant in most medium and large companies by the end of the 1980s.

Local area network (LAN). Local area network (LAN) software is common in small departments in geographically concentrated locations. It is normally used to connect 50-100 PCs. A typical LAN may compose all of the PCs on several floors of a building, just sharing programs, files, and printers.

Wide-area network (WAN). As PC networks become widespread in corporations, users want to communicate with PCs on other LANs, sometimes in distant locales. This requires additional technology called wide area network (WANs) that connect computers that are geographically dispersed.

In the 1980s, most WANs were based on mainframe or minicomputer. A typical example of a WAN was an airline reservation system. An airline would maintain a computer control center with large mainframe computers. At airports around the world, ticket counter computer terminals were connected to the central computer. WAN systems were usually developed over many years, and represented large investments by companies.

In the 1990s, the development of WANs based on PCs is technically possible, but still inefficient and expensive.

Client-server application (CSA). Client-server applications are application

software running on the server. As Lotus Development Corp. had to write different versions 1-2-3 for each operating system (DOS, OS2, MAC), CSAs are written for particular NOSs. A good example of CSA is Lotus Notes, a powerful program that runs on a server, but allows everyone on the network to share information and build common data bases.

Competition in the network software market. When the PC network software market emerged, there were many firms developing and marketing peer-to-peer products to connect PCs. Later, when client-server networking was introduced and demands for complex products increased, the need for research and development grew rapidly. The competition became intensified and an industry-wide shake-out left only a handful of significant competitors.

Among the few firms left, Novell achieved the strongest position, with approximately 60% market share. Banyan, Microsoft, and IBM are the other leading competitors.

CHAPTER FIVE

RESEARCH METHODOLOGY

5.1. Measure Development

Measures of the constructs were developed in three stages. First, based on the defined constructs, tentative measures were either borrowed or developed from the exiting literature. In particular, for the construct of competitiveness in product innovation, I integrated measures from the software industry literature, such as *Applied Software Measurement - Assuring Productivity and Quality* (Capers Jones 1991), and *Total Quality Management for Software* (Schulmeyer and McManus 1992). These books were written by experts in the software industry and provided the most relevant measures for competitiveness in software products.

In the second stage, a list of defined constructs and their measures was submitted to a panel of five academicians familiar with the subject of product innovation for item refinement. Following Churchill (1979), I requested recipients to assign each measure to the construct they considered appropriate and to note whether they thought the construct could be represented by any other measures. In the third stage, I interviewed five practitioners in the software industry with the refined measures. I asked them to comment on the clarity and the relevance of the measures to the practitioners in the software industry. Then the measures were modified to reflect their opinion.

5.2. Sampling Frame

The sampling frame of the research was 1074 software companies in the U.S. The sampling was obtained from Corporate Technology Information Services (CorpTech), Inc., a company specializing in high-technology company information. With its specialty and its company profile information updated bi-annually, CorpTech is considered one of the most authoritative sources of information on high-tech firms.

The sampling frame covered a wide spectrum of software firms in regard to annual sales, firm size, and company age. The annual revenues of the firms in the sampling frame ranged from $10 million to $4 billion. The firm size, measured in number of employees, varied from 30 to above 4,000. The company age spanned from 5 years to more than 30 years. Table 5.1. shows the profile of software firms in the sampling.

5.3. Key Informant

The method used was a survey among "key informant" decision makers within software companies. The new product decision analyzed was the firm's overall orientation in new product development. In software industry, the president or CEO is often the final decision maker in new product choice, new market direction, and R&D investment level, becasue new product development is the "pivotal event" in most software firms and corporate activities are organized around this event. The role of the chief executive in new software development was also confirmed in my pretest interviews with managers in software firms. As one

TABLE 5.1.

Profile of Software Firms in the Sampling Frame (N=1074)

Firm Size (No. of Employees)	No.of Firms	Percent
less than 50	193	17.9%
50 - 100	238	22.2%
101 - 200	308	28.7%
201 - 500	260	24.2%
501 or more	75	7.0%
	1074	100.0%

Annual Sales (in millions)	No. of Firms	Percent
$10m - $25m	529	49.2%
$26m - $50m	205	19.1%
$51m -$100m	120	11.2%
$101m-$250m	104	9.7%
$251m or more	116	10.8%
	1074	100.0%

Years of Formation	No. of Firms	Percent
5 - 10 yrs	205	19.1%
11 - 20 yrs	501	46.7%
21 - 30 yrs	226	21.0%
More than 30 yrs	142	13.2%
	1074	100.0%

manager expressed:"Our chief executive makes the major decisions about software development because in our industry more than any other industries the life and death of the firm hinge on the success and failure of new software."

5.4. Mail Survey and Sample

From March to May 1994, three waves of mailing were sent to the presidents/CEOs of the 1074 software firms in the sampling frame. The first and the third consisted of questionnaires and the second was a postcard reminder. Sixteen questionnaires were returned undelivered and twenty-three companies wrote or called back expressing regret at their inability to participate for various reasons, usually because their company policies prevented them from answering these questionnaires. From the remaining pool of potential respondents, 173 usable responses were received resulting in a 16.1% response rate. The response rate is similar to that obtained in similar large-scale surveys of executives which ranges from 5.9% to 22% (Gatignon and Robertson 1989). Table 5.2. shows a profile of the sampled software firms.

To examine the possibility of nonresponse bias, I performed a comparative analysis of the sample distribution versus the sampling distribution on key characteristics which reflect the factual information contained in CorpTech's database. These characteristics include (1) firm size measured in number of employees, (2) annual sales in millions of dollars, and (3) firm age measured in years of formation. Chi-square goodness-of-fit test was conducted to compare the distributions in the sample and the sampling frame. The low Chi-squares and high

TABLE 5.2.

Profile of Surveyed Software Firms (n=173)

Firm Size (No. of Employees)	No. of Firms	Percent
less than 50	28	16.2%
50 - 100	39	22.5%
101 - 200	60	34.7%
201 - 500	32	18.5%
501 or more	14	8.1%
	173	100.0%

Annual Sales (in millions)	No. of Firms	Percent
$10m - $25m	93	53.8%
$26m - $50m	26	15.0%
$51m -$100m	21	12.1%
$101m-$250m	16	9.3%
$251m or more	17	9.8%
	173	100.0%

Years of Formation	No. of Firms	Percent
5 - 10 yrs	25	14.5%
11 - 20 yrs	77	44.5%
21 - 30 yrs	45	26.0%
More than 30 yrs	26	15.0%
	173	100.0%

probabilities (significance all above 0.05), reported in Table 5.3. for the comparisons on these three dimensions, indicate a lack of significant difference between the sample and the sampling frame, suggesting that nonresponse bias, if any, may be negligible.

5.5. Unit of Analysis

The unit of analysis is an individual new software product introduced into the U.S. market by a software firm. The approach of selecting an individual product as the unit of analysis is rooted in research on product innovation (Griffin and Page 1993). This approach is popular because it allows researchers to measure new product performance more accurately. For example, when this unit analysis is adopted, researchers can determine precisely the market performance of a product including market share, growth rate, and profit, etc. On the other hand, if a firm is used as the unit of analysis, researchers will find it difficult to measure performance, since a firm may have a portfolio of diversified products, and performance of these products would be compounded. Further, when a firm has both old and new products in the market, the compounding will become more serious.

To conform responses to this unit of analysis, at the beginning of the questionnaire, I asked respondents to identify a new software product they had introduced into the U.S. market over the last five years, and then requested them to describe the type of software product they selected and the industry the product served. Based on their descriptions, I classified these products into 26 categories

TABLE 5.3.

Goodness-of-fit Test on Distributions of the Sample and the Sampling Frame

a. Firm Size Distribution

Firm Size (No. of Employees)	No. of Firms in the Sample (n=173)	No. of Firms in the Database (N=1074)	Chi-square Test
Less than 50	28	193	χ^2 = 4.59
50 - 100	39	238	d.f. = 4
101 - 200	60	308	sig. = 0.332
201 - 500	32	260	
501 or more	14	75	

b. Annual Sales Distribution

Annual Sales (in millions)	No. of Firms in the Sample (n=173)	No. of Firms in the Database (N=1074)	Chi-square Test
$10m - $25m	93	529	χ^2 = 2.718
$26m - $50m	26	205	d.f = 4
$51m -$100m	21	120	sig =0.606
$101m-$250m	16	104	
$251m or more	17	116	

c. Firm Age Distribution

Years of Formation	No. of Firms in the Sample (n=173)	No. of Firms in the Database (N=1074)	Chi-square Test
5 - 10 yrs	25	205	χ^2 = 4.778
11 - 20 yrs	77	501	d.f. = 3
21 - 30 yrs	45	226	sig. = 0.189
More than 30 yrs	26	142	

in Table 5.4. In addition, a total of 22 major industries, from aerospace and airline to retailing and transportation, were served by these software products (see Table 5.5).

5.6. Measure Purification and Reliability

Following Gerbing and Anderson (1988), I purified the measures by assessing their reliability and unidimensionality. First, I examined the item-to-total correlations for the items in each of the proposed scales and deleted items with low correlations if they did not represent additional domain of interest. Table 5.6 presents Cronbach's alpha for each constructs (Cronbach 1970). An inspection of the alpha coefficients reveals that among the ten alpha coefficients seven are greater than 0.80. In particular, the alpha coefficients for the three constructs of market orientation are all above .90, indicating good reliability of these constructs (Nunnally 1978). The alpha coefficients for R&D strength, market competitiveness, and technology change are somewhat smaller, but very close to the satisfactory level of .70 .

The measures were further subjected to confirmatory factor analysis through EQS (Bentler 1989) to assess their unidimensionality. Covariance matrix was used as input for the confirmatory factor analysis. Table 5.6. also carries the results of EQS confirmatory factor analysis. The Bentler-Bonnet normed fit index and nonnormed fit index (Bentler 1980) and the comparative fit index (Bentler and Bonett 1980, Bentler 1990) are all above 0.99 indicating good fit of the confirmatory measurement model. In addition, EQS confirmatory analysis also estimates the

TABLE 5.4.

Types of Software Products Represented In The Sample

Accounting software
Artificial intelligence software
Banking software
Construction software
Communication system software
Database management software
Educational software
Facilities management software
Financial analysis software
Government software
Health services software
Insurance software
Legal software
Library software
Manufacturing software
Media communications software
Natural resource management software
Office automation software
Program development software
Public utilities software
Real estate software
Sales/marketing software
Service industry software
Software services
Transportation software
Utility systems software
Warehousing/distribution software
Application software

TABLE 5.5.

Major Industries Served By The Sampled Software Companies

Aerospace	Hospitality
Airline	Insurance
Automobile	Manufacturing
Banking	Petrochemical
Communication	Petroleum
Computer	Pharmaceutical
Construction	Publishing
Education	Real estate
Electronics	Retailing
Government	Transportation
Health care	Utilities

TABLE 5.6.

Measurement Model and Confirmatory Factor Analysis by EQS

Constructs	Items	Normed fit index= 0.993 Nonnormed fit index= 0.999 Comparative fit index= 0.999	EQS Item-Construct Correlation Stand.	t-value	Cronbach's Alpha
CUSTOMER KNOWLEDGE FOCUS					.946
1.	We rarely/regularly meet customers to learn their current and potential needs for new products.		.919		
2.	Our knowledge of customer needs is scant/thorough.		.970	22.06	
3.	We rarely/regularly use research procedures, e.g. personal interviews, focus groups, and surveys, to gather customer information.		.866	13.82	
4.	We casually/systematically process and analyze customer information.		.876	13.77	
5.	Customer information is barely/fully integrated in new software design.		.929	19.50	
6.	We seldom/regularly use customers to test and evaluate new products.		.894	15.83	
7.	Our spending on learning customer needs as a percentage of product development cost is minimal/substantial.		.786	8.84	
8.	We barely/fully understand our customers' business.		.923	18.56	
9.	We rarely/regularly study customers' operations for new product development.		.895	15.58	
INTEGRAL KNOWLEDGE FOCUS					.958
	Marketing and R&D:				
1.	rarely/regularly communicate for new product development.		.946		
2.	rarely/regularly share information on customers.		.943	16.06	
3.	rarely/regularly share information about competitors' products and strategies.		.849	11.12	
4.	seldom/fully cooperate in establishing new product development goals and priorities.		.915	17.39	
5.	seldom/fully cooperate in generating and screening new product ideas, and testing concepts.		.951	17.96	
6.	seldom/fully cooperate in evaluating and refining new software.		.911	13.15	
7.	Our company never/wholeheartedly fosters a culture of cooperation between R&D and marketing.		.950	21.35	
8.	R&D and Marketing are inadequately/fully represented on our product development team.		.799	10.06	
9.	Technological knowledge and market knowledge are never/fully integrated in our new product development.		.966	22.96	

TABLE 5.6. (Cont'd)

Constructs	Items	EQS Item-Construct Correlation Stand.	t-value	Cronbach's Alpha
COMPETITOR KNOWLEDGE FOCUS				.954
1.	We rarely/regularly search and collect information about our competitors' products and strategies.	.948		
2.	We casually/systematically analyze information about competitors.	.943	19.43	
3.	Information about competitors' products is scarcely/fully integrated as a benchmark in our product design.	.890	13.18	
4.	Our knowledge of our competitors' strengths and weakness is scant/thorough.	.901	15.39	
5.	Our expense in competitor intelligence as a percentage of product development cost is minimal/minimal.	.779	6.92	
6.	We rarely/regularly study our competitors' software.	.890	9.49	
STRENGTH OF RESEARCH AND DEVELOPMENT				.693
1.	What is your annual R&D expenditure as a percentage of sales? (percentage points converted into 7 point scale: 1%<, 1-3%, 4-6%,7-9%, 10-12%, 13-15%, >.15%)	.921		
2.	How would you compare the level of your annual R&D expenditure with your largest competitor's? Our is much lower/higher.	.768	9.89	
3.	How would you compare the strength of your company's proprietary technology with your largest competitor's? Ours is much weaker/much stronger.	.790	9.90	
COMPETITIVENESS IN PRODUCT INNOVATION				.865
	Compared with our largest competitor's product, our software is not superior at all/extremely superior:			
1.	in terms of newness, i.e. the extent to which a product is new to the market.	.825		
2.	in terms of productivity, i.e. the extent to which a software increases a customer's work efficiency.	.919	20.61	
3.	in terms of reliability, i.e. the extent to which a software is free of errors.	.780	9.50	
4.	in terms of compatibility, i.e. the extent to which a software is compatible with hardware and other software.	.762	11.30	
5.	in terms of uniqueness, i.e. the extent to which a software has unique features.	.755	10.18	
6.	in terms of ease of use, i.e. the extent to which a software is easy to learn and use.	.632	8.02	
7.	in terms of functionality, i.e. the extent to which a product meets customers' functional needs.	.872	15.79	
8.	in terms of service, i.e. the extent to which a software is supported by the producer.	.439	3.33	

TABLE 5.6. (Cont'd)

Constructs	Items	EQS Item-Construct Correlation Stand.	t-value	Cronbach's Alpha
MARKET PERFORMANCE				.856
	Estimate of the market performance of this software in comparison with similar products of other firms in the same market. (5 point scale: lowest 20%, lower middle 20%, middle 20%, top 20%)			
1.	Before tax profit.	.908		
2.	Return on investment.	.914	16.45	
3.	Return on assets.	.955	24.83	
4.	Sales growth.	.663	8.64	
CUSTOMER DEMANDINGNESS				.862
	How would you compare your customers with other customers in the same industry ? Our customers are:			
1.	less/more demanding for product quality and reliability.	.869		
2.	less/more sophisticated in terms of software technical specifications.	.875	15.09	
3.	Less/more sensitive to product cost.	.610	7.71	
4.	Less/more demanding for product service and support.	.879	15.13	
5.	Less/more concerned with software productivity.	.770	9.88	
6.	Less/more concerned with a good fit between their needs and product offering.	.846	11.64	
COMPETITION INTENSITY				.683
	How would you describe your product market in general? This product market:			
1.	is predictable/unpredictable.	.901		
2.	is not competitive/very competitive.	.789	8.50	
3.	has stable market share/volatile market share.	.628	6.05	
4.	has few new domestic competitors/many new domestic competitors.	.358	3.06	
TECHNOLOGY CHANGE				.682
1.	Rate of new software introduction instigated by competitors: 1 to 7 years.	.748		
2.	Product obsolescence rate in this product market: 1 to 7 years.	.638	6.73	
3.	Rate of technology change in this product market: slow/fast.	.840	9.12	
PERCEIVED IMPORTANCE OF MARKET KNOWLEDGE				.878
	Not at all important/extremely important			
1.	Continuous interaction with users.	.945		
2.	Knowledge of customers' needs.	.940	21.94	
3.	Continuous learning of market trends and change.	.902	16.73	
4.	Generating competitive intelligence.	.886	11.49	
5.	Knowledge of competitors' products.	.872	10.93	

item-construct correlations and t-test statistics for the measurement model. An inspection of Table 5.6. shows all the 49 measures are significantly loaded into their respective constructs at a significance level of 0.01.

5.7. Hypothesis-Testing Approach

Having satisfied the requirement arising from the measurement issues, I subsequently tested the structural relationships through EQS path analysis (Bentler 1989). Using the results from the confirmatory factor analysis, a single measure was developed for each construct equal to the arithmetic mean of the constituent items. The structural relationships of the market orientation model is represented in the following sets of equations.

$$V5 = \beta_1 V1 + \beta_2 V3 + \beta_3 V4 + E_5$$

$$V6 = \beta_4 V1 + \beta_5 V4 + E_6$$

$$V7 = \beta_6 V2 + \beta_7 V3 + \beta_8 V4 + E_7$$

$$V8 = \beta_9 V1 + \beta_{10} V3 + \beta_{11} V4 + E_8$$

$$V9 = \beta_{12} V5 + \beta_{13} V6 + \beta_{14} V7 + \beta_{15} V8 + E_9$$

$$V10 = \beta_{16} V9 + E_{10}$$

where

V1 = customer demandingness

V2 = competition intensity

V3 = technology change

V4 = perceived importance of market knowledge

V5 = customer knowledge focus

V6 = integral knowledge focus

V7 = competitor knowledge focus

V8 = research and development strength

V9 = competitiveness in product innovation

V10= market performance

and β_1 and E_1 are parameters to be estimated.

V9 is competitiveness in product innovation and hypothesized to be influenced by the four market-oriented strategy components, customer knowledge focus (V5), integral knowledge focus (V6), competitor knowledge focus (V7), and R&D strength (V8). The equation with V9 on the left side tests hypotheses H_{1a}, H_{1b}, H_{1c}, and H_{1d}.

V10 is the new product market performance which is proposed to be impacted upon by competitiveness in product innovation (H_{2a}).

V5 is customer knowledge focus which is suggested to be affected by three external and internal factors, customer demandingness (V1), technology change (V3), and perceived importance of market knowledge. Hypotheses H_{3a}, H_{5c}, H_{6a} are tested through this equation.

V6 is integral knowledge focus and this strategy component is posited to be affected by customer demandingness (V1) and perceived importance of market knowledge (V4). Two hypotheses, H_{3b} and H_{6b}, are represented by the equation.

V7 is the third strategy component and is hypothesized to be correlated with competition intensity (V2), technology change (V3), and perceived importance of market knowledge (V4). The hypotheses that are tested through this equation are

H_{4a}, H_{5a}, and H_{6c}.

V8 is the last strategy component and is supposed to be affected by customer demandingness (V1), technology change (V3), and perceived importance of market knowledge (V4). Three hypotheses, H_{3c}, H_{5b}, H_{6d}, are tested through this equation.

CHAPTER SIX

RESEARCH FINDINGS AND IMPLICATIONS

Integrating several streams of literature in marketing and product innovation, the current research presents and tests a model of a market-oriented strategy and its impact on competitiveness in product innovation. In chapter 6, the focus is on the substantive interpretation of the results and the emergent findings. Additionally, managerial implications and future research directions are discussed.

6.1. Test of the Model

The model was tested through the General Least Square method (GLS) on EQS. The model converged rapidly (8 iterations) and had no problems estimating the model parameters. As shown in Table 6.1. and Figure 6.1. the fit indexes indicate a good fit of the model. The normed fit index (NFI) and the nonnormed fit index (Bentler 1980) are 0.995 and 0.993 respectively, and the comparative fit index (CFI) (Bentler and Bonett 1980) is 0.997. In addition, the average standardized residual is 0.0379. The chi-square is 37.59 with 18 degrees of freedom and p = 0.00439. While the chi-square test is not as satisfactory as the indexes, model fit is best assessed by examining fit indexes other than the chi-square statistic alone (Bagozzi and Yi 1988; Hayduk 1989; Bentler 1990; Durvasula and Sharma 1990). Based on these results, I feel the model fits the data well.

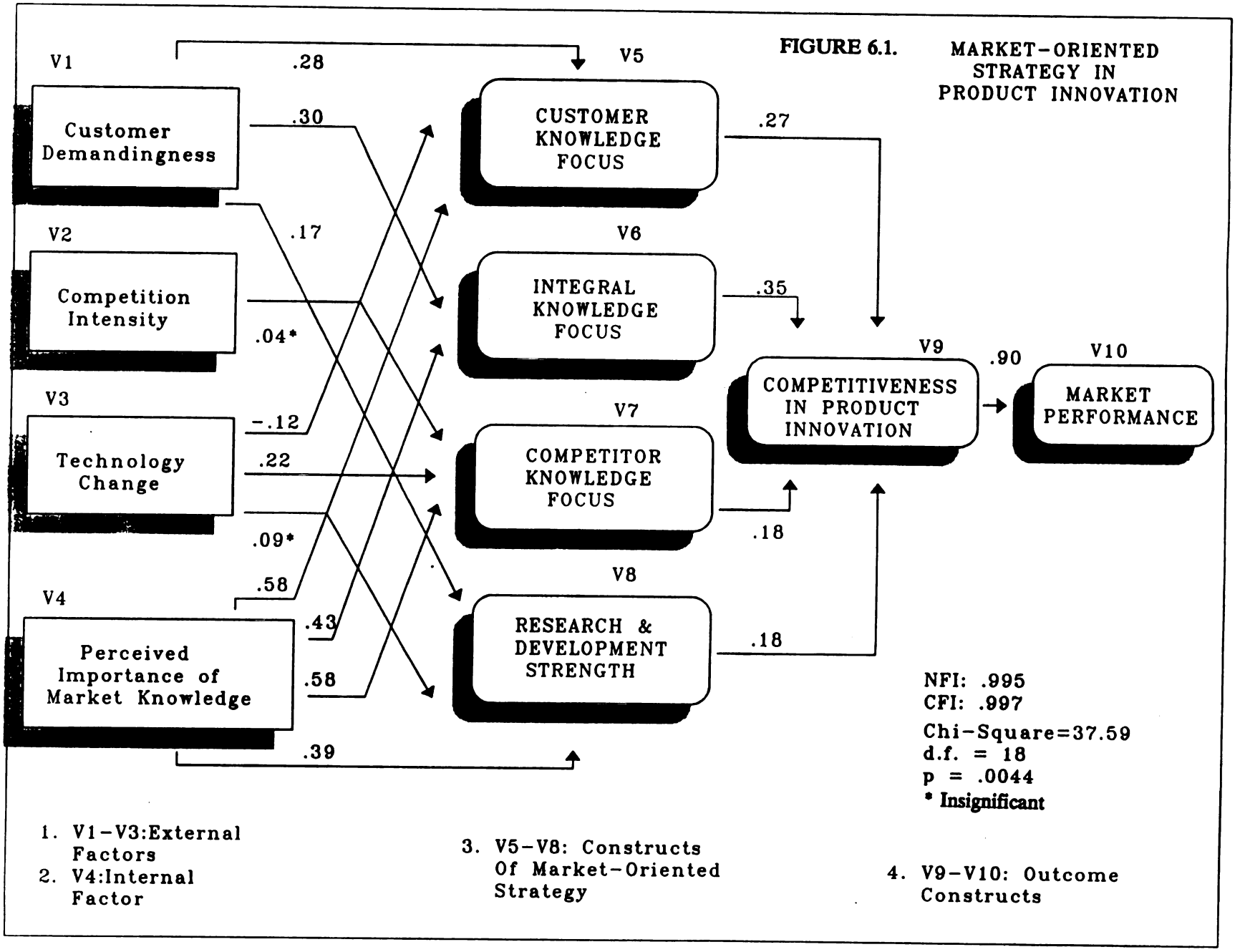

FIGURE 6.1. MARKET-ORIENTED STRATEGY IN PRODUCT INNOVATION

TABLE 6.1.

Assessment of Path Model by EQS

Model Goodness of Fit			
Normed fit index:	0.995	Chi-square:	37.59
Nonnormed fit index:	0.993	d.f.	18
Comparative fit index:	0.997	Probability	≤ 0.00439

TABLE 6.2.

Assessment of Research Hypotheses by EQS

Constructs	Hypothesis	Expected Sign	Path Coefficient (Unstand.	Stand.)	t-value	Assessment (p ≤ .01)
Competitiveness in Product Innovation						
Customer Knowledge Focus	H_{1a}	+	.238	.270	4.20	S
Integral Knowledge Focus	H_{1b}	+	.289	.352	6.08	S
Competitor Knowledge Focus	H_{1c}	+	.136	.187	3.95	S
R&D Strength	H_{1d}	+	.158	.188	3.93	S
Market Performance						
Competitiveness in Product Innovation	H_{2a}	+	.760	.908	10.58	S
Customer Knowledge Focus						
Customer Demandingness	H_{3a}	+	.387	.289	3.88	S
Technology Change	H_{5c}	+/-	-.117	-.123	-2.65	S
Perceived Importance of Market Knowledge	H_{6a}	+	.649	.584	7.92	S
Integral Knowledge Focus						
Customer Demandingness	H_{3b}	+	.443	.309	3.57	S
Perceived Importance Of Market Knowledge	H_{6b}	+	.521	.437	5.07	S
Competitor Knowledge Focus						
Competition Intensity	H_{4a}	+	.072	.048	0.80	n.s.
Technology Change	H_{5a}	+	.265	.229	3.87	S
Perceived Importance of Market Knowledge	H_{6c}	+	.785	.583	9.45	S
R&D Strength						
Customer Demandingness	H_{3c}	+	.244	.175	1.72	S at p≤.05
Technology Change	H_{5b}	+	.092	.093	1.37	n.s.
Perceived Importance of Market Knowledge	H_{6d}	+	.458	.395	4.08	S

6.2. Research Findings

6.2.1. Does a Market-Oriented Strategy Strengthen Competitiveness in Product Innovation?

This research centers on the relationship between a market-oriented strategy and competitiveness in product innovation. As shown in Table 6.2., the relationship appears to be positive with each component of a market-oriented strategy exerting a significant impact ($p \leq .01$) on competitiveness in product innovation. Customer knowledge focus, as expected, seems to drive competitiveness in product innovation (standardized b = 0.27), as well as integral knowledge focus and competitor knowledge focus (b = .352 and b = .187 respectively). These results support the view that generation of customer knowledge, integral knowledge, and competitor knowledge is critical for firms to create superior new products that meet customers needs better than competitors' products. Among the three knowledge components, it appears that integral knowledge focus exerts the strongest impact with the largest standardized coefficient. This corroborates the long-prevailing proposition in the product innovation literature that it is essential for marketing and R&D to cooperate in creating solutions pertaining to customer needs.

Turning now to the role of R&D strength, competitiveness in product innovation appears to be positively related to R&D strength (b = .188). This finding suggests that in a high-tech industry R&D intensity serves as an important factor in improving innovation competitiveness.

6.2.2. Does Competitiveness in Product Innovation Improve Market Performance?

The ultimate goal of a firm's innovation strategy is to improve market performance. As shown in Table 6.2., competitiveness in product innovation is significantly related to new product market performance which is measured by four indicators, before-tax profit, return on investment, return on assets, and sales growth. The large coefficient ($b = .908$, $p \leq .01$) suggests the relationship between the two outcome constructs is very strong. This finding provides a significant linkage between a market-oriented strategy and product market performance and demonstrates that an innovation strategy improves product market performance through enhancing competitiveness in product innovation.

6.2.3. Is a Market-Oriented Strategy Driven by External Factors?

The relationship between environmental factors and a market-oriented strategy in product innovation is another important aspect of the model. In this section, the effect of each external factor is discussed and analyzed.

6.2.3A. Customer Demandingness

As indicated in Table 6.2., Customer demandingness appears to exert a significant impact on two strategy components, customer knowledge focus ($b = .289$, $p \leq .01$) and integral knowledge focus ($b = .309$, $p \leq .01$). This suggests that a firm's implementation of a market-oriented strategy is influenced by the characteristics of its customers. When customers are more sophisticated and demanding in regard to technical specifications and product features, firms are more likely to interact with customers to understand their needs and preferences,

and to improve communication and cooperation between marketing and R&D in the process of new product development. These findings concerning customer demandingness seem to support Von Hippel's theory (1976, 1977, 1978, 1986) on "lead" users. Von Hippel proposes that possession of lead users, defined as those customers who are more sophisticated and demanding than the rest of the customers, strengthens a firm's competitiveness in new products. These findings help us explain why lead users play an important role in product innovation process. Lead users provide an impetus for firms to engage in customer learning and marketing-R&D knowledge integration. In turn, the superior customer knowledge and integral knowledge obtained may allow firms to achieve greater product competitiveness.

The relationship between customer demandingness and R&D strength is significant at $p = 0.05$ providing some evidence to support the proposition that when customers are more demanding a firm is more likely to increase its R&D investment.

6.2.3B. Competition Intensity

In the previous chapter, I propose that competition intensity affects a firm's competitor knowledge focus. The result in Table 6.2. does not support this hypothesis indicating the relationship between competition intensity and competitor knowledge focus is insignificant. The insignificant relationship may be due to the fact when a market is crowded with numerous competitors, it becomes more difficult for firms to track and monitor competitors. Alternatively, it may also be interpreted that whether to generate competitor information is a managerial

decision made independent of the external competition factor. To some extent this finding corroborates with recent studies by Jaworski and Kohli (1993) and Slater and Narver (1994) who find that competitive environment does not have an effect on the strength of the market orientation-performance relationship.

6.2.3C. Technology Change

Technology change, which refers to technology obsolescence rate and new product introduction rate, is proposed to affect customer knowledge focus, competitor knowledge focus, and R&D strength.

As indicated in Table 6.2., technology change has a significant negative impact ($b = -0.123$, $p \leq .01$) on customer knowledge focus. This finding seems to suggest that when technology changes too rapidly firms are less likely to increase their interaction with customers. Management may feel it unworthwhile to concentrate its efforts on existing customers since the emergence of new technology may render the current market obsolete.

On the other hand, the relationship between technology change and competitor knowledge focus is significantly positive ($b = 0.229$, $p \leq .01$) indicating when technology life cycle shortens and product introduction speeds up, firms are more likely to intensify their competitor intelligence activities.

Unexpectedly, the relationship between technology change and R&D strength is weak ($b = .093$) and insignificant. While it has been long hypothesized in the literature that the shortening of technology and product life cycle is the major factor for firms to increase their R&D investment, the result does not support this view. The insignificant relationship seems to suggest that it is an uncommon

practice for firms to increase their R&D investment in a market that experiences rapid technology change. Firms may feel it risky to increase R&D investment in a technologically uncertain market.

6.2.3D. Does Top Management Perception Affect Market-Oriented Strategy?

Results from Table 6.2. indicate that top management perceived importance of market knowledge has a significant effect on all four components of a market-oriented strategy, customer knowledge focus, integral knowledge focus, competitor knowledge focus, and R&D strength.

Additionally, an inspection of the standardized coefficients shows that the correlations between top management perception and the four strategy components are very strong, all above 0.39, which is larger than any of the correlations between the strategy components and external factors. This suggests that top management plays a critical role in shaping a market-oriented strategy. Further, these findings imply that a market-oriented strategy is more driven by top management's philosophical thinking than by external environment.

6.3. Significance of the Research Findings

The findings of this research are significant in several ways. In particular, this study builds a unifying framework, identifies major determinants of strategic behavior, and resolvs issues concerning information intensive products.

6.3.1. Drucker's Theory as a Unifying Framework

First, this research demonstrates that Drucker's theory of knowledge-based innovation can be used as a framework to unify different perspectives in product innovation. Previously, product innovation research was fragmented with various views and beliefs. The most popular among these were market orientation perspective (Calantone and Cooper 1977, 1981; Kohli and Jaworski 1990; Narver and Slater 1990), marketing-R&D integration perspective (Griffin and Hauser 1992; Gupta, Raj, and Wilemon 1986; Souder 1988), and R&D investment perspective (Galbraith 1952). Based on Drucker's theory, this study identifies knowledge as a common denominator underlying these perspectives and then assigns each perspective to a particular aspect of knowledge generation. The results show that this integrated framework, named market-oriented strategy, is a valid multiple-construct model, and as an innovation strategy it indeed exerts a significant impact on competitiveness in product innovation. Academically, through the construction and application of this integrated framework, this study presents a rallying point for researchers with different perspectives in product innovation.

The integrative power of the knowledge-based theory is not limited to its ability to unify the three perspectives discussed above. This framework is also capable of blending other theoretical perspectives. For example, in product innovation, two other prominent theories are "market pull" hypothesis and "technology push" hypothesis. While market pull hypothesis believes that successful product innovation is driven by market demand, technology push hypothesis advocates that innovation success depends on superior technology.

Both of these theories can be integrated into this framework handily. Market pull hypothesis, in essence, emphasizes on understanding of customer demand, and thus belongs to the domain of customer knowledge focus. On the other hand, technology pull hypothesis centers on the development of technological capability, and thus fits into technological knowledge focus.

6.3.2. Top Management's Beliefs as Major Determinant of Strategic Behavior

Second, this research shows that top management's beliefs are the major determinant of a firm's strategic behavior. This finding advances our understanding on the issue.

According to the traditional contingency theory (Zeithaml and Zeithaml 1984), external environment is the major causal variable that drives a firm's strategic posture. In other words, external factors are the primary determinant of a firm's strategy formulation while internal factors, if there are any, are secondary.

Contrary to the traditional view, this research finds that top management's perception of market knowledge exerts a major impact on a market-oriented strategy, and its impact on each strategic component is much larger in magnitude (as measured in standardized coefficients) than that of any of the environmental factors.

The finding of top management as the primary determinant of a market-oriented strategy demonstrates that a firm's choice of strategy depends on its top management's philosophical thinking and environmental influences, if there are any, are secondary.

This finding explains why firms operating in a similar environment may adopt

dissimilar strategies. The strategic variation is mainly attributable to top management's diverse philosophical beliefs. The strategic variation would be uninterpretable under the contingency approach which would expect firms facing a similar environment to employ identical strategies.

Additionally, this finding suggests that firms do not have to react to the environment passively. It is entirely appropriate for firms to establish a proactive strategic posture through adopting a positive managerial philosophy.

6.3.3. Resolving Issues Concerning Information-Intensive Products

Third, the findings of this research also provide timely answers to issues concerning information intensive products and industries.

As the economy transforms from industrial-based to information-based, the informational component is becoming an increasingly large part of the product or offering itself. Accordingly, a considerable interest in information intensive products has been developed in the marketing literature. While Glazer (1991) defines information intensity as the degree that a product is based on the information collected and processed as part of exchanges along the value-added chain, many issues remain unsolved. In particular, what types of knowledge are required to develop an information intensive product? And what strategy can be implemented to strengthen innovation competitiveness in an information intensive industry?

Based on Drucker's theory, this research develops a typology for the study of information intensive products in two steps. First, this research classifies knowledge into four categories: customer knowledge, integral knowledge,

competitor knowledge, and technological knowledge (R&D strength). Then it rationalizes each type of knowledge with extensive literature review. The development of this typology offers further insight into the nature of information intensive products and lays a foundation for studying the issue in a more systematical manner.

Based on the typology, this research proposes a market-oriented strategy and investigates empirically the impact of the strategy on competitiveness in product innovation in an information intensive industry. The empirical results are, in particular, meaningful to practitioners in information intensive industries since their primary interest is to improve their organizational performance. For those practitioners who have already followed a market-oriented approach, the significant results will reinforce their own beliefs.

6.4. Managerial Implications

The main objective of the study was to empirically test several hypotheses advanced in the marketing and product innovation literature regarding consequences of a market-oriented strategy in product innovation. The findings of the research indicate that (1) a market-oriented strategy exerts a strong impact on competitiveness in product innovation, and (2) competitiveness in product innovation, in turn, leads to superior market performance. The significant linkage found between a market-oriented strategy and innovation outcomes suggests that managers should implement a market-oriented strategy in their efforts to strengthen new product competitiveness and market performance.

More importantly, the study uncovers four major components of a market-oriented strategy: customer knowledge focus, integral knowledge focus, competitor knowledge focus, and R&D strength. It appears that knowledge generation is a common thread that links the four strategic elements together. As such, it is imperative for managers to focus their attention on customer and competitor knowledge generation. In addition, managers should continue to improve communication and cooperation between marketing and R&D in order to generate integral knowledge which is critical for creating solutions to customers needs.

The study also reveals that competitiveness in product innovation is a construct with multiple facets, including product newness, uniqueness, reliability, functionality, and productivity, etc. This finding seems to suggest that managers should take multiple measures to gorge their product competitiveness. Relying on any single aspect of product functions and features may be detrimental to product market performance.

In addition to the consequences of a market-oriented strategy, the study investigates the relationship between a market-oriented strategy and external and internal factors. The results demonstrate that top management perception of market knowledge is the most important factor in shaping up a market-oriented strategy. This finding implies that undervaluation of market knowledge by top management may be the greatest hindrance to the implementation of a market-oriented strategy. Hence, a firm's new product development program may be benefitted from a critical reevaluation of top management's view on market knowledge.

In regard to the relationship between environmental factors and a market-oriented strategy, the results show that customer demandingness and technology change appear to affect certain strategy components. Specifically, customer demandingness is found to be positively related to customer knowledge focus and integral knowledge focus. This result seems to suggest that managers should adjust their market-oriented strategy according to the characteristics of their customers. Additionally, it may be beneficial to actively seek those customers who are more sophisticated and demanding in terms of technological features and specifications. Possession of such customers may be a valuable asset rather than a burden. Technology change is found to exert a positive impact on competitor knowledge focus, but a negative impact on customer knowledge focus. This finding suggests that when technology experiences a rapid change managers should constantly monitor their competitors' product development strategies. Negligence of competitor information in time of swift technology innovation may weaken a firm's competitive position. On the other hand, managers may not want to devote all their attention on their current customers in time of rapid technology evolution since such change may render the current market obsolescent.

6.5. Future Research Directions

There appears to be several areas in need of future research attention. The first relates to the assessment of the consequences of a market-oriented strategy in product innovation. In our research, the unit of analysis for the product innovation outcomes is an individual new product and related product market.

Although such unit of analysis presents certain degree of measurement accuracy, the resultant assessment of the impact of a market-oriented strategy may be partial and incomplete. Future research may employ the product development program as the unit of analysis. The inclusion of the whole product program may help us depict a full picture of the impact from a market-oriented strategy. However, using the product program may also present some research challenges. For example, these new products may serve various product markets and therefore result in heterogeneous performances, can we develop an integrated measure to account for these differences. Further, is it possible for a product development program to generate both success and failure by employing the same strategy? If so, how can such discrepant phenomenon be explained?

Second, this research focuses on one industry, computer software. While the principles investigated by this study may be applied to other related high-tech industries, the generalizability of the research is limited. This limitation may be overcome in the future through a multiple industry research. For this purpose, some measures need to be adapted and modified, since measures developed in this research are idiosyncratic of the software industry. Nevertheless, a comparative study on multiple industry settings will both enhance the generalizability of the model and enrich our understanding of product innovation and strategy.

Third, the domain of the current study is the software industry in the U.S. market. It seems desirable to assess the impact of a market oriented strategy not only in the U.S. but also in the international market. Are the strategic principles

uncovered in this study only applicable to the U.S. market? Can they be extended to the foreign export market? Particularly, the performance of the U.S. software products has been considered an exceptionally bright spot in the international market. What role does a market-oriented strategy play in the U.S. software success abroad? Future research is needed to address these issues.

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